MOOD CHANGES ASSOCIATED WITH ANABOLIC-ANDROGENIC STEROID USE IN MALE BODYBUILDERS

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In memory of Lillian Cochrane

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Abstract

The present study described the daily moods of male bodybuilders who self-administered large doses of anabolic-androgenic steroids (AS) through a full cycle of steroid use. Male bodybuilders (N=13) who had been self-administering AS for 2.5 to 12 years served as subjects and participated in a 14 to 16 week experience sampling procedure wherein brief mood questionnaires were filled out twice daily. An ABA design including a 3-week pre-cycle measurement period, a 3-week post-cycle measurement period, and a 6 to 8-week on-steroid measurement period was employed. Measures of the subjects' frequency and intensity of positive and negative affect, average positive and negative affect, as well as aggression, self-confidence and fatigue were computed from the experience sampling questionnaires (Deiner et al., 1984). Data were analyzed according to principles of single-subject design using visual graphic analysis and spectral analysis. Findings revealed that 11 of the 13 subjects experienced self-reported mood changes in association with AS use. In particular, 2 subjects (subjects 4 & 11) experienced quite dramatic changes in mood. It is concluded that there is much variability with regards to the psychological effects that humans may display in association with AS use.

Data are discussed in terms of the effects that AS use may have on mental health.

Résumé

Cette étude porte sur l'humeur quotidien d'athlètes masculins s'administrant des doses superthérapeutiques de stéroïdes androgènes-anabolisants pendant un cycle complet de consommation. Des athlètes (N=13) prenant ces substances depuis de 2.5 à 12 ans ont servis de sujets à l'étude. Pour une durée de 14 à 16 semaines, ceux-ci ont participé à une procédure d'échantillonage des expériences ("experience-sampling") qui consistait à répondre à un bref questionnaire sur l'humeur, deux fois par jour. Un dessin expérimental ABA comprenant trois périodes de mesure a été utilisé. La première période fut d'une durée de trois semaines précédant le cycle, la deuxième, de trois semaines suivant le cycle, et la dernière, de six à huit semaines durant le cycle de stéroïdes. La fréquence et l'intensité des émotions positives et négatives, de même que l'aggressivité, la confiance en soi et la fatigue, ont servis de mesures dépendantes. Les données ont été analysées suivant les principes d'un protocole à cas unique, en utilisant l'analyse graphique visuelle et l'analyse spectrale. Les résultats démontrent que 11 des 13 sujets ont ressentis des changements d'humeur reliés à l'usage de stéroïdes androgènes-anabolisants. En particulier, deux sujets, (#4 et #11) ont vécu des changements d'humeur dramatiques. On peut conclure qu'il existe beaucoup de variabilité en ce qui concerne les effets psychologiques reliés à l'usage d'androgènes-anabolisants.

Les répercussions des données pour la santé mentale sont discutées.

PART I: LITERATURE REVIEW

Therapeutic and Non-Therapeutic Uses of Anabolic-Androgenic Steroids

The study of the psychological changes associated with anabolic-androgenic steroid (AS) use can be divided into analyses of fluctuations related to therapeutic uses and to non-therapeutic uses of ASs. Therapeutically, ASs are used in the treatment of testosterone deficiency disorders in males. ASs are used non-therapeutically, as ergogenic aids mainly by athletes in strength oriented sports. This review shall focus on: the therapeutic uses of ASs, the prevalence of non-therapeutic AS use, mood changes associated with therapeutic AS use, mood changes associated with non-therapeutic AS use, non-therapeutic AS use and personality, and possible mechanisms for the psychological effects of ASs. The specific purposes of the review are to make a statement about what is known about the psychological correlates of AS use and to identify the methodological limatations of previous work.

Natu :e and Therapeutic Uses of Anabolic-Androgenic Steroids

Some basic information about the biology of steroids provides a useful starting point for the relationship between mood and anabolic steroids (AS). Steroids are hormones which are derived from cholesterol. Androgens, which are secreted mainly from the Leydig cells of the testes, are steroids which are responsible for typical male physical characteristics and behavior (Wright, 1980). The most important natural androgens are testosterone and androstenedione. Testosterone is secreted in the highest

quantities and has the highest potency (Wright & Stone, 1985).

Testosterone functions can be categorized into androgenic actions and anabolic actions. The androgenic actions of steroids include sexual differentiation, spermatogenesis, the development and maintenance of secondary sexual characteristics in males, gene regulation, and male-pattern behavior (Wilson & Griffin, 1980). The anabolic actions of testosterone and its' derivatives include stimulation of red blood cell production, bone growth, and increased skeletal muscle mass (Taylor, 1987).

Androgenic steroids were first used clinically to produce male secondary sex characteristics in the treatment of hypogonadism and other conditions characterized by insufficient testosterone production (Kopera, 1985). The anabolic effects of androgens were first noted when hypogonadal males receiving androgen replacement therapy were found to have increases in body weight and muscle mass (Kopera, 1985).

Due to the fact that ASs promote red blood cell production, they have been used in the treatment of certain anemias (Neff, Goldberg, Slifkin, Eiser et al., 1985). Because of their anabolic effect on bone tissue ASs have also been used clinically to prevent and treat osteoporosis in post-menopausal women (Henneman & Wallach, 1957; Dequeker & Geusens, 1985), and for the medical treatment of other debilitating illnesses such as brain injury and burns (Mosebach, Hausmann, Caspari, & Stoeckel, 1985). Because testosterone is rapidly degraded by the liver, it has little physiological effect unless it is chemically modified. One

chemical modification called esterification, which produces steroids known as esters of testosterone, prolongs the duration of the hormonal action by allowing for gradual release into circulation (Wilson & Griffin, 1980). The esters of testosterone are usually given by intramuscular or subcutaneous injection (Wright & Stone, 1985). The other main chemical modification yields the 17-alpha-alkylated androgen which can be administered orally (Wilson & Griffin, 1980). This alteration prolongs considerably the lifespan of the steroid in the body (Wilson & Griffin, 1980).

In sum, ASs are synthetic derivatives of testosterone which can be administered either orally or by injection. ASs are used therapeutically to promote tissue growth and treat testosterone deficiencies.

Incidence of Non-Therapeutic Use of Anabolic-Androgenic Steroids

Due to the fact that AS promote muscle growth and red blood cell production, some healthy individuals use these drugs for the enhancement of athletic performance. AS have been used by athletes to enhance performance for many years. The first ergogenic use of testosterone was reported to have occurred at the 1954 World Weightlifting Championships in Vienna and it is suspected that it was used as early as the 1952 Olympics in Helsinki (Todd, 1987). Since that time, the popularity of these drugs has increased and their use has become quite commonplace in certain professional and strength sports. AS use has been estimated to be as high as 80% for

professional football players (Stevenson, 1991) and as high as 100% for professional wrestlers (Araton, 1991). In 1972 at the Munich Olympic Games, Silvester (1973) polled a sample of track athletes and found that 68% reported AS use in preparing for the games. Another group of athletes, among whom AS use is said to be widespread, are bodybuilders. Anecdotal reports have put AS use as high as 100% amongst competitive bodybuilders (Freed, Banks, & Longson, 1975; MacDougall, 1983). In 1981 the Addiction and Drug Research Foundation of Ontario claimed that 99% of male professional bodybuilders and 10% of female bodybuilders used ASs (MacDougall, 1983). The few data-based studies which have been done on competitive bodybuilders do not support such epidemic-like usage patterns, however they do suggest that a significant amount of bodybuilders are using ASs as ergogenic aids (Lindsrtom, Nilsson, Katzman, Janzon, & Dymling, 1990; Tricker, O'Neill, & Cook, 1990). In a study of 138 swedish bodybuilders, Lindstrom et al. (1990) found that 53% reported AS use. Tricker et al. (1990) reported that, of 176 competitive bodybuilders from Kansas and Missouri, 54% used AS as part of their training regimen.

Furthermore it is evident that AS use is not limited just to the Olympic or professional sport ranks, their use has become quite common at the high school and collegiate level (Buckley, Yesalis, Freidl et al., 1988; Pope, Katz & Champoux, 1988; Chaikin & Telander, 1989; Johnson, Jay, Shoup, & Rickert, 1989; Windsor & Dumitru, 1989; Terney & McLain, 1990; Anderson, Albrecht, McKeag, et al., 1991.). In the United States, it is estimated that 3% to

11% of male high school students are users of AS (Windsor & Dumitru, 1989; Johnson et al., 1990). At a national level, these percentages would translate to approximately half a million to one million high school students using AS. In a national survey of alcohol and drug use by 3,264 college athletes, Anderson et al. (1991) found that 5% of all athletes reported using AS in the past 12 months. Unfortunately there are no good published studies about the prevalence of AS use in Canada. However, the RCMP does estimate that 10 million dollars worth of AS are sold annually in Canada ("Anabolic steroids", 1989).

Due to the fact that AS use is banned in most sports, it is reasonable to assume that incidence studies experience underreporting of actual AS use. Yesalis et al. (1988) found that powerlifters at the National Championships of the U.S. Powerlifting Federation reported more AS use in a follow up telephone interview (55%) than when canvassed at the actual event (33%). Yesalis et al. (1988) suggested that the levels of AS use which are reported in surveys, such as above, probably represent the lower bounds of steroid use.

Most AS users obtain the drugs illegally from drug traffickers, gym owners, coaches, trainers, other athletes, pharmacists, or physicians. Alarmingly, 30-40% report getting the drugs from physicians (Crawshaw, 1985). Furthermore, there is evidence that athletes using ASs for physique enhancement are employing extraordinary doses ranging from 5 to 20 times the recommended therapeutic doses (Burkett & Falduto, 1984).

Psychological Effects of Anabolic-Androgenic Steroids

Given the widespread use of AS, numerous studies have been conducted for the purpose of assessing the effects of anabolic steroids on muscular size and strength. Apart from the muscle building properties of ASs some serious physical and psychological side effects have been reported. The anabolic and androgenic effects of these agents, when taken in large doses, result in adverse physical side-effects such as reduced sperm production (Alen & Suominen, 1984), reduced high-density-lipoprotein cholesterol (Hurley et al., 1984) and connective tissue abnormalities (Laseter & Russell, 1990). The psychological side-effects associated with AS use include increased irritability and aggression (Strauss, Wright, Finerman, & Catlin, 1983), euphoria (Brower et al., 1991) and possibly even psychotic episodes (Annitto & Layman, 1980), as well as depression and fatigue when use is terminated (Chaikin & Telander, 1988). The evidence available to support the existence of these psychological side-effects is reviewed in the two sub-sections which follow.

Aggression, Testosterone and Anabolic Steroids

Numerous studies have shown relationships between testosterone levels and aggressive behavior in various species of animals such as chickens (Allee, Collias, & Lutherman, 1939), mice (Beeman, 1947), rats (Albert, Walsh, Gorizalka, Siemens, & Louie, 1986) and nonhuman primates (Rejeski, Brubaker, Herb, Kaplan, & Koritnik,

1988; Rejeski, Gregg, Kaplan, & Manuck, 1990; Steklis, Brammer, Raleigh et al., 1985). For example, Rejeski et al. (1988) found that the administration of testosterone propionate over an 8-week treatment period resulted in significant increases in aggression amongst a group of cynomolgus monkeys. Interestingly, this change in behavior seemed to be mediated by the animals' social status in that the incidence of both contact and noncontact aggression in dominant monkeys was greater than the frequency of these behaviors in subordinate monkeys. In a similar study, Rejeski, Gregg, Kaplan and Manuck (1990) found that the administration of testosterone to a group of 24 cynomolgus monkeys increased dominant behavior amongst dominant monkeys and submissive behavior amongst subordinate monkeys. A second finding of this study was that there was a "ripple effect" in that the dominant and submissive behaviors of control monkeys, who were forced to interact with the testosterone-treated animals, followed a similar pattern to those receiving testosterone. As a result of this latter finding, Rejeski et al. (1990) concluded that the mechanism underlying psychological changes associated with AS use were not strictly pharmacological; rather, they involved the interaction effect of the drug, personality and social factors.

The relationship between endogenous and exogenous androgens in humans is not as clear as in the animal research. Correlational studies of serum testosterone levels and aggressive or hostile behavior in normal males are contradictory in that some do find a positive relationship between testosterone levels and aggressive

behavior (Brown & Davis, 1975; Olweus, Mattsson, Schalling & Low, 1980; Persky, Smith & Gopal, 1971) while others do not (Mayer-Bahlburg, Boon, Sharma & Edwards, 1974; Monti et al., 1977). However, studies of testosterone levels in criminal or prison populations are more conclusive about the positive relationship between testosterone levels and aggressive behavior (Dabbs, Frady, Carr & Besch, 1987; Ehrenkrantz, Bliss & Sheard, 1974; Kreuz & Rose, 1972; Rada, Laws & Kellner, 1976; Schiavi, Theilgaard, Owen et al., 1984). Kreuz and Rose (1972) suggest that within such populations (i.e. criminal), which may have been predisposed by social factors to develop anti-social behaviors, higher levels of testosterone may facilitate or promote aggressive or violent behavior.

One problem with correlational studies which focus on serum levels of testosterone and aggression, is that testosterone levels can fluctuate from minute to minute in normal individuals (Doering, Brodie, & Kraemer, 1975). Therefore studies which utilize single measurements of testosterone levels may be suspect in that they are not gauging the real relationship between testosterone and aggressive behavior.

On an anecdotal basis increased aggression has been reported in association with AS use (Chaikin & Telander, 1988; Todd, 1987). Case reports link AS use with criminal activity and violent crimes in previously law-abiding individuals (Conacher & Workman, 1989; Lubell, 1989; Pope & Katz, 1990). In a study of side-effects of AS use in 32 bodybuilders and powerlifters, Strauss et al. (1983)

found that 56% of the subjects experienced self-reported increases in aggression and hostility. In the only data-based study of the relationship between AS use and aggression, Swanson (1989) used the Taylor Reaction Procedure, a behavioral measure of aggression, and the Buss-Durkee Hostility Inventory (BDHI, Buss & Durkee, 1957), a self report measure of aggression, in a study designed to elicit aggressive and hostile behavior through parallel competition. Swanson (1989) found no differences between 17 AS users, 17 nonuser athletes and 17 nonuser nonathletes on the behavioral measure of aggression or the scales of the BDHI.

In sum AS use does seem to be associated with increased aggressive and hostile tendencies. The existence of negative findings does however point to the necessity of identifying mediating factors in the relationship between AS use and aggression as well as to developing more sophisticated measurement technologies.

Anabolic Steroid Therapy and Mood in Testosterone Deficient and Hypogonadal Males

As mentioned previously, testosterone and its' synthetic derivatives are very often used in the treatment of testosterone deficiency disorders such as hypogonadism and for the treatment of penile and erectile dysfunctions in males. In reporting results of clinical studies, researchers often have provided evidence about the psychological side-effects of therapeutic AS administration.

In the treatment of 8 hypogonadal males, O'Carroll, Shapiro,

and Bancroft (1985) administered testosterone undecanoate at dosages of 40, 80, 120, and 160 mg/day in 4 successive one month periods. O'Carroll et al. (1985) found a significant improvement in self-reported well-being and mood as a result of androgen replacement. In addition, a significant dose response relationship was demonstrated in that as dosages of testosterone undecanoate were increased reports of frequency of sexual thoughts, arousal accompanying sexual thoughts and well-being increased. Similarly, as a result of high dose (160 mg/day) testosterone undecanoate administration versus placebo, Skakkebaek, Bancroft, Davidson, and Warner (1981) reported a significant improvement in mood, as measured by the Profile of Mood States (POMS, McNair, Lorr & Droppleman, 1971), in 12 males suffering from varying degrees of testosterone deficiency. Subjects displayed less tension/anxiety and fatigue and more vigor while being treated.

In a double blind experiment, Davidson, Camargo and Smith (1979) found no significant differences in mood, as measured by the POMS, between treatments of either 25 or 100 mg/wk of testosterone enanthate, or a placebo, in 6 males suffering from varying degrees of hypogonadism. Likewise, O'Carroll and Bancroft (1984) observed no significant differences in mood as a result of administering biweekly doses of 250 mg of testosterone esters (Sustanon), or a placebo, to 20 males experiencing various sexual deficiencies.

In sum, the findings from the preceding studies are mixed. Some demonstrate significant psychological effects or mood changes as a result of therapeutic ASs administration while others do not.

Interpretations of mood data from studies on the therapeutic effects of AS are limited. First, there is a problem in that the subjects in these studies are receiving AS therapy for various physical problems and their moods are probably very dependent upon the outcome of the therapy. For example, people may demonstrate positive moods if the therapy works and their ailment is relieved. Therefore, the observed mood changes may be more a result of cognitive interpretations of how their therapy is going as opposed to actual pharmacological effects on their emotions. Secondly, the two studies which reported significant effects in mood as a result of AS administration (O'Carroll et al., 1985; Skakkebaek et al., 1981) used much higher dosages than the studies which reported no significant effects (Davidson et al., 1979; O'Carroll & Bancroft, 1984). In fact, O'Carroll et al. (1985) noted a dose response relationship in that as dosages of testosterone decanoate were increased from 40 to 160 mg/day more mood changes were reported. Thus it appears that therapeutic administration of ASs can be associated with mood changes in selected circumstances. However, methodological problems prevent any firm conclusions.

Supertherapeutic Doses of Anabolic-Androgenic Steroids and Mood in Healthy Athletes

Anecdotal evidence from athletes using supertherapeutic dosages of AS reveals that psychological side-effects such as euphoria, delusions, anxiety, and rage can be experienced while on

the steroids and depression and fatigue can occur when use is terminated (Annitto & Layman, 1980; Chaikin & Telander, 1988; Lubell, 1989; Pope & Katz, 1987; 1988; 1990; Perry, Yates & Anderson, 1990). Controversy exists, however, in the data-based mood studies on athletes using AS as to the generalizability of the effects of AS use on mood and psychological functioning. Several studies report mood changes related to AS use (Rozenek, 1985; Choi, Parrott, & Cowan, 1989; Lefavi, Reeve, & Newland, 1990; Humbert, 1990) while other studies report no fluctuations in mood as a result of AS use (Wright, Bahrke, Strauss, & Catlin, 1986; Bahrke, Wright, O'Connor, Strauss, & Catlin, 1990; O'Connor, Bahrke, & van Dijk, 1991).

Specifically, in a study of 8 male weightlifters, 5 male weightlifters using steroids and 5 controls, Rozenek (1985) found that, after an intense bout of exercise, the AS users had significantly higher anger-hostility scores as measured by the POMS than the lifters or controls. In a review of behavioral effects related to AS use in athletes, Choi et al. (1989) briefly report on one of their studies in which they used standardized questionnaires to measure mood in male strength athletes self-administering ASs. The athletes were tested four times over a period of eight weeks. It was found that AS users were significantly more aggressive and hostile than controls at all times throughout the study. These higher levels of aggression and hostility were even more pronounced during the steroid cycle. Using a single administration of the Multi-Dimensional Anger Inventory (MDAI, Siegel, 1986), Lefavi et

al. (1990) found that male AS users (n=13) scored significantly higher than non-users (n=14) on two dimensions of the MDAI, namely Anger-Arousal and Hostility Outlook. Humbert (1990) studied 19 male AS users, 20 nonuser athletes and 20 nonuser nonathletes. Subjects were administered the POMS five times, at three week intervals. According to Humbert (1990), athletes who began a cycle of AS experienced a rise in levels of anger and hostility as well as in overall levels of mood disturbance. Collectively these four studies support the idea that AS use has negative repercussions on mood.

However Wright et al. (1986) studied the psychological states of 12 current AS users, 14 previous users and 24 nonusers. With a single administration of the POMS and the BDHI, the researchers found no significant differences in mood between groups. In a comparable study, Bahrke et al. (1990) found no significant differences in aggression, anger or hostility between 30 male AS users, 23 previous users and 40 nonusers. Bahrke et al. (1990) did however find that AS users had significantly higher scores on the guilt scale of the BDHI than either the previous users or nonusers. The authors attributed this latter finding to the fact that possession of AS use is illegal in most states of the U.S. and there is a certain social stigma attached to their use. Data from this study were yielded through a single administration of the POMS and BDHI. In a similar study, O'Connor et al. (1991) found that 38 male AS users differed from 18 previous users and 37 nonusers only on the guilt scale of the BDHI. The AS users had significantly

higher scores on the guilt scale than either the previous users or the nonusers. These latter three studies cast doubt on the stability and generalizability of the effects of AS use on affective states in that no reliable differences were observed.

In sum, while anecdotal reports support the existence of psychological effects related to AS use, the data-based studies are equivocal: some studies reveal increased mood disturbance in association with AS use but others do not reveal such effects. The studies are characterized by single measurement or 2 to 5 repeated measurements of mood with standardized questionnaires.

Supertherapeutic Doses of AS and Personality in Healthy Athletes

Studies of the relationship between personality and AS use are equally as confounding as the mood studies. Chapman (1984) used the Sixteen Personality Factors Questionnaire (16PF, Cattell, 1946) to distinguish between bodybuilders, bodybuilders using steroids, and a normative population (total n=64 males). The steroid users were significantly different from the normative population on 8 factors, including warmth, boldness, suspiciousness, and tough poise. However, the bodybuilders not using steroids differed from the normative population on 9 factors indicating that the greatest differences may occur between an athletic population and a non-athletic population rather than between steroid users and non-steroid users. To determine whether personality psychopathology is common among AS users, Yates, Perry and Anderson (1990) evaluated a group of 20 weightlifter AS users and compared them with a group

of 20 alcoholics, 20 weightlifter controls, and 20 community controls. They found that AS users were more likely than community controls to demonstrate cluster B traits (histrionic, narcissistic, antisocial, borderline) according to the Diagnostic and Statistical Manual for Mental Disorders (DSM III-R). Seventy-five percent (75%) of AS users in this study demonstrated cluster B traits as opposed to 10 % of the community controls. However, in a similar finding to Chapman (1984), this difference may partially be due to a weightlifter group membership effect as 50% of weightlifter controls also demonstrated more cluster B traits than community controls. Pope and Katz (1988) used the DSM III criteria to evaluate personality in 41 bodybuilders who were using AS. They found that 22% of the bodybuilders displayed a full affective syndrome and 12% displayed psychotic episodes in association with AS use. Pope and Katz (1988) concluded that "major psychiatric symptoms may be a common adverse effect of these drugs" (p. 487).

Annitto & Layman (1980) present a case in which they suspect that AS use brought about the development of an acute schizophrenia illness in a 17 year old bodybuilder. The patient began to experience psychotic symptoms 6 months after the initiation of AS use. These symptoms dissipated after the termination of AS use. Pope and Katz (1987) report the case of 2 men who were admitted to hospital due to psychotic episodes believed to have been brought on by AS use. One man was a bodybuilder who was using AS (methandrostenolone 15 mg/day) to increase musculature while the

other man was using AS (methyltestosterone 20 mg/day) therapeutically to treat impotence. The psychotic episodes stopped with the cessation of AS use in both cases. Pope and Katz (1987) concluded that ASs were probably the cause of the episodes especially since no symptoms were reported during 2 years of follow-up.

In sum, reports do exist to suggest that AS use may modify personality. However, much of the evidence is based on case study reports and thus await further validation.

Psychological Dependence and Withdrawal Effects of AS

In an heuristic examination of AS and psychological factors, Taylor (1987) has suggested that people may become addicted to steroids in order to avoid the depression and anxiety which may accompany the off-cycle. Following up on this idea, Kashkin and Kleber (1989) have suggested an AS addiction hypothesis which supports these psychological observations with physiological evidence. They cite several case studies (Brower, Blow, Beresford, & Fuelling, 1989; Tennant & Black, 1988) in which the patients, who were AS users, were diagnosed as being addicted to steroids. Not only did the patients experience severe mood swings but they also exhibited physiological withdrawal symptoms when deprived of ASs. In a study of 49 male weightlifters who were using ASs, Brower, Blow, Young and Hill (1991) found that 57% displayed symptoms consistent with a diagnosis of dependence as measured by the DSM-III-R. Using regression and correlation analysis, the authors

found that the best predictors of dependence were dosage and dissatisfaction with body size.

In sum, recent studies suggest that ASs may be addictive. However, more information is needed about the possible physiological and psychological mechanisms involved in AS dependence.

Possible Mechanisms for Psychological Effects of ASs

Two explanations for some of the psychological effects associated with AS use, which have been reported in the literature, are available. The first is a biochemical explanation while the second is psychological.

The biochemical explanation suggests that ASs may increase the levels of neurotransmitters such as norepinephrine (Klaiber, Broverman, & Kobayashi, 1967) and dopamine (Hannan et al., 1988 in Bahrke, Yesalis, & Wright, 1990) in the brain. Klaiber et al. (1967) suggest that these biochemical changes may be brought on by the inhibition of MAO (monamine oxidase) activity. MAO is an enzyme which breaks down neurotransmitters. Norepinephrine and dopamine are neurotransmitters which are associated with mood regulation, maintenance of arousal and emotional response. An overabundance of these neurotransmitters could result in depression, irritability, euphoria, hypomania, and schizophreniform psychotic episodes (Humbert, 1990). Therefore large doses of ASs,

resulting in higher levels of neurotransmitters, may cause serious mood changes and even psychotic episodes. Itil et al. (1974) have provided support for a physiological theory of behavioral effects associated with AS use. They analyzed electroencephalographic profiles of subjects using mesterlone at varying dosages and found that these profiles were similar to those seen with psychostimulants such as amphetamines and antidepressants, thus supporting the idea that the mood-modifying properties of ASs may be mediated by changes in the brain's electrical activity.

The second explanation for some of the psychological changes associated with AS use has to do with cognitive appraisals. Athletes, bodybuilders and weightlifters in particular, use ASs to increase muscle mass. Therefore these athletes' moods may be very dependent upon how well their training regimen and the ASs are at increasing weight and muscle mass (Taylor, 1987). For example, as a bodybuilder goes on a steroid cycle he gains weight and muscle mass (Forbes, 1985). He may thus experience more positive moods because he is achieving a central goal of increased weight and performance. However as his cycle comes to an end, and he stops taking steroids, he can lose anywhere from 5 to 13 kg in body weight (Crawshaw, 1985). More negative moods could likely ensue in that losses in weight and musculature can be very upsetting to an athlete who depends upon such physical characteristics for successful performance.

Brower (1989) takes this explanation one step further and claims that many people, bodybuilders in particular, who turn to

ASs to increase bulk have an "over-reliance on physical attributes for self-worth". In fact, Brower et al. (1991) found that one of the best predictors of dependency in AS users was dissatisfaction with body size. Therefore the ASs are a tool, along with weight-training, which they use to increase their size and thus their self-esteem.

In sum, there is support for the idea that ASs can cause some sort of hormonal effect on the central nervous system (CNS) which is similar to the effects that stimulants such as amphetamines may have. Also, it is reasonable to believe that many of the mood changes, that athletes report in association with AS use, are related to the athletes' cognitive appraisals about their body size and strength. More than likely, many of the psychological effects that athletes display as a result of AS use are a combination of biochemical or pharmacological effects, cognitive appraisals and personality (Gregg & Rejeski, 1990).

Conclusion

In conclusion, it appears that there is a relationship between AS use and psychological change. Specifically, increases in aggression, hostility, euphoria, mood swings, and possible psychological dependence and withdrawal have been reported. It is also evident that there is a dearth of methodologically and theoretically sound studies of mood and affect in AS users. Even

though anecdotally many athletes report mood disturbances as a result of steroid use the data-based studies are not quite as conclusive. Therefore studies of mood change as a result of AS administration are required in order to better understand the psychological changes associated with AS use and to better counsel athletes as to their deleterious effects on health.

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PART II: DATA-BASED STUDY

The recent popularity of strength and power oriented activities, the "Ben Johnson" affair, and the Dubin Inquiry have increased public awareness about the use of anabolic steroids (AS) among elite and recreational athletes. Statistics show that the use and abuse of these substances have grown over the past decade (Frankle, Cicero, & Payne, 1984; Pope, Katz, & Champoux, 1988; Windsor & Dumitru, 1989; Anderson, Albrecht, McKeag et al. 1991). Buckley, Yesalis, Freidl et al. (1988) estimate that 6.6% of high school seniors in the United States are using ASs. Unfortunately there are no good published studies about the incidence of AS use in Canada. However, the RCMP does estimate that 10 million dollars worth of ASs are sold annually in Canada ("Anabolic steroids", 1989).

Most of the scientific studies dealing with non-therapeutic AS use focus on physical effects such as changes in strength, body composition, and performance (Wright, 1980). Apart from the muscle building properties of ASs, some serious physical and psychological side-effects have been reported (Chaikin & Telander, 1988; Mochizuki & Richer, 1988; Overly, Fankoff, Wang & Singh, 1984; Pope & Katz, 1988; Strauss, Wright, Finnerman & Catlin, 1983). Physical side-effects include reduced sperm production (Alen & Suominen, 1984), reduced high-density-lipoprotein cholesterol (Hurley, Seals, Hagberg et al., 1984) and connective tissue abnormalities (Laseter & Russell, 1990).

On the psychological side, clinical studies on humans indicate

that long term therapeutic doses of ASs can cause such affective and psychotic symptoms as mood disorders, mania, and paranoia (Luisi & Franchi, 1980; O'Carroll, Shapiro & Bancroft, 1985; Wilson, Prange & Lara, 1974). Anecdotal evidence from athletes using extraordinary dosages of ASs reveals that behavioral side-effects such as euphoria, delusions, anxiety, and rage can be experienced while on the steroids and depression and fatigue can occur when use is terminated (Annitto & Layman, 1980; Chaikin & Telander, 1988; Lubell, 1989; Pope & Katz, 1987; 1988; 1990; Perry, Anderson, & Yates, 1990). Controversy exists, however, in the data-based mood studies on athletes using ASs as to the generalizability of the effects of AS use on mood and psychological functioning. Several studies report mood changes related to AS use (Rozenek, 1985; Choi, Parrott, & Cowan, 1989; Lefavi, Reeve, & Newland, 1990; Humbert, 1990) while other studies report no fluctuations in mood as a result of AS use (Wright, Bahrke, Strauss, & Catlin, 1986; Swanson, 1989; Bahrke, Wright, O'Connor, Strauss, & Catlin, 1990; O'Connor, Bahrke, & van Dijk, 1991).

Specifically, in a study of 8 male weightlifters, 5 male weightlifters using steroids and 5 controls, Rozenek (1985) found that, after an intense bout of exercise, the AS users had significantly higher anger-hostility scores as measured by the Profile of Mood States (POMS, McNair, Lorr, & Droppleman, 1971) than the lifters or controls. In a review of behavioral effects related to AS use in athletes, Choi et al. (1989) briefly report on one of their studies in which they used standardized questionnaires

to measure mood in male strength athletes self-administering ASs. The athletes were tested four times over a period of eight weeks. It was found that AS users were significantly more aggressive and hostile than controls at all times throughout the study. These higher levels of aggression and hostility were even more pronounced during the steroid cycle. Using a single administration of the the Multi-Dimensional Anger Inventory (MDAI, Siegel, 1986), Lefavi et al. (1990) found that male AS users (n=13) scored significantly higher than non-users (n=14) on two dimensions of the MDAI, namely Anger-Arousal and Hostility Outlook. Humbert (1990) studied 19 male AS users, 20 nonuser athletes and 20 nonuser nonathletes. Subjects were administered the POMS five times, at three week intervals. According to Humbert (1990), athletes who began a cycle of ASs experienced a rise in levels of anger and hostility as well as in overall levels of mood disturbance. Collectively these four studies support the idea that AS use has negative reprecussions on mood.

However Wright et al. (1986) studied the psychological states of 12 current AS users, 14 previous users and 24 nonusers. With a single administration of the POMS and the Buss-Durkee Hostility Inventory (BDHI, Buss & Durkee, 1957), the researchers found no significant differences in mood between groups. In a comparable study, Bahrke et al. (1990) found no significant differences in aggression, anger or hostility between 30 male AS users, 23 previous users and 40 nonusers. Bahrke et al. (1990) did however find that AS users had significantly higher scores on the guilt

scale of the BDHI than either the previous users or nonusers. The authors attributed this latter finding to the fact that possession of AS use is illegal in most states of the U.S. and there is a certain social stigma attached to their use. Data from this study were yielded through a single administration of the POMS and BDHI. In a similar study, O'Connor et al. (1991) found that 38 male AS users differed from 18 previous users and 37 nonusers only on the guilt scale of the BDHI. The AS users had significantly higher scores on the guilt scale than either the previous users or the nonusers. Finally, in a study designed to elicit aggressive and hostile behavior through parallel competition, Swanson (1989) found no differences between 17 AS users, 17 nonuser athletes and 17 nonuser nonathletes (n=17) on the scales of the BDHI. These latter four studies cast doubt on the stability and generalizability of the effects of AS use on affective states in that no reliable differences were observed.

Three major problems exist with the data-based studies on the relationships between mood and AS use: namely, sample heterogeneity, mood conceptualization and measurement of mood. The first of these problems, sample heterogeneity, refers to the fact that AS users are treated as a homogenous group when in reality they are usually quite heterogeneous in terms of the different drugs and dosages they self-administer. In previous research on the psychological effects of AS use, all ASs have been treated as though they had the same pharmacological and psychological effects. In other words, steroid users have been collapsed into one group,

and designs have often been between subject or within subject designs with few repeated measures. This may create artificially large variances and mask any underlying differences related to AS use.

This problem is compounded further by the fact that the population under investigation is suspicious of outsiders and hesitant to participate in research. As a result, sampling procedures are based on convenience and availability, and are as far from randomized as they can be.

Moreover, due to ethical considerations, drug regimens can not be altered in order to render subjects similar. Classical experimentation must therefore be ruled out and alternative methodologies entertained.

One way to overcome some of the problems of sampling in field research on AS use is to employ a within subject design in which each subject is analyzed individually rather than as part of a group (i.e. single-subject design, Kazdin, 1982). In this type of design, each subject is evaluated across baseline and treatment periods acting as his own control. Problems of heterogeneity and sampling are minimized with this design because subjects are analyzed idiographically rather than as part of a group. The sample need only consist of one subject in order for this design to be used. Generalizability is achieved through the aggregation of results from many single-subject studies.

The second problem deals with the conceptualization of mood. Previous AS research used convenient clinical tools (i.e. POMS and

BDHI) to measure mood without regard for underlying concepts. Basically, these tools were devised for the purpose of detecting pathological mood states in clinical populations. While some athletes using ASs may experience clinically significant changes in mood, it may be that many users experience sub-clinical or non-pathological changes in mood as a result of steroid use. The measurement technology and underlying conceptualizations used in previous research preclude the examination of this question.

However, social psychological data support the idea that non-pathological moods consist of two factors, namely positive affect (PA) and negative affect (NA) (Deiner & Emmons, 1984; Deiner, Larson, Levine & Emmons, 1984; Watson & Tellegen, 1985). Deiner and Emmons (1984) have further described PA and NA as a function of three characteristics, namely frequency, intensity, and variability. Frequency refers to how often PA or NA is experienced over time; intensity is the strength with which one experiences a particular affect; variability refers to frequency of fluctuations in mood or emotions over time. Thus the description of mood in terms of frequency, intensity and variability of PA and NA appears to be useful conceptually.

The third problem in previous research pertains to the measurement of mood. In existing research, mood has not been measured often enough nor accurately enough to detect daily mood swings. For example, Wright et al.(1985), Swanson (1989), Lefavi et al. (1989), Bahrke et al.(1990) and O'Connor et al. (1991) measured mood only once in their studies. By contrast Rozenek

(1985), Choi et al. (1989), and Humbert (1990) measured mood 3, 4, and 5 times respectively. While more encompassing, than the studies which measured mood only once, the time elapsed between measures could still have camouflaged any frequent changes in mood which may have occurred. In order to understand better the mood changes associated with AS use a more frequent assessment of mood should be made because by definition, mood is a variable susceptible to great fluctuation. The frequent measurement of mood is particularly critical during the steroid phase when, due to the pharmacological nature of the steroids, abrupt mood swings may occur (Klaiber, Broverman, & Kobayashi, 1967; Itil et al., 1974; Perry et al., 1991). Other research supports the idea that mood changes from day to day (Larsen & Kasimatis, 1990) and that there are predictable weekly patterns of mood change. Some research even supports the idea of circadian mood rhythms (Thayer, 1989).

One way in which repeated measurement of mood can be obtained is through the use of the Experience Sampling Method (ESM - Hormuth, 1986). The ESM involves obtaining repeated measurements of a mood at random or pre-determined times during the day over an extended period of time. In one specific application of the ESM subjects are required to complete a 9 item mood rating scale (see Appendix A). Composite scores are then calculated for the frequency, intensity and variability of PA and NA. The overall procedures provide a more accurate and detailed description of mood as evidenced by the work of Diener et al. (1984), Diener and Emmons (1984) and Larson (1987).

In sum, previous research on the mood-related changes associated with AS use is equivocal with some studies reporting mood changes associated with AS use and others reporting no mood changes. Furthermore, existing research is wanting in that between subject designs, convenient samples, and inappropriate mood measures and conceptual definitions have been employed.

In an effort to overcome some of these methodological pitfalls and clarify existing controversies, the purpose of the present study is to describe fluctuations in the frequency, intensity and variability of PA and NA in male bodybuilders who are self-administering large doses of ASs throughout a full cycle of steroid use. To achieve this end, an ESM procedure and single-subject designs will be used. A secondary purpose is to examine self-reports of aggression, self-confidence and fatigue, using the same ESM approach, to shed light on the viability of anecdotal reports.

It was hypothesized that the frequency of positive affect (FPA) would be higher during the steroid phase of the cycle, than during the off phases, because of increases in confidence and euphoria. The frequency of negative affect (FNA) would be higher during the off phases of the cycle than during the steroid phase. FNA would increase during the off-phases due to the fatigue and depression which typically accompanies steroid withdrawal (Brower et al., 1991). Intensity of positive affect (IPA) and intensity of negative affect (INA) would be greater during the steroid phase of the cycle than during the off phases. Due to the stimulant nature of steroids (Itil, 1974), it was expected that both PA and NA would

be experienced more intensely. Based on anecdotal reports, it was expected that feelings of confidence and aggression would be more frequent and intense during the steroid phase. Finally, according to anecdotal reports fatigue would be more frequent during the off cycle.

Methodology

Subjects

Thirteen subjects (13) were recruited on a voluntary basis for the study. All subjects were informed of the purpose and the requirements associated with the study prior to giving written consent. The subject pool consisted of bodybuilders who were self-administering AS. All subjects were from the Montreal area.

Two assistants recruited most of the subjects. Since these subjects are typically hesitant about revealing or discussing their steroid use, it was imperative that they trust the recruiters, who are bodybuilders, otherwise they would not volunteer for such a study. The assistants acted only as go-betweens. Subjects were also recruited through the use of posters distributed about universities and gymnasiums in Montreal.

Subjects were interviewed and screened based upon the following pre-established criteria:

1. Male
2. Age 18 years or older
3. Anticipated steroid use for at least six weeks.

4. Anticipated an off-cycle of at least four weeks.

5. Had previous experience with steroids.

6. No other drug use (i.e. cocaine, marijuana, etc.) for the full measurement period.

In return for participation in this study subjects were provided with individual feedback relevant to the study and information pertaining to the possible negative effects of AS use on health.

Measurement Instruments

Mood questionnaire. The ESM questionnaire consisting of 9 mood adjectives which are highly representative of positive affect (PA) and negative affect (NA) was used. Specifically, Deiner and Emmons (1984) found that the PA items of happy, pleasant, joyful, and enjoyment/fun and the NA items of unhappy, depressed/blue, frustrated, angry/hostile, and worried/anxious have an internal consistency of approximately .80. Furthermore, the subject was required to indicate how much of each emotion he experienced during the "past few hours", using a 7 point rating scale ranging from 0 (not at all) to 6 (extremely much). Composite scores were then calculated for the frequency, intensity, and average positive and negative affect.

Apart from the 9 items on the ESM questionnaire, three extra items pertaining to confidence, fatigue, and aggression were included. Anecdotal reports (Chaikin, 1988; Todd, 1987) and data-

based studies (Humbert, 1990) suggest that AS most effect these psychological parameters in weightlifters and bodybuilders. Subjects were instructed to respond to the items based upon on how they felt "over the past few hours" using the same 0 to 6 scale (see Appendix A for copy of questionnaire).

Personal Data Form. The Personal Data Form (PDF) consisted of questions pertaining to age, height, weight, years of AS use, current AS use, current dosages, and length of current steroid cycle (see Appendix B).

Study Design

A single-subject ABA design (Kratochwill, 1978), repeated on each of the 13 subjects, was used in this study. The baseline periods (A), or the pre and post cycles, were three weeks in length. The intervention (B), or steroid cycle, was eight weeks in length for all subjects except for subject 3 who had a steroid cycle of ten weeks. There were 9 dependent variables: frequency and intensity of PA and NA; average PA, average NA, self-confidence, aggression and fatigue.

Procedures

Each subject was required to fill out the ESM questionnaire, twice a day, for a period of 14-16 weeks (depending on the length of their cycle) including three weeks before their steroid cycle, throughout the cycle, and three weeks following the cycle. A

steroid cycle usually consists of six to ten weeks on AS. The twice daily ESM questionnaires were collected once a week. Apart from the ESM questionnaire, subjects were also required to fill out the personal data form (PDF).

Data Analysis

Due to the fact that subjects were using different drugs and dosages, it was felt that a group analysis was inappropriate. Instead data were analyzed within a single-subject design framework. Comparisons of descriptive statistics (i.e. means and standard deviations) and visual graphic analyses were performed on the time-series plots of the following dependent variables: FPA, FNA, IPA, INA, daily PA, daily NA, SC, AGG, and FAT. In order to assess variability of mood, and to further gauge changes occurring from the off to the on-steroid phases, spectral analysis was performed on daily PA and NA.

Computation of Composite Mood Scores. The positive affect (PA) at each sampling was calculated by summing the scores on the positive scales and dividing by the total number of positive items (N=4). Daily or average PA was based upon taking the mean of the PAs for that day. Similarly, NA was calculated by summing the scores on the negative scales and dividing by the total number of negative items (N=5). Daily or average NA was based upon taking the mean of the NA's for the day. Frequency of PA (FPA) was calculated by summing the days in which daily PA scores exceeded

daily NA scores, and dividing this number by the total number of days sampled. Frequency of NA (FNA) was calculated by summing the days in which daily NA scores exceeded daily PA scores, and dividing this number by the total number of days sampled. Basically, FNA equals 1-FPA. Intensity was the strength with which subjects experienced their dominant affect. Therefore intensity of PA (IPA) was defined as the average PA on those days when average PA was greater than average NA. Similarly, intensity of NA (INA) was computed as the average NA on those days when average NA was greater than average PA (see Appendix C for computations of the composite scores). The daily self-confidence (SC), aggression (AGG) and fatigue (FAT) scores were calculated by taking the average for each variable per day.

Visual graphic analysis. In single-subject research, experimental criterion is met by examining the effects of the intervention at different points over time (Kazdin, 1982). In an ABA design, such as that used in this study, the effect of the intervention is clear if there are systematic changes in parameters during the intervention phase (B) when compared to the baseline periods (A). According to Kazdin (1982), the primary method of data evaluation for single-subject research is based on visual inspection of data which is graphically displayed. Line graphs are used to represent the data over time and across phases. Inferences based on visual inspection rely on several characteristics of single-subject data; mean, level, trend across phases, and latency

(Kazdin, 1982). A change in mean across the phases refers to a shift in average dependent measure between phases. Change in level refers to a marked discontinuity or shift in the dependent variable from one phase to the next. Changes in trend refer to changes in the direction or slope of the data. Finally, latency pertains to the speed of change in parameters after the implementation or discontinuity of a phase. Mean and level are characteristics related to magnitude, while trend and latency are related to rate.

In this study a graphical representation of the data was used to describe the pattern of mood fluctuations throughout the steroid cycle and the two off-cycles in male bodybuilders. Specifically, daily scores on PA, NA, IPA, INA, SC, AGG, and FAT were plotted over time. Mean lines and standard deviations were used to compare between the phases of the cycle. Mean lines are depicted on the graphs in order to aid in visual analysis. Changes in level, trend and latency were examined by visual inspection.

Cut-off Criteria for Mood Changes. In order to make more systematic comparisons between baseline and steroid phases cut-off criteria were established. Since it is not appropriate to conduct statistical tests of significance on single-subject designs (e.g. violations of basic assumptions), theoretically or psychologically significant cut-off points were determined. Consistent changes in a dependent variable were said to occur for PA, NA, IPA or INA, when mean mood scores from one phase to another increased or

decreased by .333 of one unit on the 6 point mood scale. For FAT, AGG, or SC the cut-off point is .5 of one unit on the 6 point mood scale. The rationale underlying the selection of these cut-off points is as follows. PA, NA, IPA and INA are composite scores; PA and IPA are based upon 8 mood adjectives/day, while NA and INA are based upon 10 mood adjectives/day. If mean PA increases by .333 from the baseline period to the steroid phase, this translates to an increase of approximately 2.5 points per day (.333 x 8). In other words, in 3 of the 8 ratings the subject would be making a rating of one unit higher or lower than he had previously. When subjects reach the on-steroid phase of their cycle, they have completed approximately 504 ratings of mood (24/day x 21 days); this systematic change in more than one third of their ratings amounts to something which most probably reflects a subjectively perceived change. Using the same example for NA an increase of approximately 3 points would occur (.333 x 10) which would mean that in 3 out of 10 ratings the subject is giving a consistently higher or lower rating. A higher cut-off value was set for FAT, AGG, and SC because they are not based upon composite scores. Therefore an increase in mean PA of .5 from the baseline period to the steroid phase would translate to a change of 1 point per day (.5 x 2) or a change of 1 on one of the 2 ratings per day. While the cut-off points may seem arbitrary, they do reflect what subjects report as subjectively different. Furthermore, in the area of steroid use such incursions into theoretical versus statistical significance are justified because a concern exists for

the well-being of the subject. What may not achieve statistical significance may have real impact in the subject's everyday life.

Spectral Analysis. In order to assess the variability of mood, or the frequency of mood change, time series analysis in the frequency domain was performed on average PA and NA data for each subject. Specifically, spectral analysis was applied. Spectral analysis is somewhat like regression in that the objective is to account for variance by fitting a model to the data (Larsen, 1987). Unlike regression, in which a linear model is used, spectral analysis involves the non linear application of many sine-cosine waves to the data and assess the fit of each one. The waves differ in their length of period, amplitude and phase and account for different amounts of variance. This process results in a collection of estimates called the spectral density function in which each estimate represents how much variance in the raw data can be explained by the sine-cosine waves with different period lengths or frequencies (Larsen, 1987). The spectral density function is equivalent to the fast Fourier transform of the autocovariance function of the time series (Chatfield, 1989). In this study the spectral density function was calculated by use of the fast Fourier transform which is available in SYSTAT (Wilkinson, 1988). Since this type of Fourier transform should be done on series with lengths (number of cases) which are powers of 2 (Chatfield, 1989; Wilkinson, 1988) the data for each subject were

padded so as to increase the number of cases from 98 to 128. This padding was done by use of a cubic spline technique (Brodlie, 1980). The cubic spline technique involves re-plotting a large number of data points on the same curve which was produced by a smaller number of points. The replotting does not change the shape of the curve but includes more data points in it.

Performing spectral analysis on a series which contains a trend violates the stationarity assumption of spectral analysis (Chatfield, 1989). Therefore in order to make sure that there were no violations of stationarity in this study, all subjects' PA and NA data were detrended before analysis. Detrending consists of removing the linear trend from the series thereby leaving the residuals for use in the spectral analysis (Wilkinson, 1989).

Results

The results of this study are presented in four sections: (1) results of personal data form for all subjects, (2) results of visual graphical analysis of the mood variables, (3) results of spectral analysis, and (4) a summary of each subject's mood profile.

Results of Personal Data Form

Table 1 features the physical characteristics of the subjects in this study. The subjects ranged in age from 19 years old to 49

years old. The shortest subject was 60 inches in height and the tallest was 74 inches in height. They ranged in weight from 180 lbs. to 260 lbs.

Insert Table 1 about here

Information pertaining to each subject's AS use during the study is presented in Table 2. The average steroid cycle was eight weeks. Only subject 3 deviated from this pattern with a 10 week cycle. Thirteen different drugs were used by the subjects in this study with most of them using two or more at a time (i.e. "stacking"). Subjects 4, 8, and 12 were the only subjects to use one drug.

Insert Table 2 about here

Mood Analysis

Frequency of Positive Affect (FPA). Table 3 presents FPA for each bodybuilder across phases. Visual inspection reveals that 11 out of 13 subjects (subjects 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12) displayed higher FPA in the baseline phase when compared to the post phase. In particular, subject 9 experienced the most dramatic change with a decrease in FPA of 24% from the baseline to the post phase. Two subjects (subjects 10, 13) had equivalent baseline and

post phase percentages for FPA. Six subjects (subjects 3, 4, 5, 10, 11, 13) displayed higher FPA in the steroid phase when compared to the baseline and post phase.

Insert Table 3 about here

Frequency of Negative Affect (FNA). Visual inspection of Table 3 reveals that 11 out of 13 subjects (subjects 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12) displayed higher FNA in the post phase when compared to the baseline phase. The other two subjects (subjects 10, 13) had equivalent baseline and post-phase percentages for FNA. Two subjects (subjects 1, 6) displayed higher FNA in the steroid cycle as opposed to the baseline and post phase.

Positive Affect (PA). Figure 1 illustrates the PA scores for each bodybuilder throughout the measurement period. Visual inspection and mean line comparisons revealed that 9 out of 13 subjects (subjects 1, 2, 3, 6, 7, 8, 10, 12, 13) showed no consistent differences in PA between the pre cycle, steroid cycle, and post cycle. However, all subjects experienced their highest PA scores while they were in their steroid cycle. Four subjects (subjects 4, 5, 9, 11) displayed consistently higher PA during their steroid cycle as opposed to the pre and post periods. Seven subjects (4, 5, 7, 8, 9, 10, 11) experienced more variability or

fluctuation in PA while they were on steroids as evidenced by range and standard deviations. Comparisons between subjects showed varying degrees of level and trend.

Insert Figure 1 about here

Negative Affect (NA). Mean line comparisons and visual inspection of the NA graphs (Figure 2) revealed that 11 out of 13 subjects (subjects 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13) showed no consistent differences in NA between the pre cycle, steroid cycle, and the post cycle. However 8 of those 9 subjects (subjects 4, 5, 6, 7, 8, 9, 10, 11) did experience higher NA in the post cycle as opposed to the steroid or pre cycle. Two subjects (subjects 1, 2) displayed consistent differences between the cycles. Subjects 1 and 2 experienced an increase in NA with the onset of their steroid cycle which continued on through to the post cycle.

Insert Figure 2 about here

Intensity of Positive Affect (IPA). Figure 3 illustrates the IPA scores for each bodybuilder throughout the measurement period. Visual inspection and mean line comparisons revealed that 8 out of 13 subjects (subjects 1, 2, 3, 6, 8, 10, 12, 13) showed no

consistent differences in IPA between the pre cycle, steroid cycle, and post cycle. However, all subjects experienced their highest IPA scores while they were in their steroid cycles. Five subjects (subjects 4, 5, 7, 9, 11) displayed consistently higher IPA during their steroid cycle as opposed to the pre and post periods. Seven subjects (4, 5, 7, 8, 9, 10, 11) seemed to experience more variability or fluctuation in IPA while they were on steroids. Comparisons between subjects showed varying degrees of level and trend.

Insert Figure 3 about here

Intensity of Negative Affect (INA). Mean line comparisons and visual inspection of the INA graphs (Figure 4) revealed that 10 out of 13 subjects (subjects 1, 2, 4, 5, 6, 7, 8, 11, 12, 13) displayed differences in INA between the pre cycle, steroid cycle and post cycle. Five of those subjects (subjects 1, 2, 4, 6, 8) experienced an increase in INA during the steroid cycle which carried over into their post cycles. The other five subjects (subjects 5, 7, 11, 12, 13) experienced an increase in INA during the steroid cycle which dissipated during the post cycle. Three subjects (subjects 3, 9, 10) experienced no consistent differences in INA throughout the three cycles.

Insert Figure 4 about here

Self-Confidence (SC). Figure 5 illustrates the SC scores for each bodybuilder throughout the measurement period. Visual inspection and mean line comparisons revealed that 8 out of 13 subjects (subjects 1, 3, 4, 6, 8, 9, 10, 13) showed no consistent differences in SC between the pre cycle, steroid cycle and post cycle. Five subjects (subjects 2, 5, 7, 11, 12) displayed consistent differences between the cycles in SC scores. Four of those subjects (subjects 5, 7, 11, 12) experienced greater SC in the steroid cycle as opposed to the pre or post cycles. Subject 2 experienced a decrease in SC during his post cycle rather than an increase in the steroid cycle.

Insert Figure 5 about here

Aggression (AGG). Mean line comparisons and visual inspection of the AGG graphs revealed that 8 out of 13 subjects (subjects 1, 2, 3, 6, 8, 10, 12, 13) experienced no consistent differences between the pre cycle, steroid cycle and post cycle. Five subjects (subjects 4, 5, 7, 9, 11) displayed consistent differences in AGG

between the three cycles. All five subjects experienced greater AGG in the steroid cycle as opposed to the pre and post cycles.

Insert Figure 6 about here

Fatigue (FAT). Figure 7 illustrates the FAT scores for each bodybuilder throughout the measurement period. Visual graphic analysis and mean line comparisons reveals that 7 out of 13 subjects (subjects 1, 2, 4, 8, 9, 11, 12) showed consistent differences in FAT between the three cycles. Five of those subjects (subjects 1, 2, 8, 9, 12) experienced an increase in FAT during the steroid cycle which continued increasing through the post cycle. Subjects 4 and 11 experienced a decrease in FAT during the steroid cycle as opposed to the pre and post cycles. Six subjects (subjects 3, 5, 6, 7, 10, 13) showed no consistent differences among the three cycles.

Insert Figure 7 about here

Spectral Analysis

Analysis of positive affect. Figure 8 illustrates the spectral analysis results for PA for each subject. Visual inspection reveals that 7 out of 13 subjects (subjects 1, 2, 3, 6,

8, 10, 12) display similar spectral density functions in that the peak variance occurs before a period length of 7 days. In other words, the variance of these subjects' PA can be explained by moderately fast sine-cosine waves. Their PA is fluctuating within or on a weekly basis. Three subjects (subjects 4, 7, 13) display similar spectral density functions in that their peak variance occurs in periods ranging from 7 to 14 days. Finally, three subjects (subjects 5, 9, 11) display very similar spectral density functions in that their peak variance occurs at a period length of 49 days. Thus the variance for subjects 5, 7 and 9 can be explained by a very slow sine-cosine wave which could correspond to the on-steroid phase.

Insert Figure 8 about here

Analysis of negative affect. Visual inspection of the spectral density functions for NA (Figure 8) revealed that all 13 subjects displayed similar spectral densities. The highest peak in the spectral density function occurred at or very near the 7 day period length for all subjects. This means that a sine-cosine wave with a period length of approximately 7 days accounts for the most variance in NA for each subject. Overall, it seems that variance in NA is explained by moderate to fast sine-cosine waves. In other

words the subjects' NA changed rather frequently over time.

Insert Figure 9 about here

Subject Summary

In this section each subject's mood profile throughout the measurement period is discussed briefly. Specifically any consistent changes in mean are highlighted (see Table 4 for a summary).

Insert Table 4 about here

Subject 1 displayed consistent differences in three dependent variables - NA, INA, FAT - between the baseline, steroid cycle and post-steroid phase. This subject experienced an increase in NA, INA and FAT during the steroid cycle which carried over to the post phase.

Subject 2 displayed consistent differences in four variables - NA, INA, SC, FAT - between the three phases. This subject experienced higher SC during the steroid cycle than during the baseline or post phases. In a similar pattern to subject 1 this subject experienced increases in NA, INA and FAT during the steroid cycle which carried over into the post phase.

Subject 3 displayed no consistent differences on any of the mood variables throughout the measurement period.

Subject 4 displayed consistent differences in five dependent variables - PA, IPA, INA, AGG, FAT - between the phases. This subject was one of three who displayed wholesale changes in mood in association with AS use.

Subject 5 displayed consistent differences in five variables - PA, IPA, INA, SC, AGG - between the phases. This subject also experienced a wide range of changes in mood.

Subject 6 experienced an increase in INA during the steroid cycle which carried over into the post phase. This was the only variable in which this subject displayed any consistent differences.

Subject 7 displayed consistent differences in four dependent variables - IPA, INA, SC, AGG - between the three phases. For all four variables this subject experienced higher scores during the steroid cycle as opposed to the pre or post phases.

Subject 8 displayed consistent differences in two variables - INA, FAT - between the phases. This subject experienced an increase in INA and FAT during the steroid cycle which carried over into the post cycle.

Subject 9 displayed consistent differences in four dependent variables - PA, IPA, AGG, FAT - between the phases.

Subject 10 displayed no consistent differences on any of the dependent variables throughout the measurement period.

Subject 11 experienced the most changes in mood in association

with AS use. This subject displayed consistent differences in six variables - PA, IPA, INA, SC, AGG, FAT - between the three phases.

Subject 12 displayed consistent differences in four variables - NA, INA, SC, FAT - between the phases.

Subject 13 experienced greater INA during the pre phase when compared to the post phase. This was the only variable in which this subject displayed consistent differences.

In association with AS use, 11 out of 13 subjects experienced changes greater than the cut-off criteria for at least one mood variable. Three subjects (subjects 4, 5 & 11) experienced changes on five or more of the variables. Two subjects (subjects 3 & 10) experienced no mood changes as a result of AS use.

Discussion

The purpose of this study was to describe fluctuations in SC, AGG and FAT along with the frequency, intensity and variability of PA and NA in male bodybuilders who are self-administering large doses of ASs throughout a full cycle of steroid use. The findings and implications of the present study will be described in three parts: (1) discussion of the specific hypotheses, (2) suggestions for future research, and (3) conclusions.

Hypotheses

Data from the subjects in this study were analyzed within a

single-subject framework. The major reason for using the single-subject design was to eliminate some of the methodological problems that exist in previous research on ASs use and mood (i.e. sample heterogeneity). However, in order to discuss the hypotheses which have been proposed subjects were compared as a group in order to highlight any commonalities which may exist.

Changes in frequency of positive affect (FPA). The first hypothesis was that the 13 AS users would exhibit greater FPA during the steroid phase when compared to the baseline and post phases.

This prediction was not fully supported. Six subjects (subjects 3, 4, 5, 10, 11, 13) did display higher FPA in the steroid cycle, however, 7 subjects did not. More interesting was the fact that, except for subjects 3 and 10, all subjects experienced higher FPA in the baseline phase when compared to the post phase. This latter finding suggests that the majority of subjects have experienced a change in mood, as a result of AS use, which has resulted in less positive affect during the post phase. Thus, only selected subjects experienced increases in FPA as a result of AS use but most subjects experienced a decrease in FPA in the post phase.

Changes in frequency of negative affect (FNA). The second hypothesis was that the 13 AS users would exhibit higher FNA in the post phase when compared to the steroid phase. This prediction was

largely supported in that 10 out of 13 subjects (subjects 2, 4, 5, 7, 8, 9, 10, 11, 12, 13) experienced higher FNA in the post phase when compared to the steroid phase. However, it should be pointed out that 5 of those subjects (subjects 2, 6, 7, 8, 9) experienced higher FNA during the steroid phase when compared to the baseline phase. Thus it would seem that the increase in FNA witnessed during the post phase may actually originate during the steroid phase. For example, a subject may experience symptoms of depression during the steroid phase which increase even more when steroid use is terminated. Thus it would seem that some subjects do experience a higher FNA during the post-steroid phase.

Intensity of positive (IPA) and negative affect (INA). Hypothesis three proposed that IPA and INA would be greater in the steroid phase when compared to baseline and post phases.

In the case of IPA there seems to be only modest support for this hypothesis in that 5 out of 13 subjects (subjects 4, 5, 7, 9, 11) display consistently higher IPA in the steroid cycle when compared to the baseline phases.

Possibly the most startling finding of this study has to do with the number of subjects who displayed changes in INA as a result of AS use. It was found that 10 out of 13 subjects (subjects 1, 2, 4, 5, 6, 7, 8, 11, 12, 13) experienced changes in INA across the three phases. Eight of those subjects (subjects 1, 2, 4, 5, 6, 7, 11, 12) displayed consistently higher INA during the steroid cycle when compared to the baseline phase. However,

consideration must be given to the fact that the average INA scores for each phase were based upon few observations. In many cases the INA score was based upon one observation. Therefore, conclusions about the relationship between INA and AS use are limited.

Self-confidence (SC) and aggression (AGG). Hypothesis four proposed that the 13 AS users would display higher SC and AGG during the steroid cycle when compared to the two off-steroid phases.

In the case of SC there is modest support for this prediction in that 5 out of 13 subjects (subjects 2, 5, 7, 11, 12) displayed consistently higher SC during the steroid cycle than either in the baseline phase or in the post phase. Ignoring the cut-off criteria there seems to be a trend in that all of the subjects, except for subject 10, display higher SC in the steroid cycle when compared to the other two phases.

With regards to AGG, there once again seems to be modest support for hypothesis 4 in that 5 out of 13 subjects (subjects 4, 5, 7, 9, 11) display consistently greater AGG during the steroid cycle when compared to either the baseline or post phase. Ignoring the cut-off criteria there seems to be a trend in that all 13 subjects experienced more AGG during the steroid phase when compared to the other two phases. In sum, it does seem that some AS users experience increases in AGG and SC in association with AS use.

Increases in fatigue (FAT) during the post-steroid phase. Hypothesis five proposed that FAT would be greater during the off-steroid phases. In particular it was expected that FAT would be greater during the post-steroid phase than during the steroid phase.

Only little support was found for this prediction in that 2 out of 13 subjects (subjects 4 & 11) displayed greater FAT during the post phase when compared to the steroid phase. However, 5 out of 13 subjects (subjects 1, 2, 8, 9, 12) displayed consistently more FAT during the post phase when compared to the baseline phase. Even more interesting, was the fact that 2 subjects (subjects 1 & 2) displayed consistently greater FAT during the steroid phase when compared to the baseline phase. Ignoring cut-off criteria, all subjects, except for subjects 4 and 11, displayed greater FAT during the steroid cycle when compared to the baseline phase. In all 11 cases, these increases in FAT carried over into the post phase.

It would seem that AS users experience more FAT during the post-steroid period when compared to baseline. These increases in FAT may carry over from the steroid phase. Humbert (1990) made similar observations in that he found a significant increase in FAT on the POMS as a result of AS use, amongst 20 male bodybuilders, when compared to pretreatment and post treatment periods. Humbert (1990) suggested that these increases in FAT may be due to the fact that ASs accelerate recuperation rate thus allowing the athlete to train longer and more intensely. Therefore, short-term reductions

in FAT may lead to long-term exhaustion due to the fact that the athletes are working harder during the AS cycle. However, we can not forget the fact that subjects 4 and 11 experienced less FAT during the steroid cycle when compared to the post phase.

Summary. AS use may bring about serious distortions in psychological functioning. In association with AS use subjects in this study experienced changes in mood such as reductions in FAT and FNA and increases in SC, AGG, IPA and FPA. However, in terms of these mood changes, there was much variability between the 13 subjects in this study. Apart from differences in personality, it is most likely that the variability in mood changes, observed between subjects, was a result of the different combination of drugs and dosages that each subject was using.

Alternative Reasons for Mood Changes and Variability. Other than the pharmacological effects of ASs there are several reasons why the observed effects may have occurred. First of all, there may have been an expectancy effect in that some of the subjects may have known what was expected of them with regards to mood changes. For example, when on ASs some of the subjects may have reported more aggression because they knew that was expected of them. Results may therefore be contaminated by expectancy effects. Secondly, there may be a bias in that this group of AS users have maintained their steroid use because they do not experience severe side-effects as a result of AS use. Thus the effects witnessed in these subjects may be mild in comparison to those which occur in

other previous users or non-users.

Future Research

The findings of this descriptive study underscore the need to further address several issues related to the psychological effects of ASs. Many questions still remain without answers. For instance, what is the relationship between drug, dosage and length of steroid cycle to mood disturbances, both pathological and non-pathological? Why do some individuals demonstrate very obvious mood changes as a result of AS use while others do not? Finally, do ASs have an addictive potential?

Due to the fact that it is unethical and illegal to administer non-therapeutic dosages of ASs to subjects, quasi-experimental design or field research will have to be further developed to study the effects of AS on humans.

If between subject designs are to be employed, some method of controlling for the drug being used, dosages and length of steroid cycle should be included in the research. However it is recommended that researchers use a repeated measures design in order to increase internal validity and control for individual differences among subjects over time. One useful method for collecting repeated measures of mood is the experience sampling method (ESM). While this study presented one application of the ESM, other applications also seem relevant. For example, in association with the daily reports of mood it would be interesting to acquire consensual reports of the subjects' mood from external

observers such as family and friends. The spouse or close friend could be asked to fill out daily behavior questions pertaining to the users apparent mood. In this way the problem of subjective mood assessment, which is typical of paper and pencil questionnaires, would be reduced. Furthermore, a nomothetic analysis, which would increase external validity, will allow us to make generalizations about the effects of ASs on mood. However, subjects in such a study should also be analyzed idiographically in case there are some who demonstrate very different behavior compared to the group (Larsen, 1989). The wide variety of mood patterns observed across subjects in this study support the need for subjects to be analyzed on an individual as well as group basis.

Apart from the assessment of mood, variations in other parameters such as self-esteem and self-concept of athletes throughout a full cycle of AS use could also be examined. Some AS users experience dramatic changes in weight and lean body mass as a result of cycling on and off steroids. One researcher has suggested that these changes in body size would cause fluctuations in self-esteem and self-concept which may eventually lead to habituation (Humbert, 1990). In fact, Brower et al. (1991) found that one of the best predictors of dependency in AS users was dissatisfaction with body size. This hypothesis could be examined in future research and could also be contrasted with other more physiologically-based hypotheses.

Conclusions

The present study supported a relationship between mood states and AS use in some individuals. As a group, the AS users in this study did not demonstrate the sweeping mood changes in association with AS use which are reported anecdotally. The fact that this was a purely descriptive study, using a single-subject design, means that inferences about causal relationships between AS use and mood changes can not be made. However, daily measures of mood taken across baseline, steroid and post-steroid periods showed a uniformity of mood change for some subjects (i.e. subjects 4 & 11) which implied a strong relationship between AS use and changes in mood.

The most important finding of this study was the fact that subjects displayed a wide range of mood changes in association with AS use. Several subjects (subjects 4 & 11) experienced quite dramatic changes in mood while others (subjects 3 & 10) demonstrated minimal if no effects as a result of AS use. Future research should be designed to account for such large variability.

Table 1

Physical and Age Characteristics of 13 Anabolic-Androgenic Steroid Users

Subject #	Age	Height (in.)	Weight (lbs.)
1	19	60	180
2	39	70	225
3	30	73	260
4	21	72	235
5	27	71	250
6	22	70	230
7	38	74	235
8	28	73	215
9	25	74	250
10	49	69	195
11	22	72	210
12	35	71	230
13	21	67	225

Table 2

Anabolic-Androgenic Steroid Profile of 13 Users

Subject	Cycle	Drug	Dosage
1	8 weeks	#Oxymetholone	150 mg/day
		*Stanozolol V	350 mg/wk.
2	8 weeks	#Oxymetholone	50 mg/day
		Sustanon 250	600 mg/wk.
3	10 weeks	#Fluoxymesterone	50 mg/day
		Testosterone Propionate	400 mg/wk.
4	8 weeks	Testosterone Enanthate	300 mg/wk.
5	8 weeks	*Stanozolol V	300 mg/wk.
		Methenolone Enanthate	200 mg/wk.
6	8 weeks	#Oxymetholone	100 mg/day
		Testosterone Enanthate	450 mg/wk.
7	8 weeks	#Stanozolol	12 mg/day
		*Boldenone Undecylenate	470 mg/wk.
8	8 weeks	Testosterone Cypionate	500 mg/wk.
9	8 weeks	#Oxandrolone	20 mg/day
		Stanozolol V	200 mg/wk.
		*Boldenone Undecylenate	400 mg/wk.
10	8 weeks	Methandrostenolone	50 mg/wk.
		*Stanozolol V	210 mg/wk.
		Testosterone Propionate	400 mg/wk
11	8 weeks	Testosterone Propionate	200 mg/wk.
		Testosterone Cypionate	200 mg/wk.
12	8 weeks	Nandrolone Decanoate	300 mg/wk.
13	8 weeks	*Boldenone Undecylenate	175 mg/wk.
		Testosterone Cypionate	200 mg/wk.
		Nandrolone Decanoate	200 mg/wk.

* Veterinary drugs
# Oral compounds

Table 3

Frequency Table of Positive Affect (FPA)* for Each Phase Expressed as a Percentage

Subject	Baseline	Steroid	Post-Phase
1	100	87.27	95.24
2	95.24	92.73	85.71
3	85.00	90.00	85.00
4	89.47	90.20	88.24
5	76.19	81.13	71.43
6	90.00	88.68	89.47
7	95.24	90.00	88.89
8	89.47	87.23	82.35
9	85.71	80.36	61.90
10	85.71	91.07	85.71
11	88.89	95.83	87.50
12	95.00	94.55	85.00
13	90.00	92.59	89.47

* FNA=(100-FPA)

Table 4

Summary of Changes in Mood Associated with AS Use Which Were Detected Through Visual Graphic Analysis

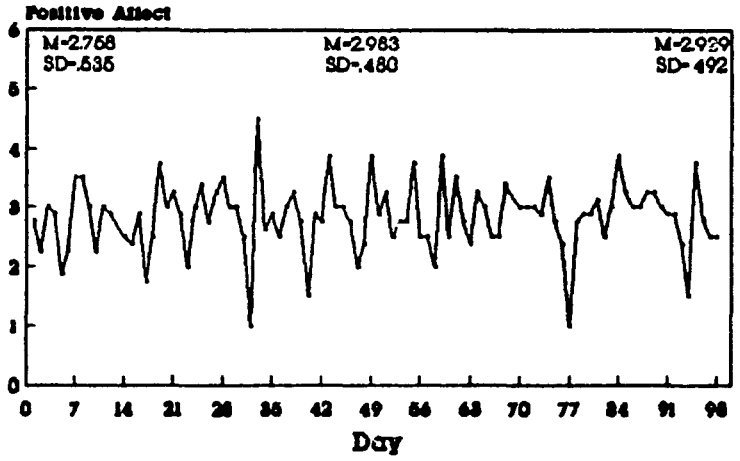
Sub.	PA	NA	IPA	INA	SC	AGG	FAT
1		X		X			X
2		X		X	X		X
3							
4	X		X	X		X	X
5	X		X	X	X	X	
6				X			
7			X	X	X	X	
8				X			X
9	X		X			X	X
10	X						
11			X	X	X	X	X
12				X	X		X
13				X			

Note. X - denotes a subject who displayed changes greater than the cut-off criterion for that variable.

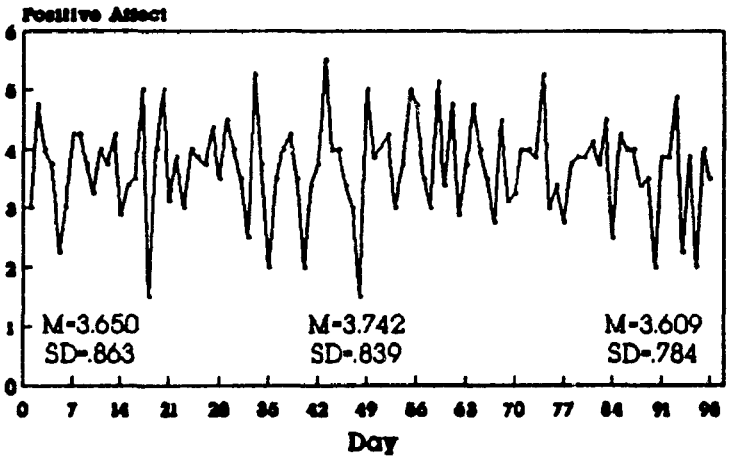
Figure Caption

Figure 1. Plots of daily positive affect for 13 male bodybuilders across a steroid cycle and two baseline periods. Means (M) and standard deviations (SD) for each phase are depicted on the plots.

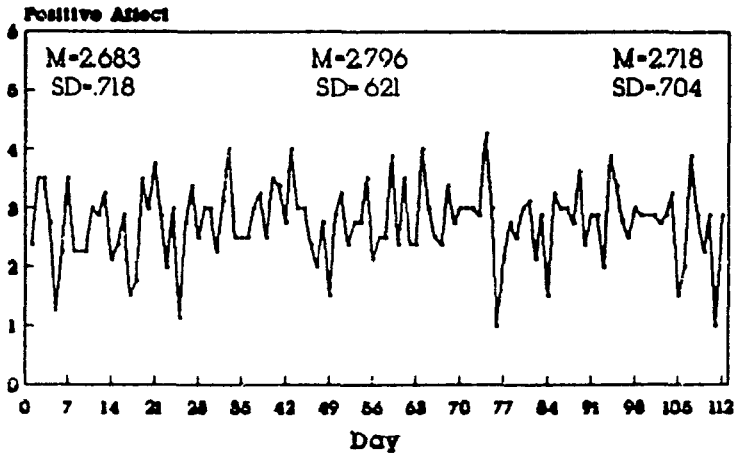
Subject #1



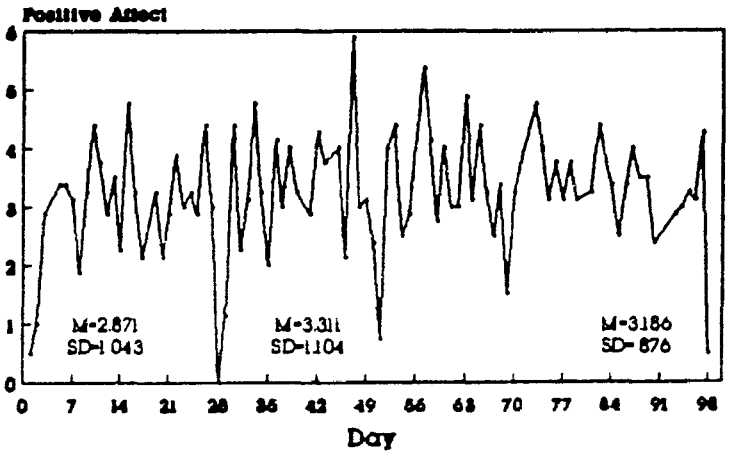
Subject #2



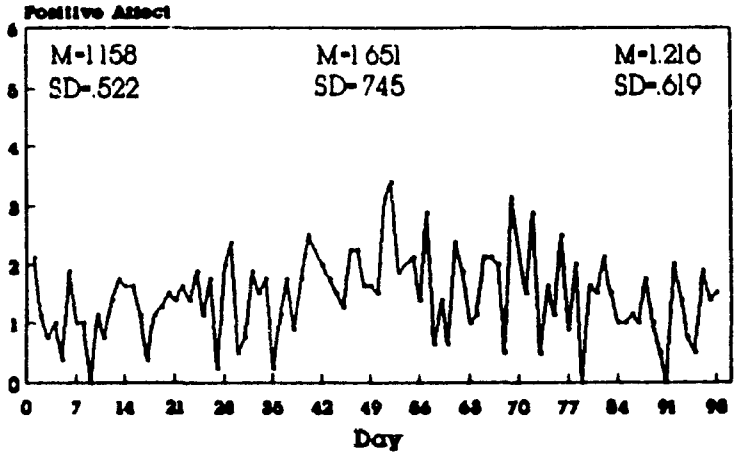
Subject #3



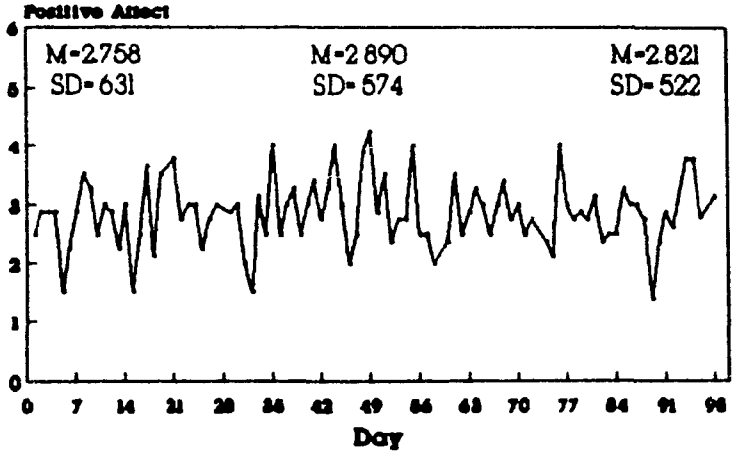
Subject #4



Subject #5



Subject #6



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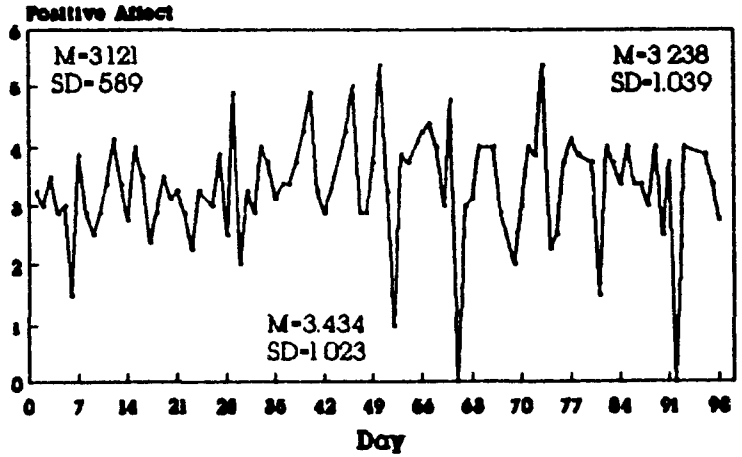

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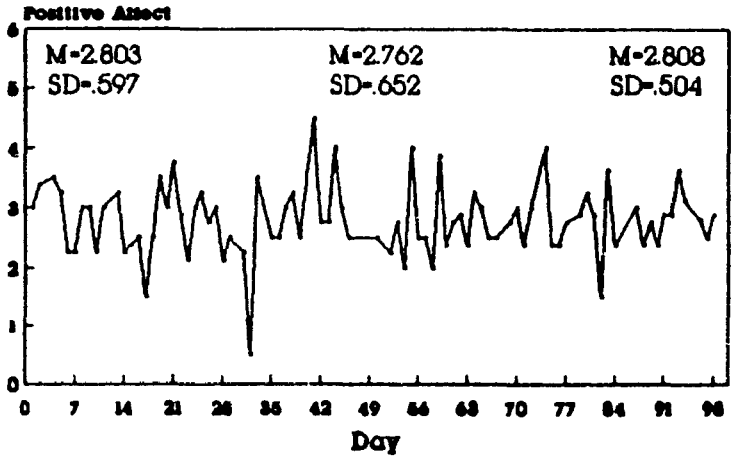

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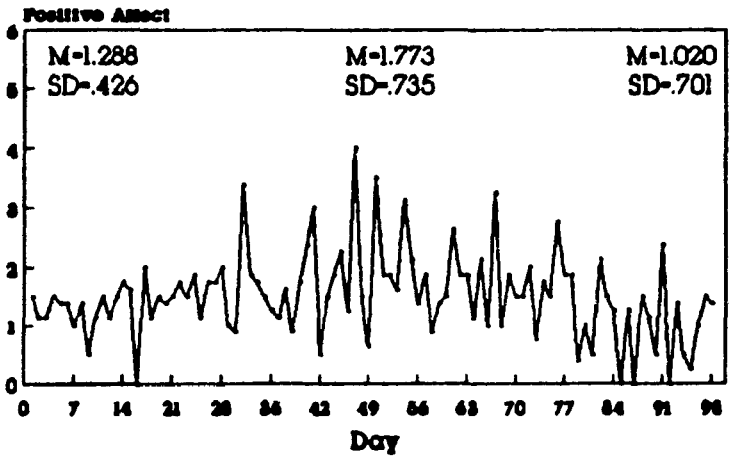

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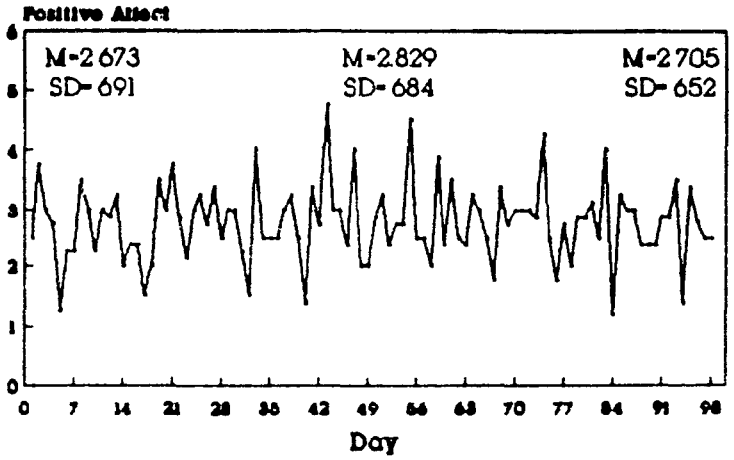

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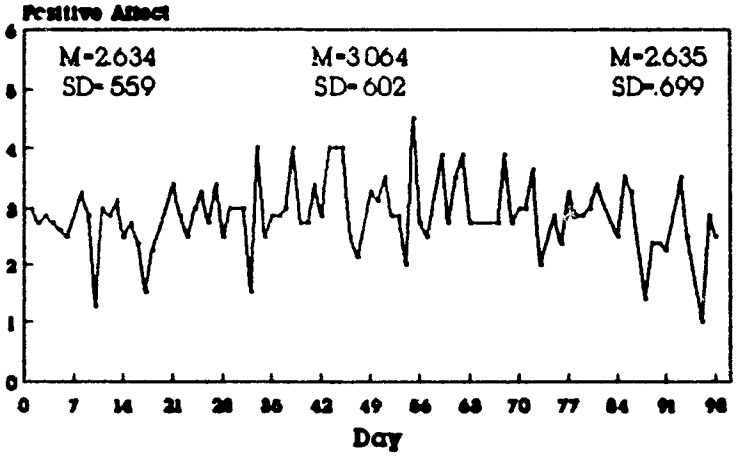

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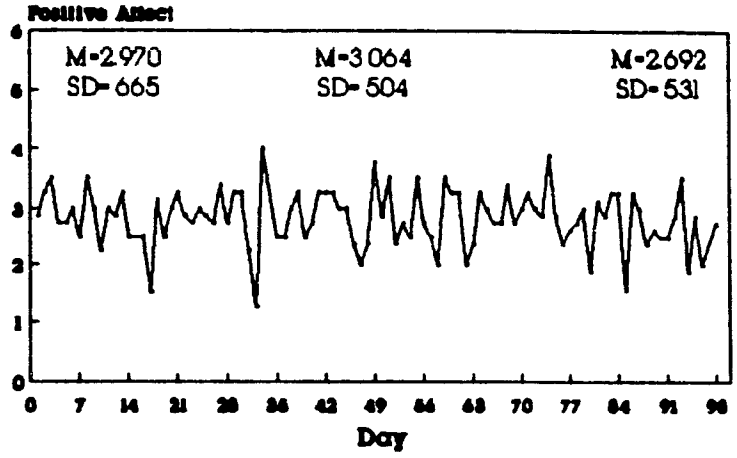

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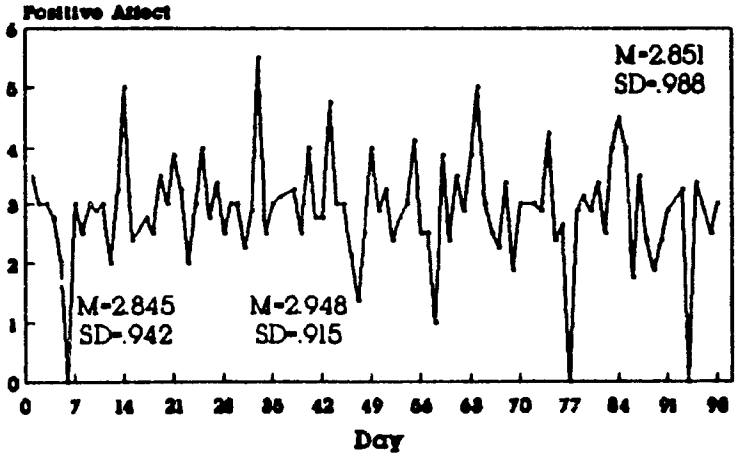
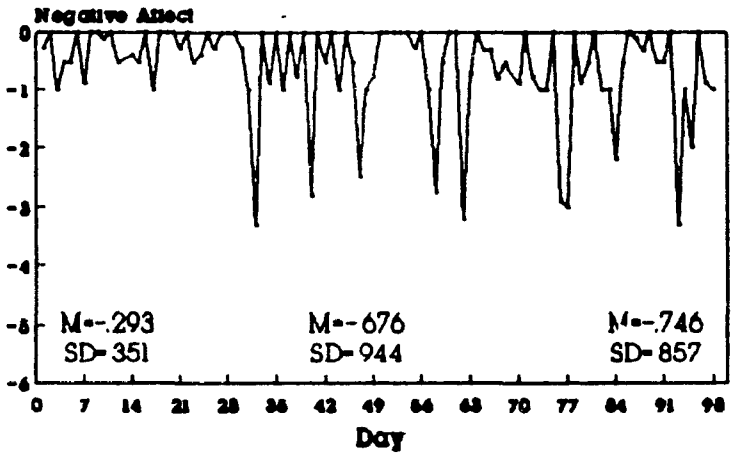


Figure Caption

Figure 2. Plots of daily negative affect for 13 male bodybuilders across a steroid cycle and two baseline periods.
Means (M) and standard deviations (SD) for each phase are depicted on the plots.

Subject #1



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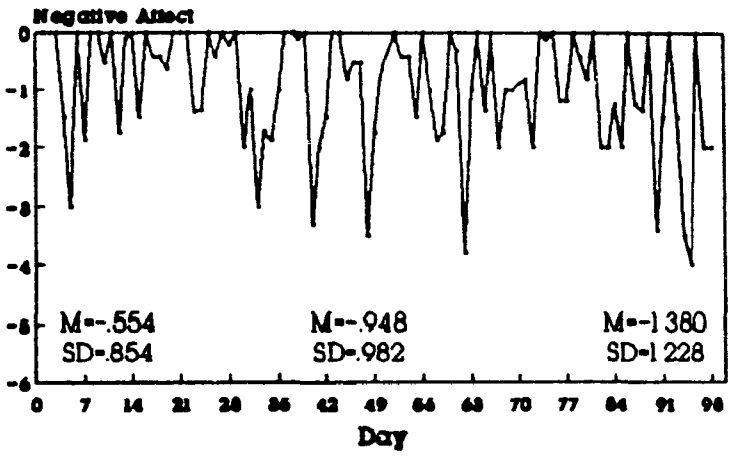

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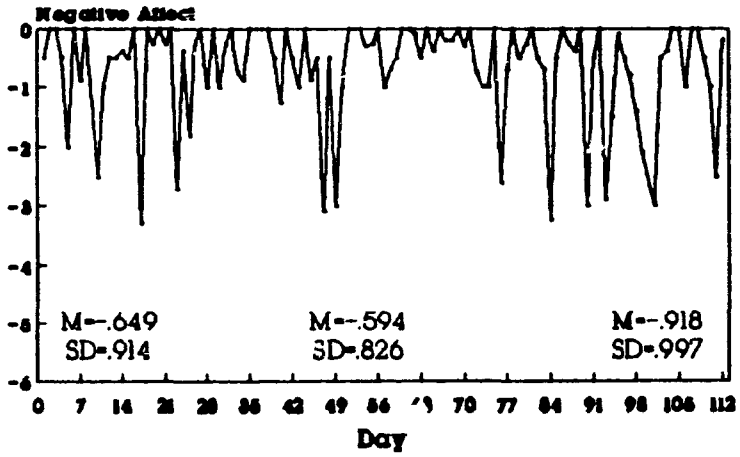

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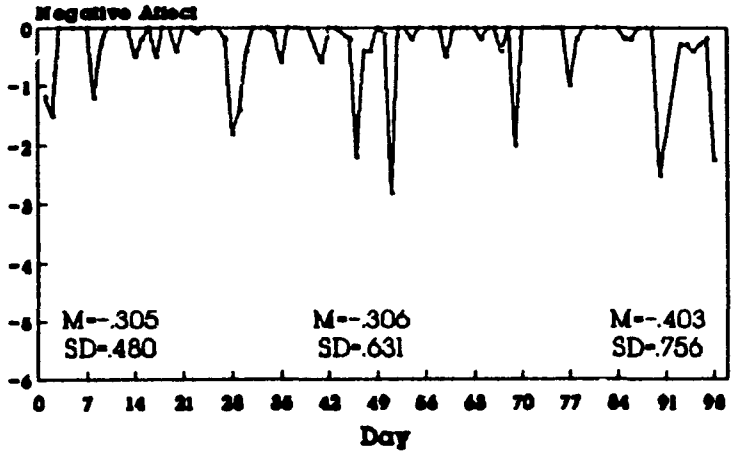

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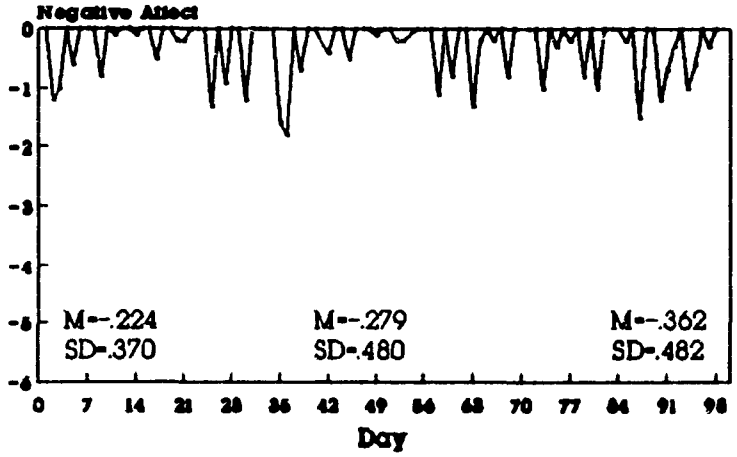

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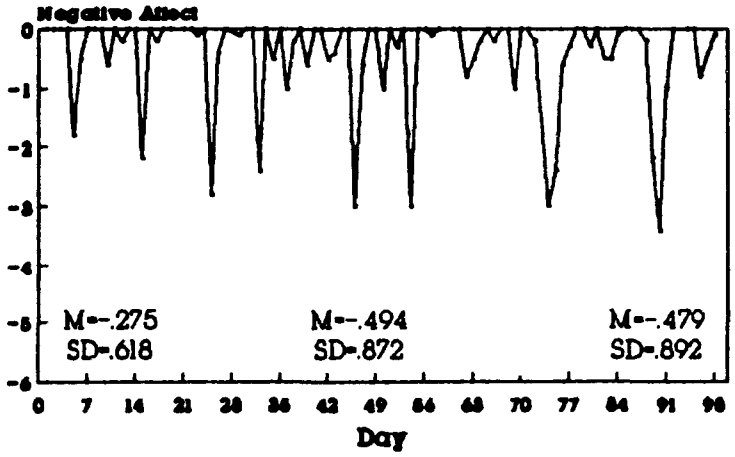

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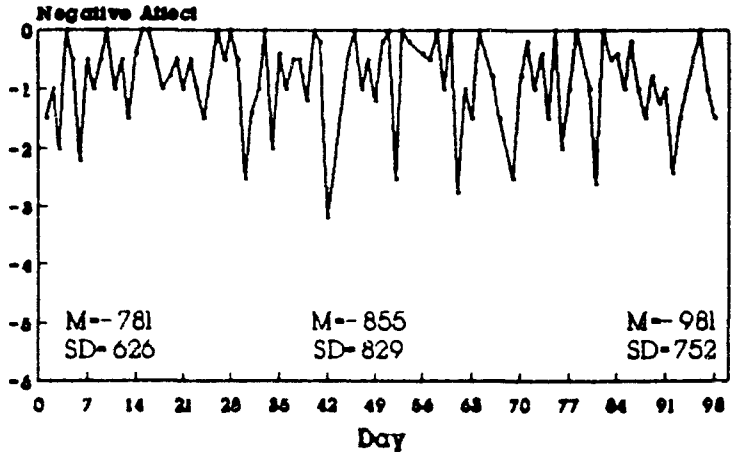

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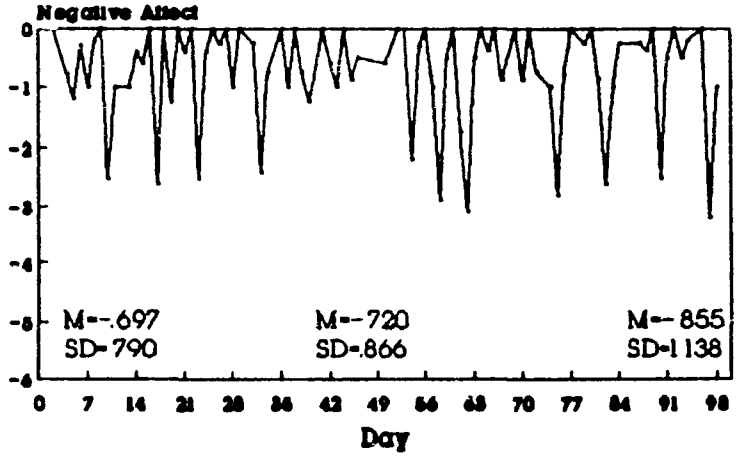

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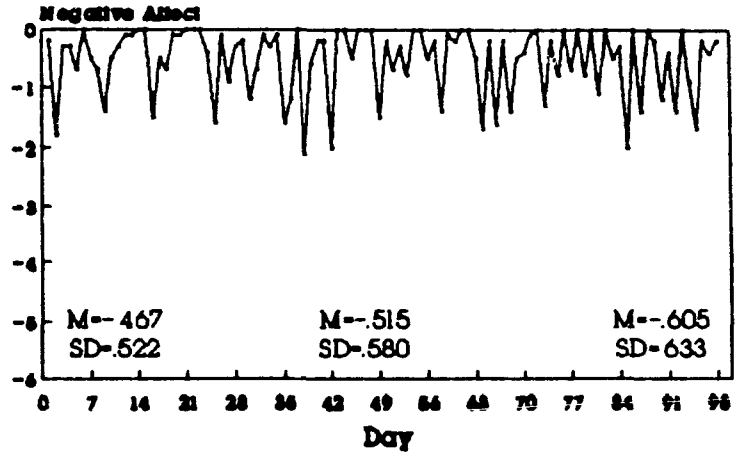

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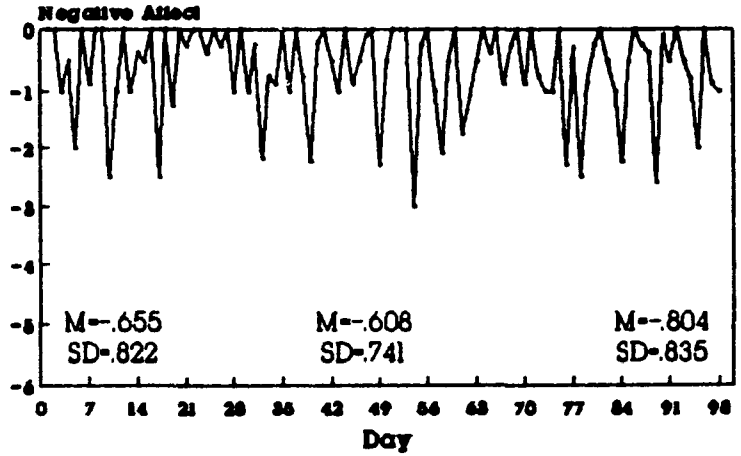

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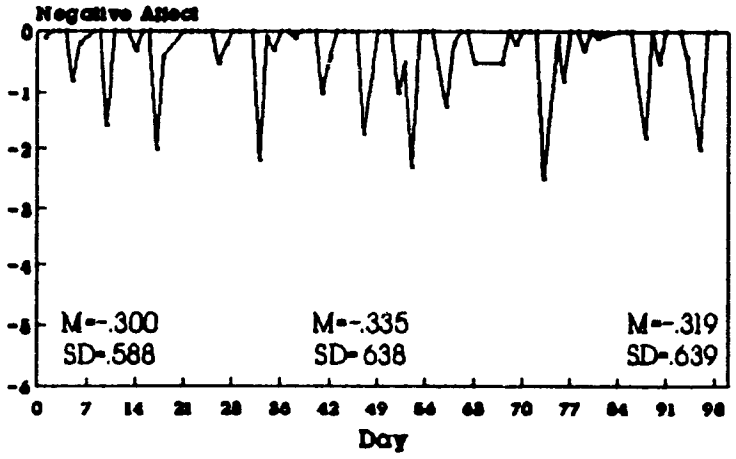

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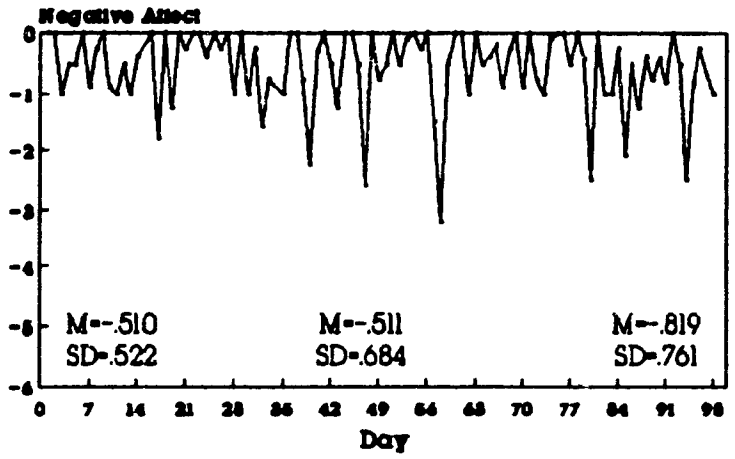

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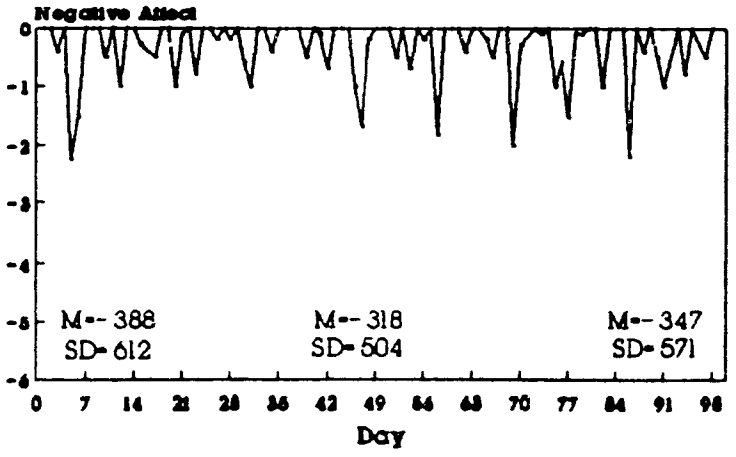
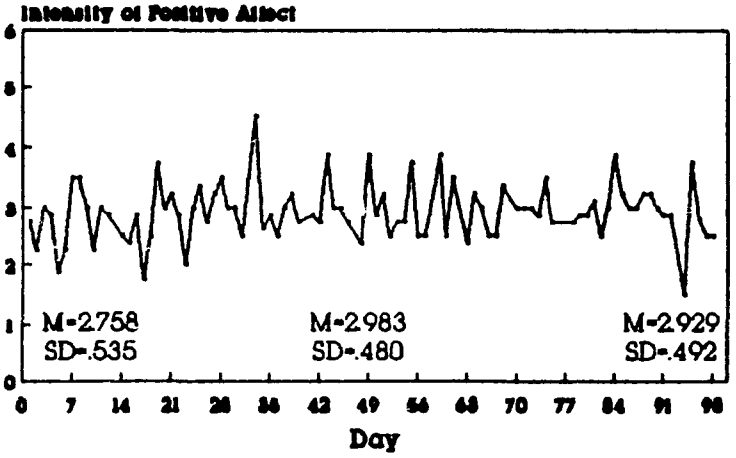


Figure Caption

Figure 3. Plots of intensity of positive affect for 13 male bodybuilders across a steroid cycle and two baseline periods. Means (M) and standard deviations (SD) for each phase are depicted on the plots.

Subject #1



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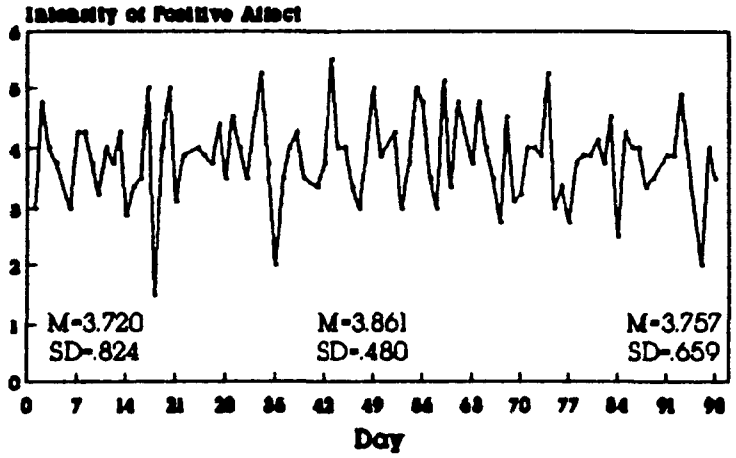

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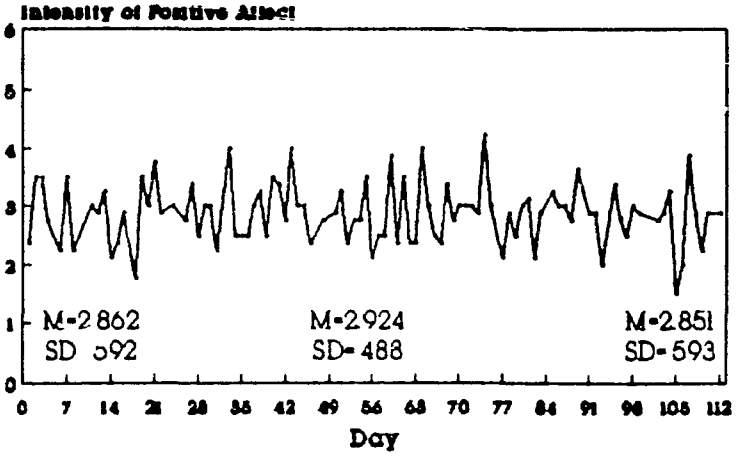

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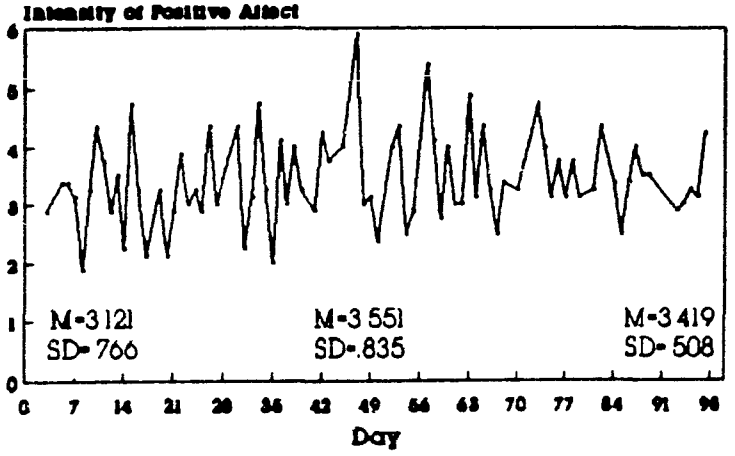

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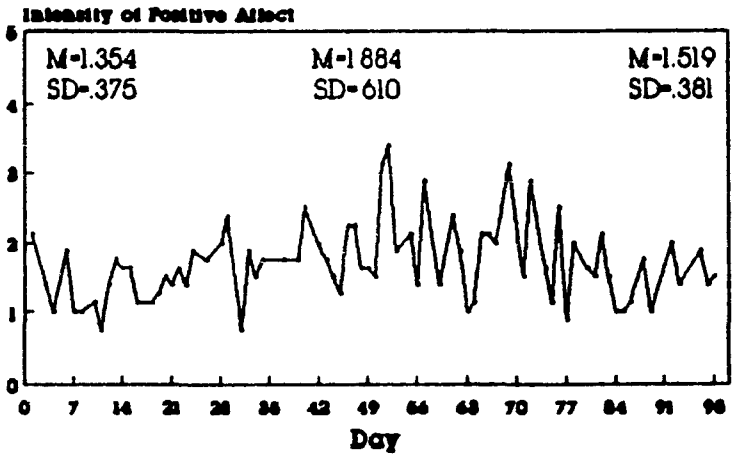

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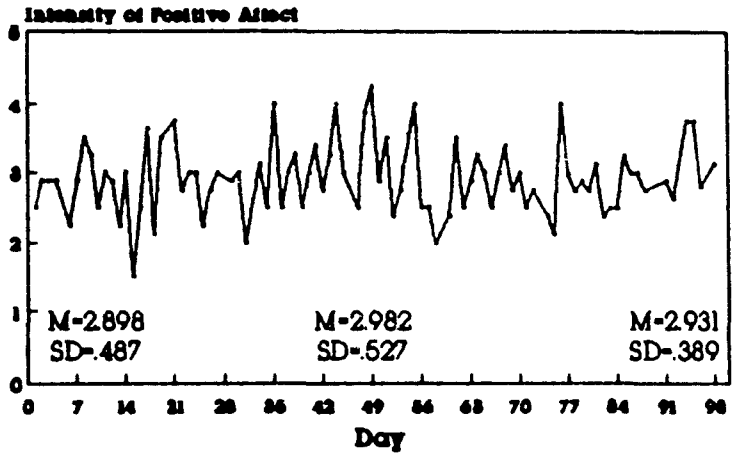

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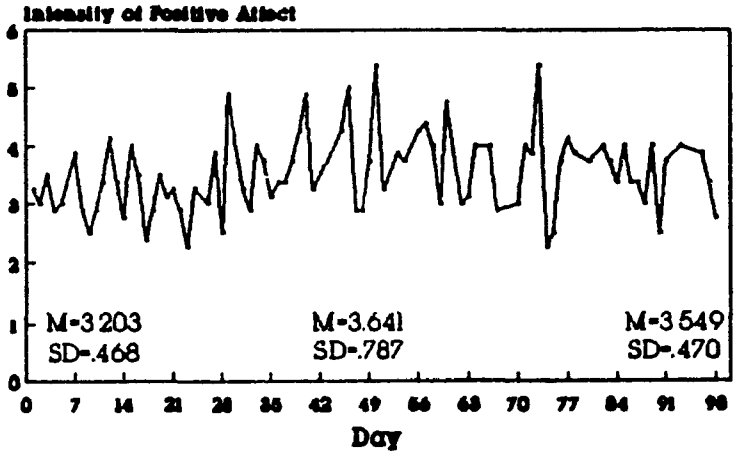

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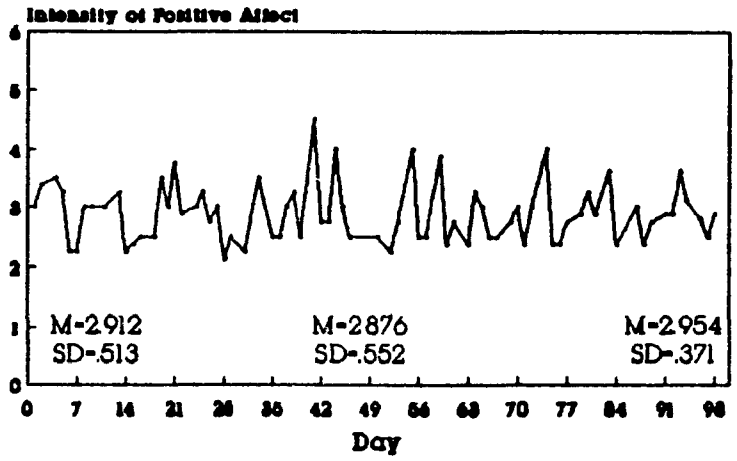

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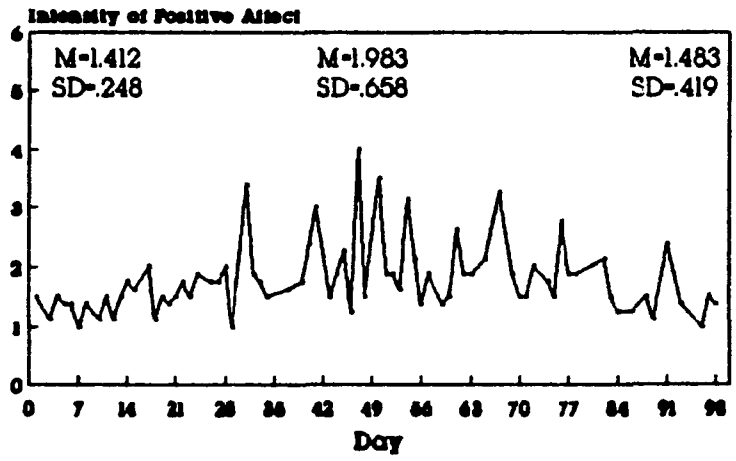

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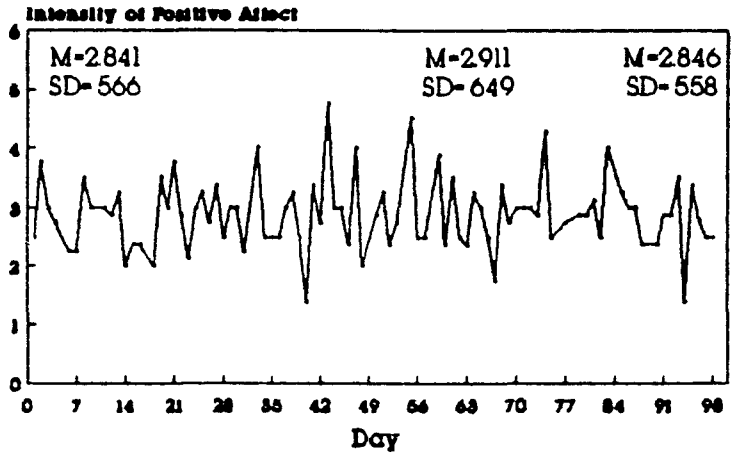

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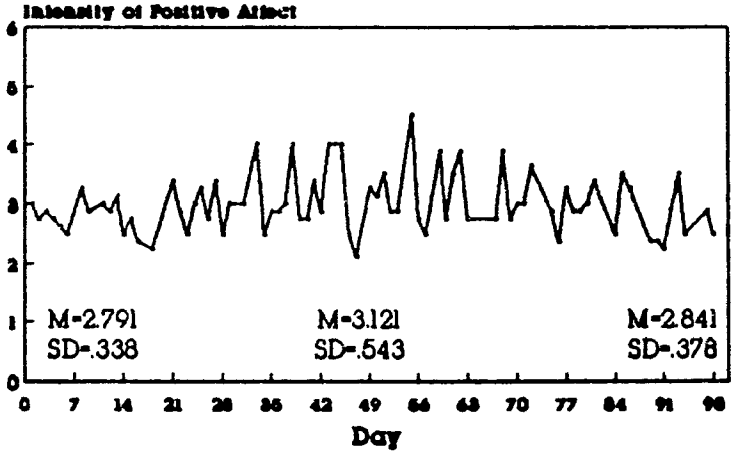

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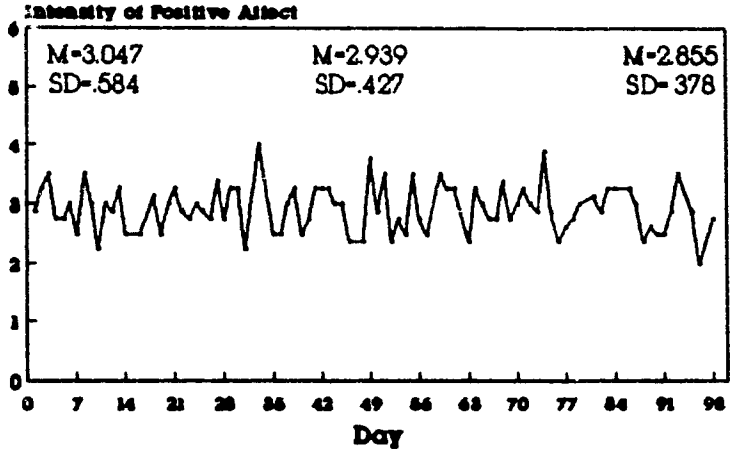

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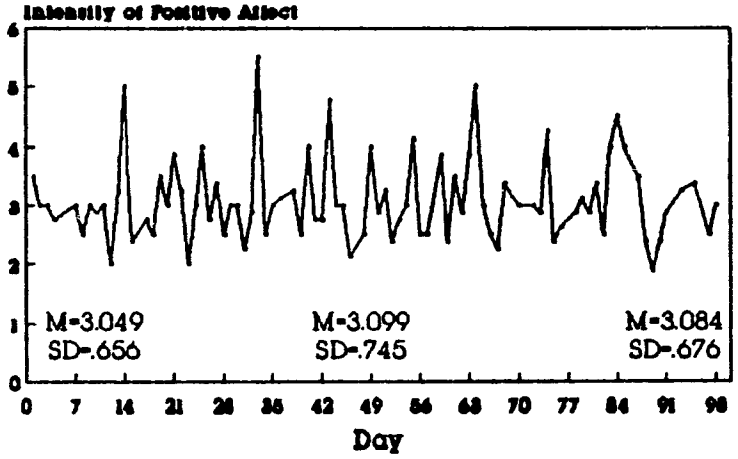
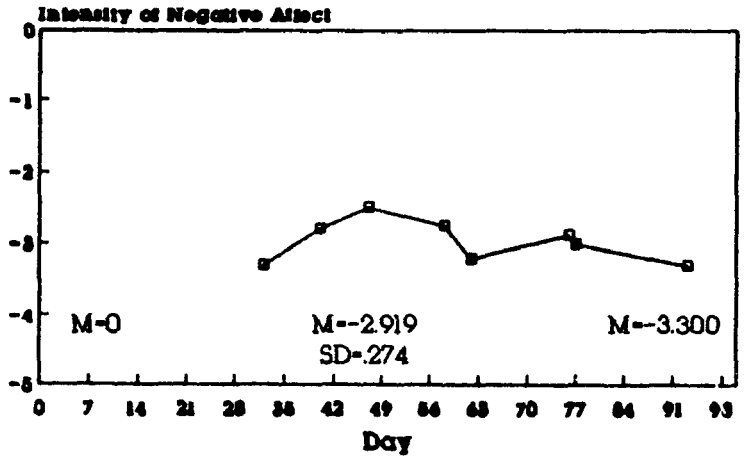


Figure Caption

Figure 4. Plots of intensity of negative affect for 13 male bodybuilders across a steroid cycle and two baseline periods. Means (M) and standard deviations (SD) for each phase are depicted on the plots.

Subject #1



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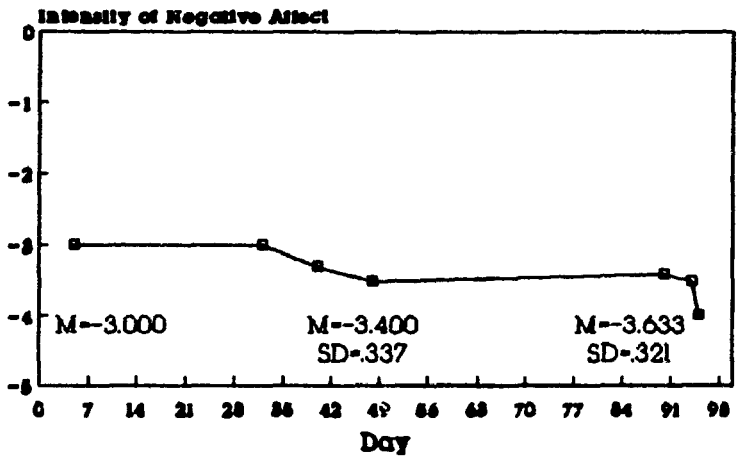

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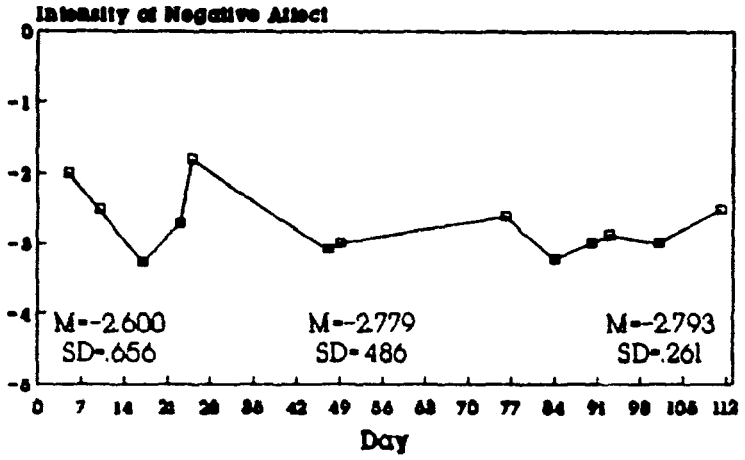

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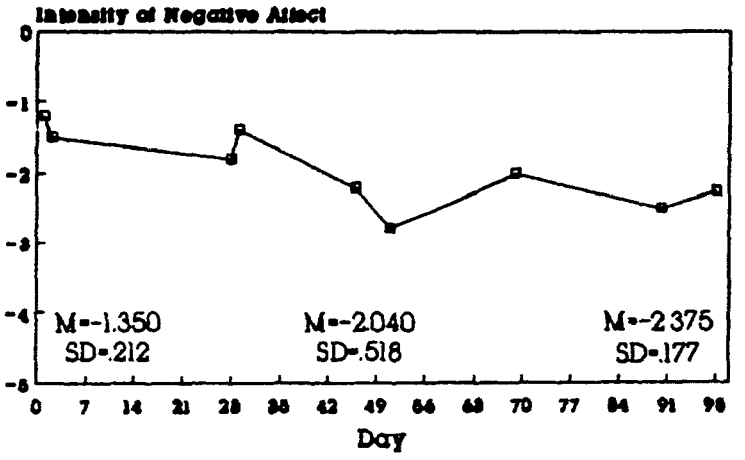

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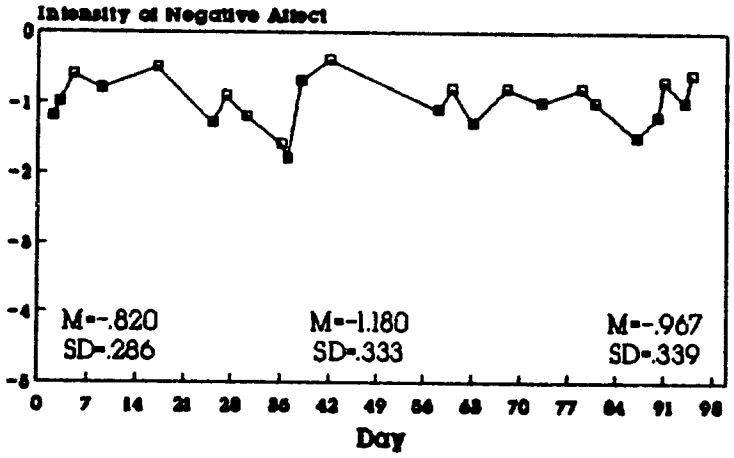

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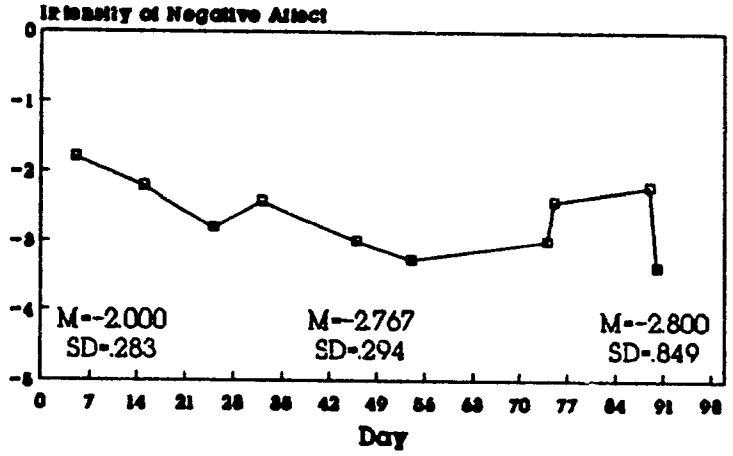

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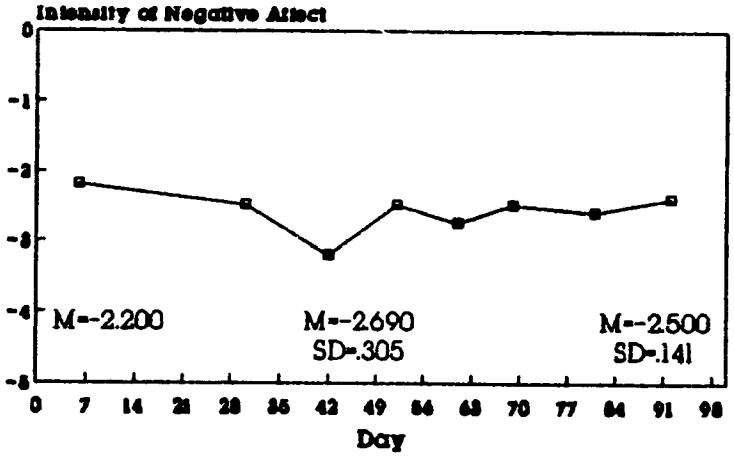

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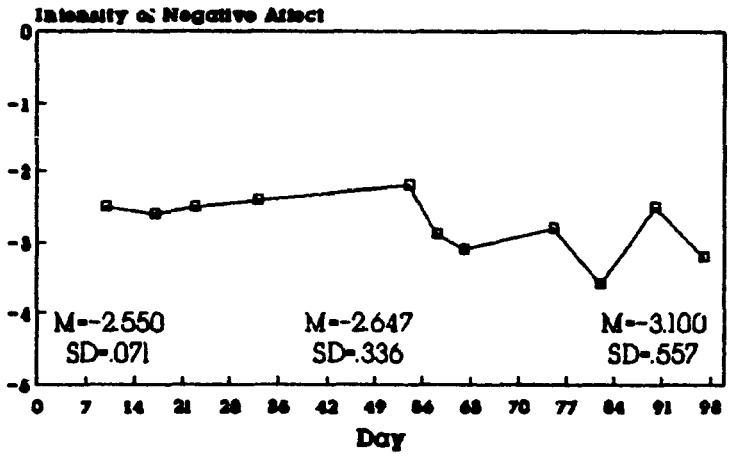

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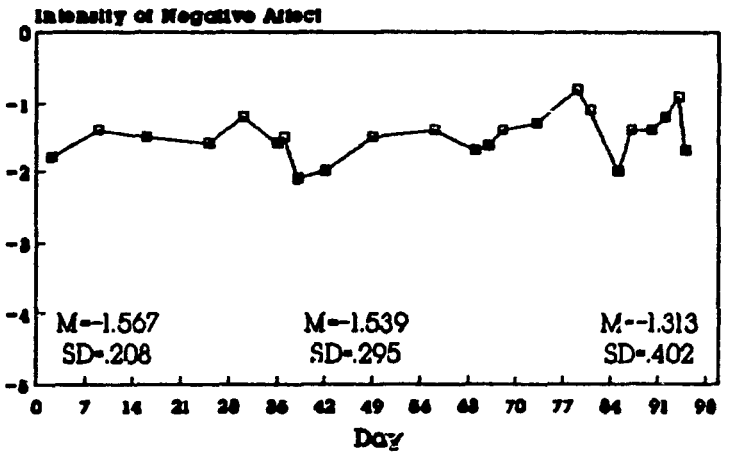

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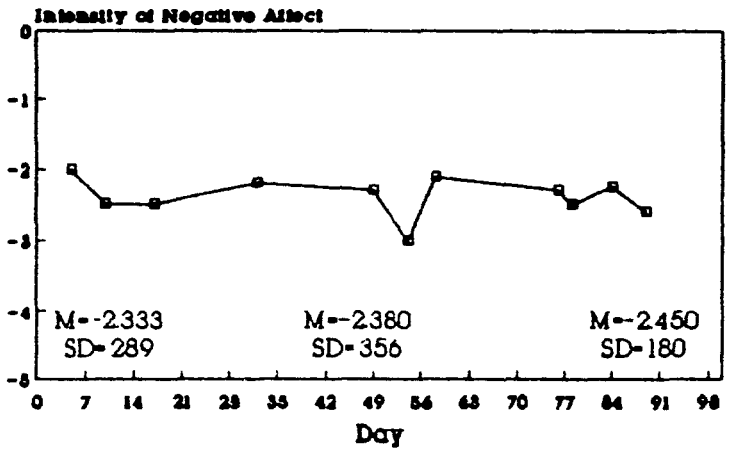

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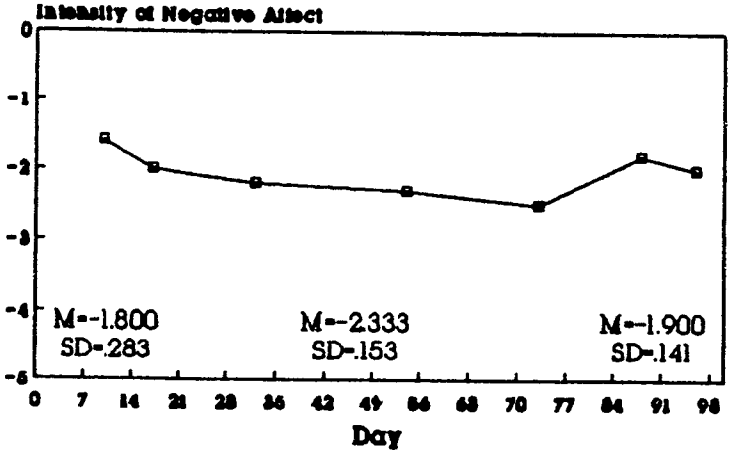

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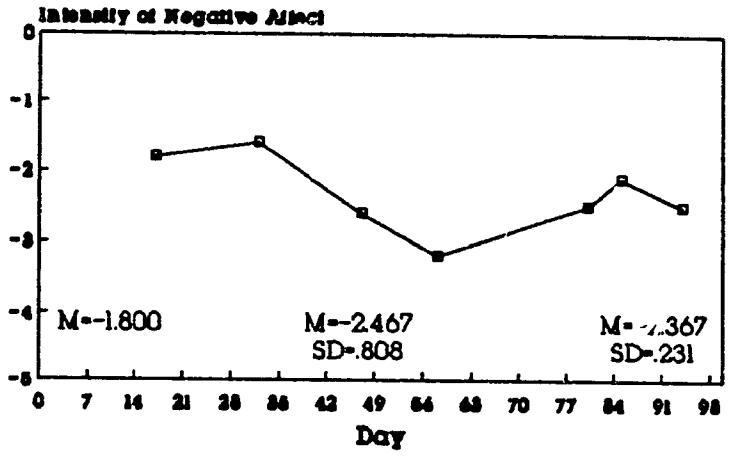

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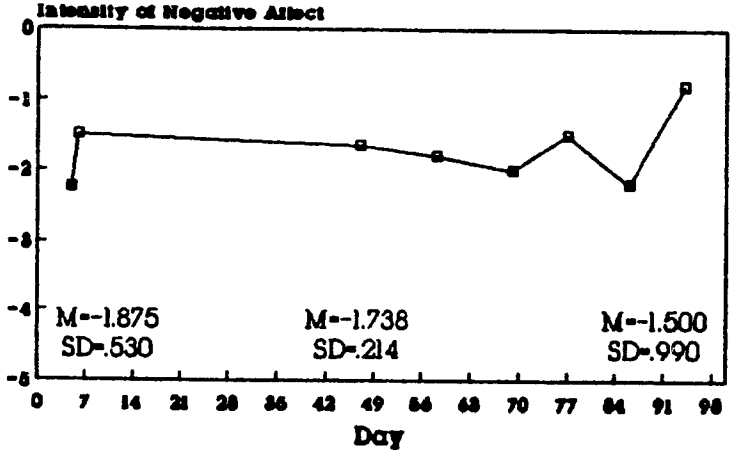
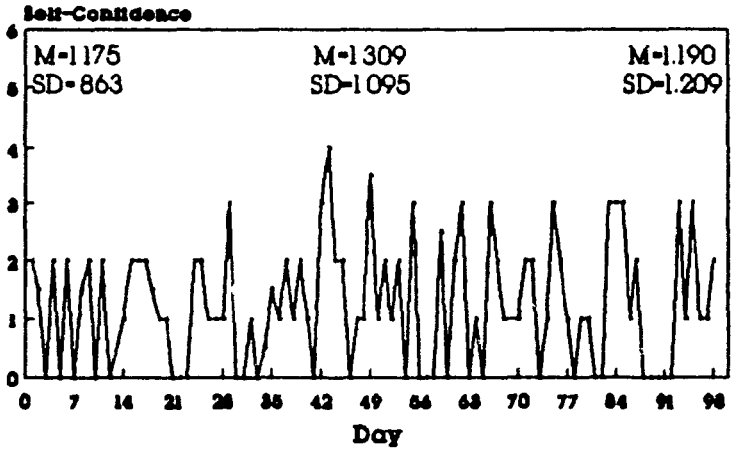


Figure Caption

Figure 5. Plots of daily self-confidence for 13 male bodybuilders across a steroid cycle and two baseline periods.

Means (M) and standard deviations (SD) for each phase are depicted on the plots.

Subject #1



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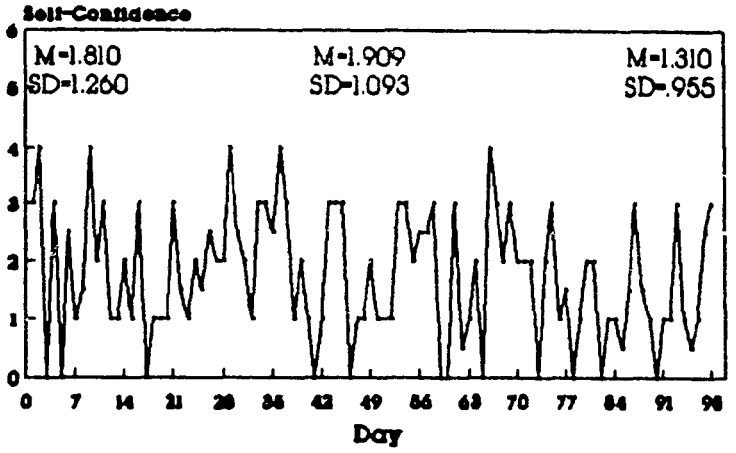

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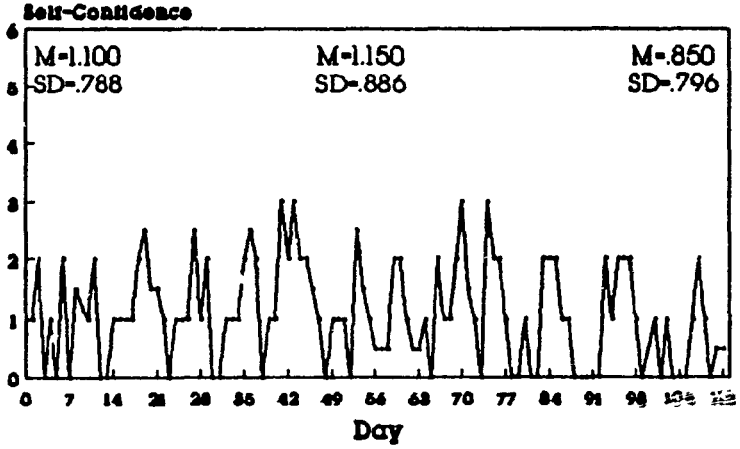

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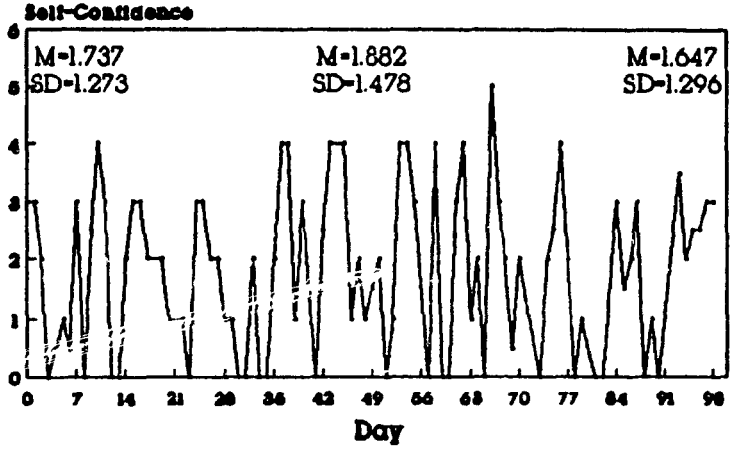

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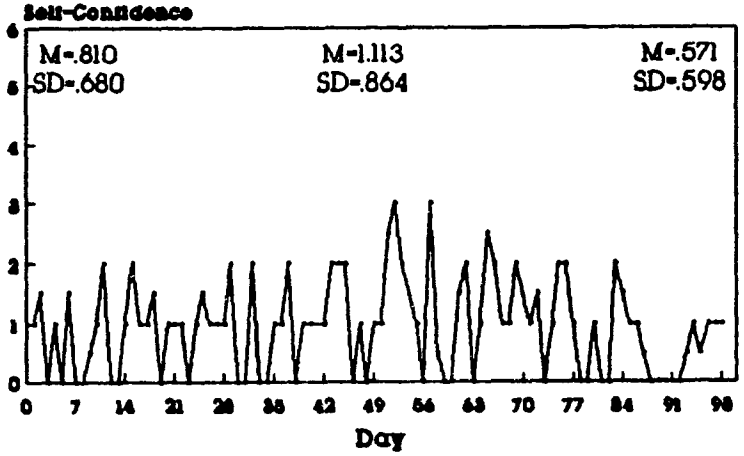

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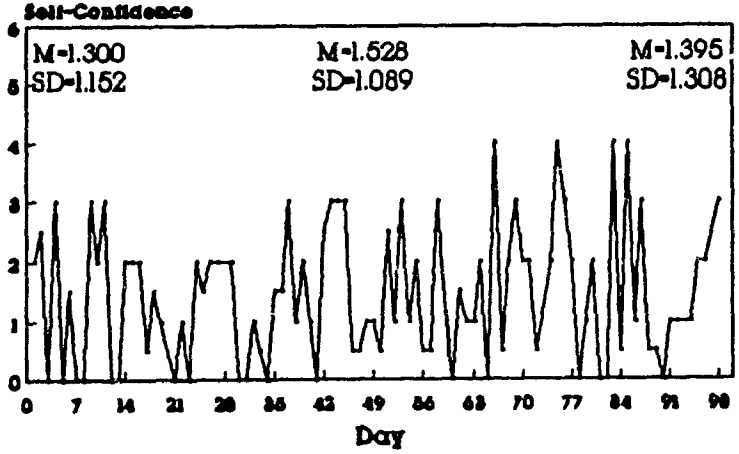
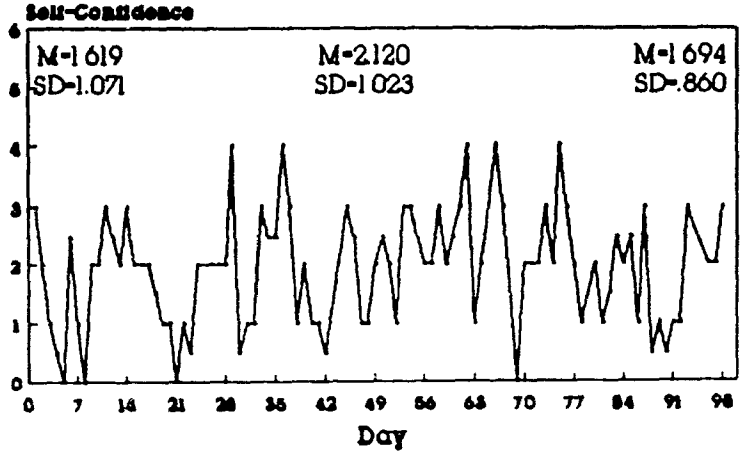


Subject #7



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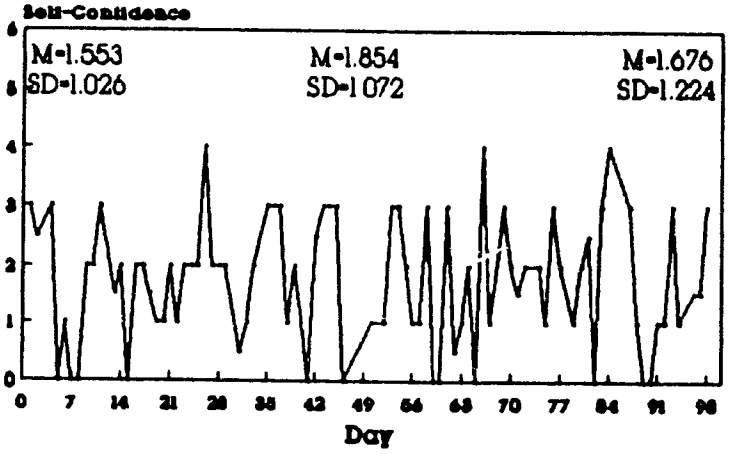

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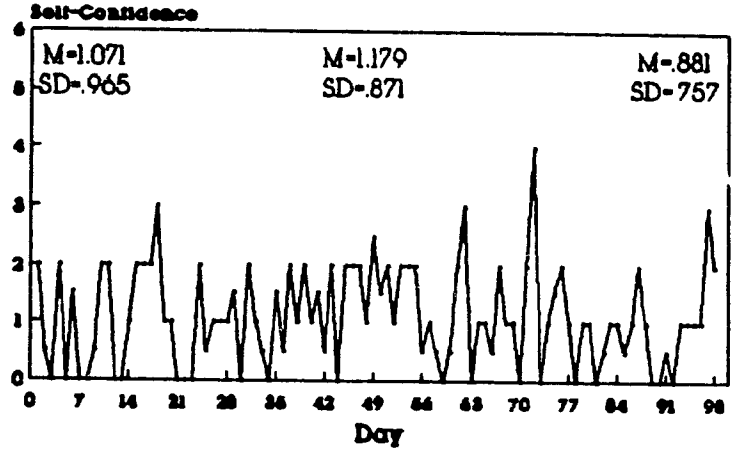

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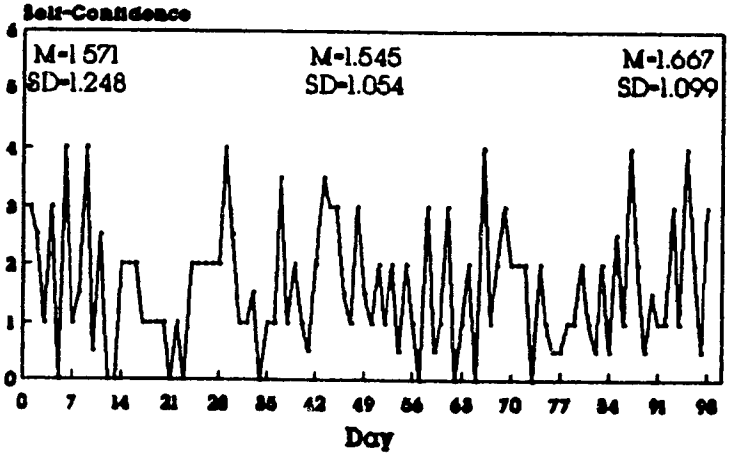

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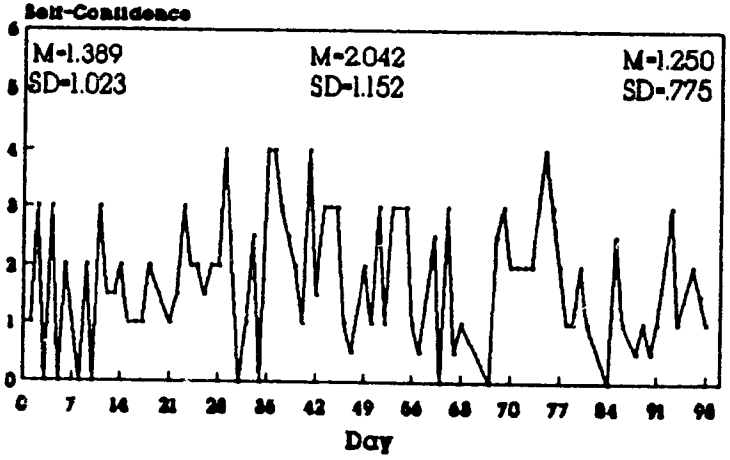

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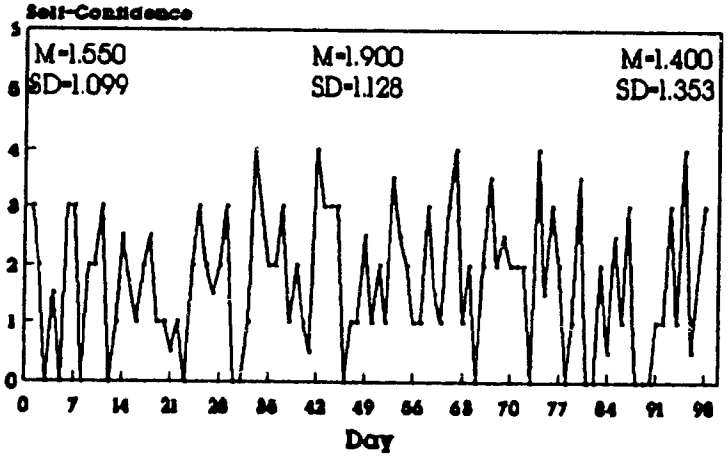

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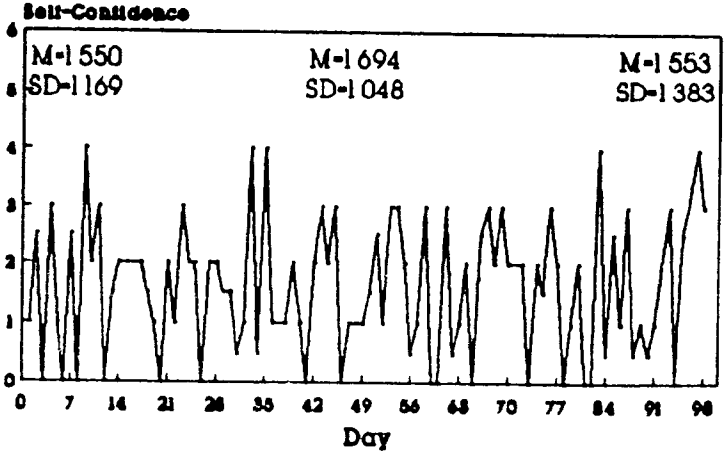
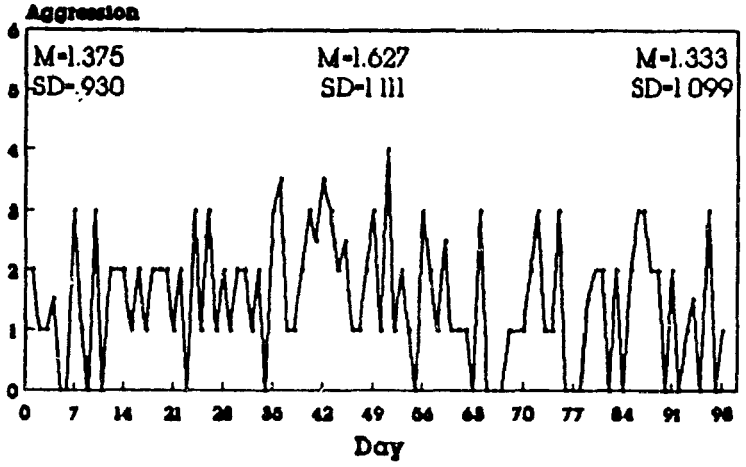


Figure Caption

Figure 6. Plots of daily aggression for 13 male bodybuilders across a steroid cycle and two baseline periods. Means (M) and standard deviations (SD) for each phase are depicted on the plots.

Subject #1



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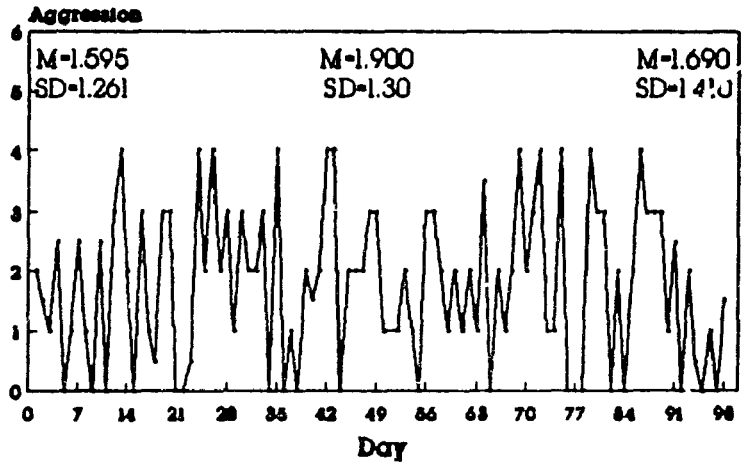

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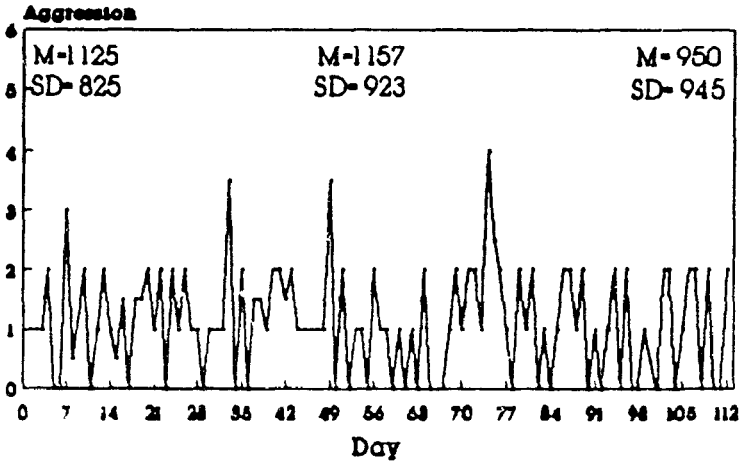

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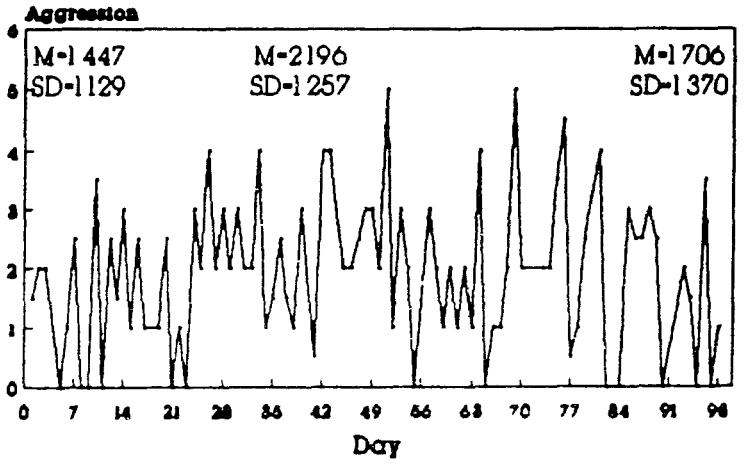

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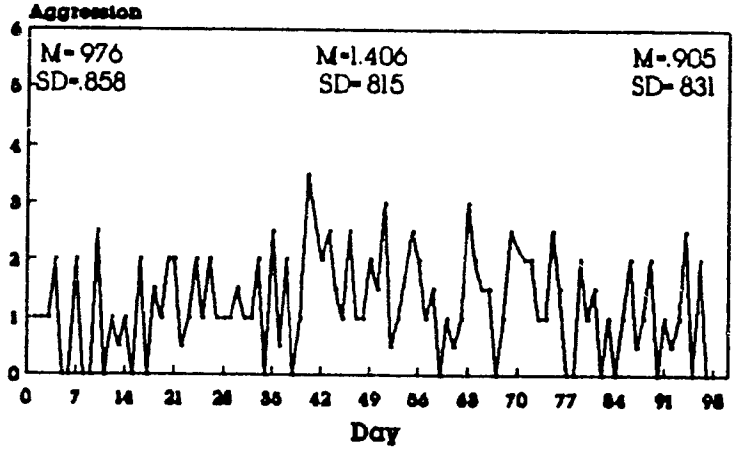

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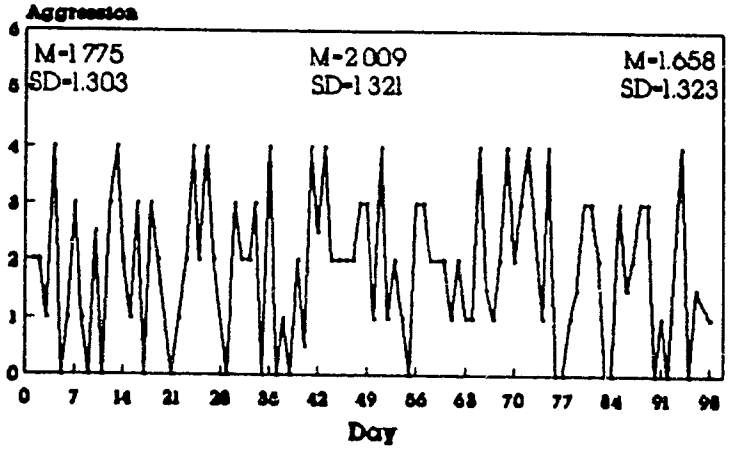

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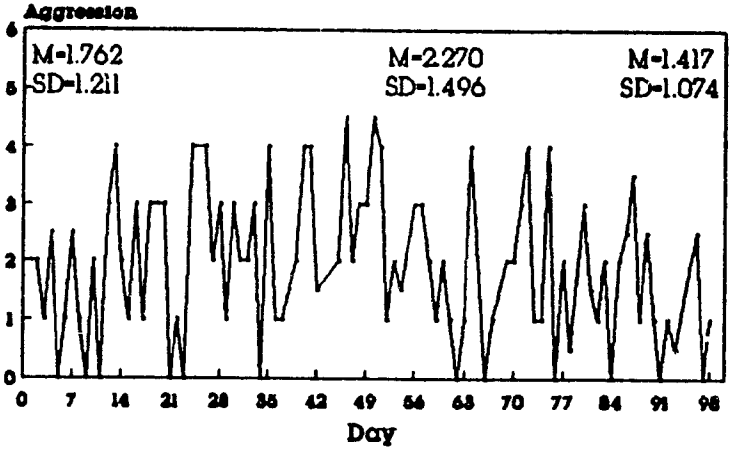

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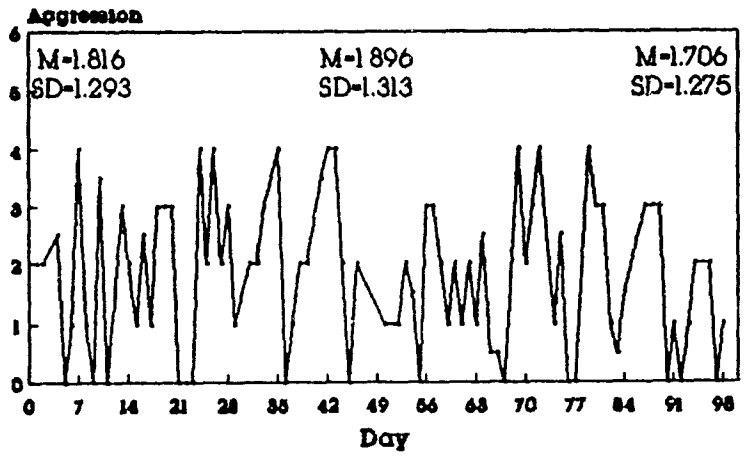

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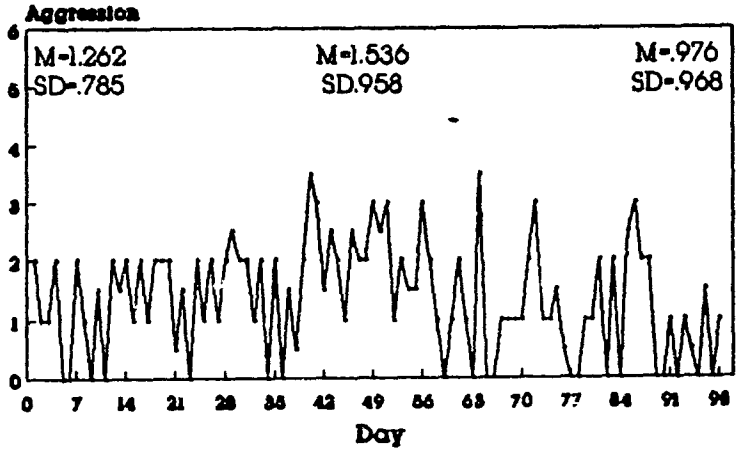

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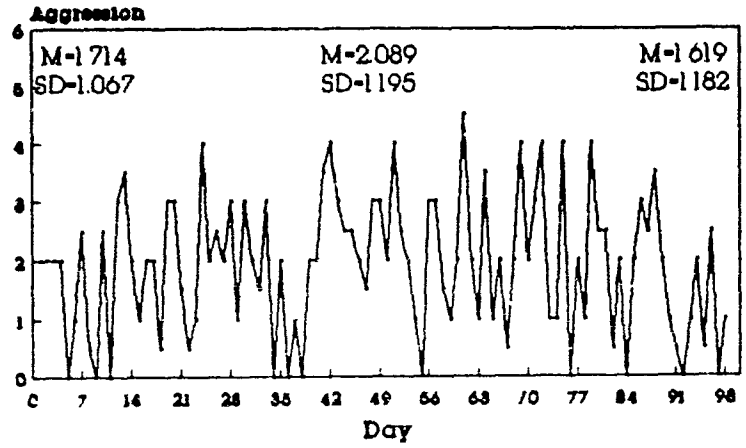

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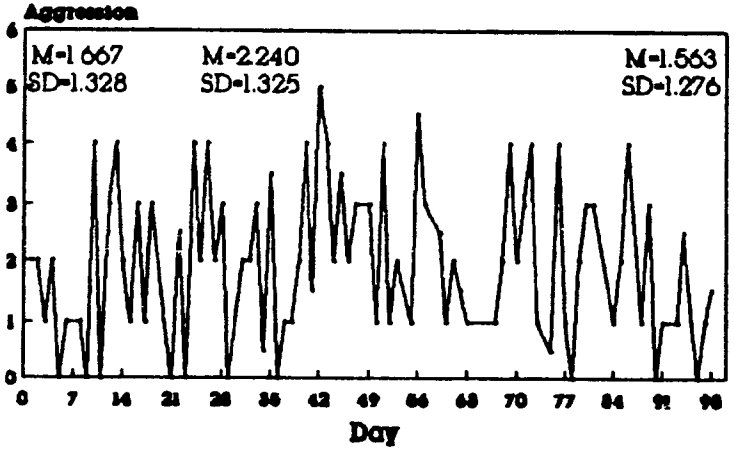

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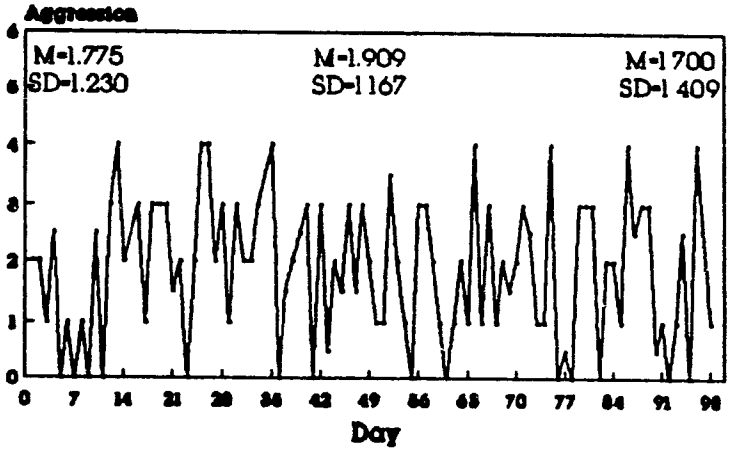

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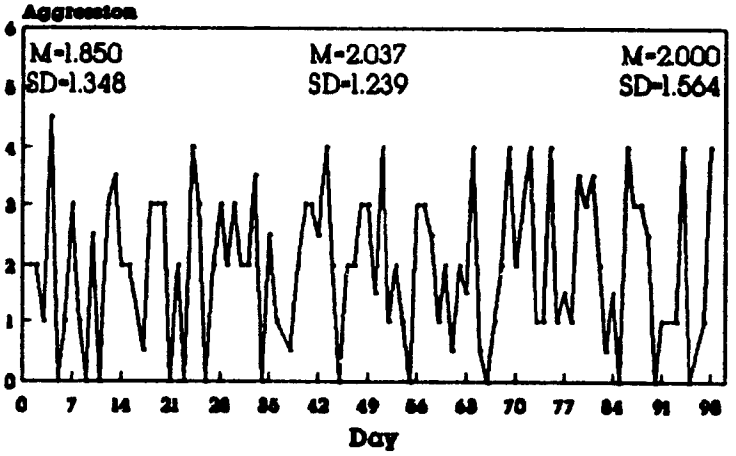
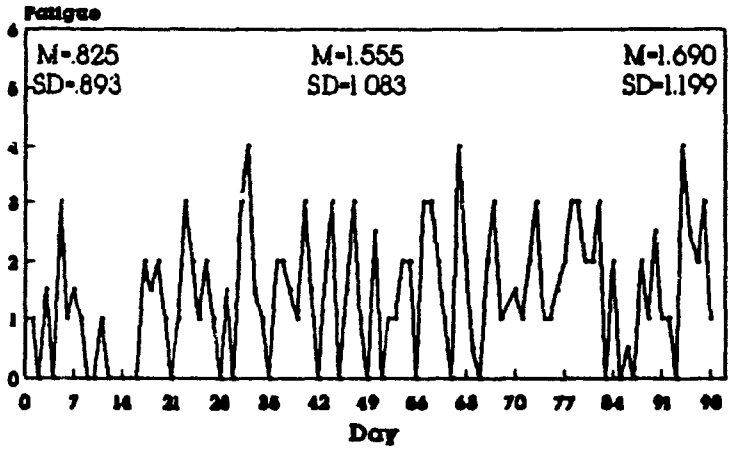


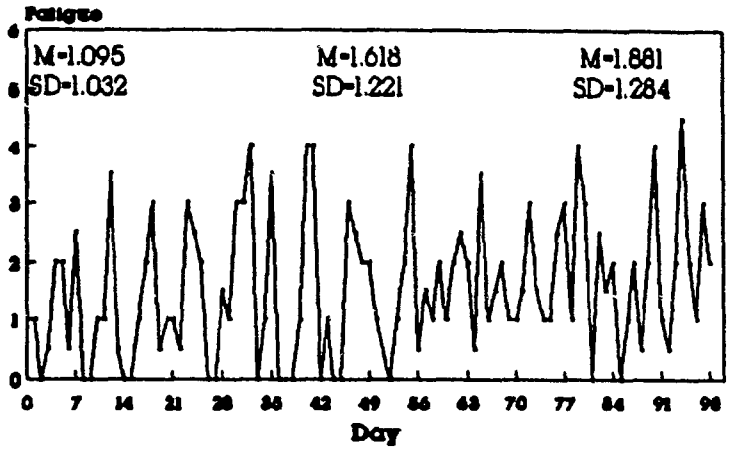
Figure Caption

Figure 7. Plots of daily fatigue for 13 male bodybuilders across a steroid cycle and two baseline periods. Means (M) and standard deviations (SD) for each phase are depicted on the plots.

Subject #1



Subject #2



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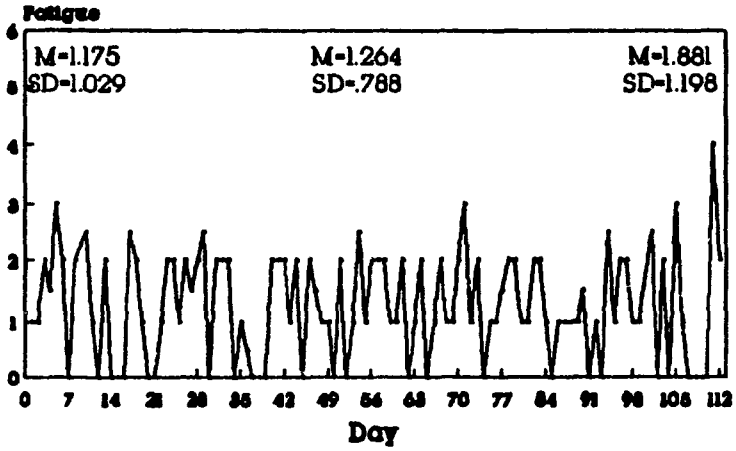

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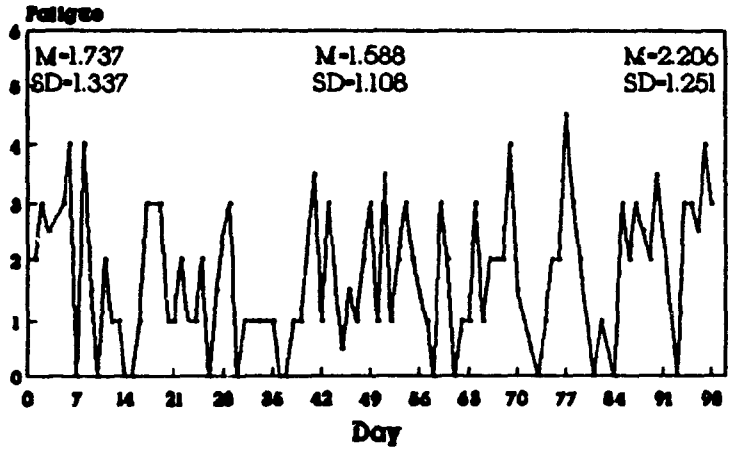

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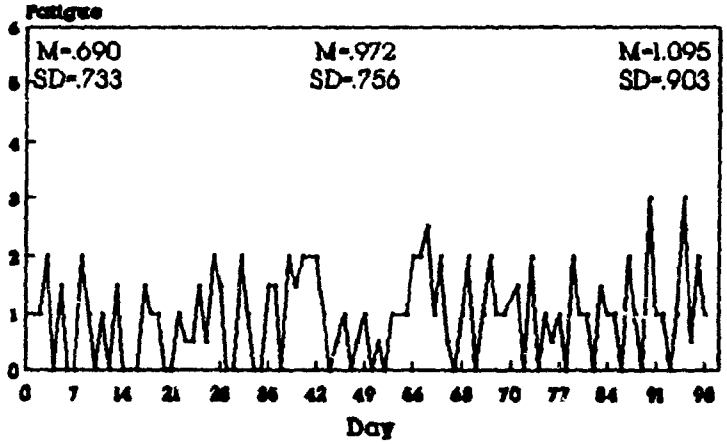

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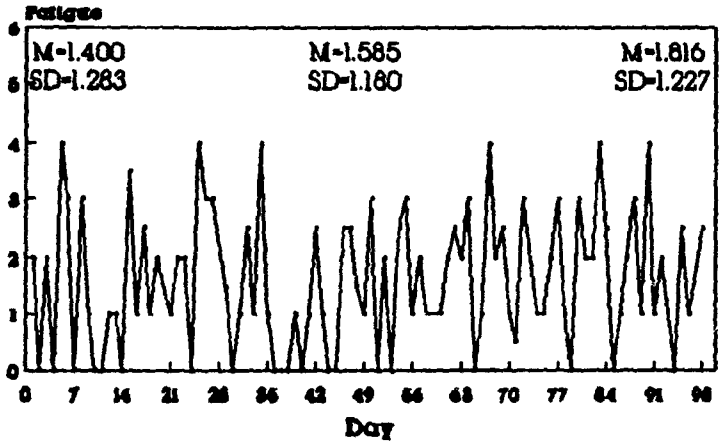

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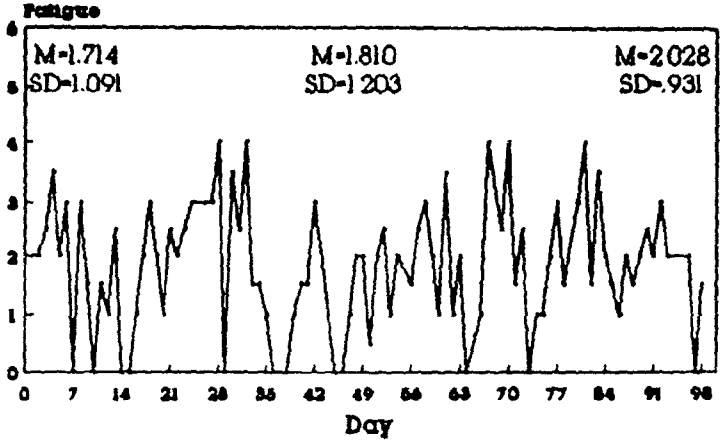
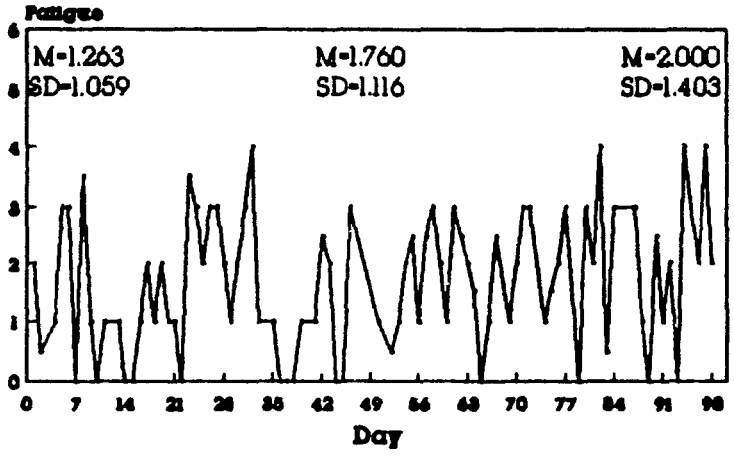


Subject #8



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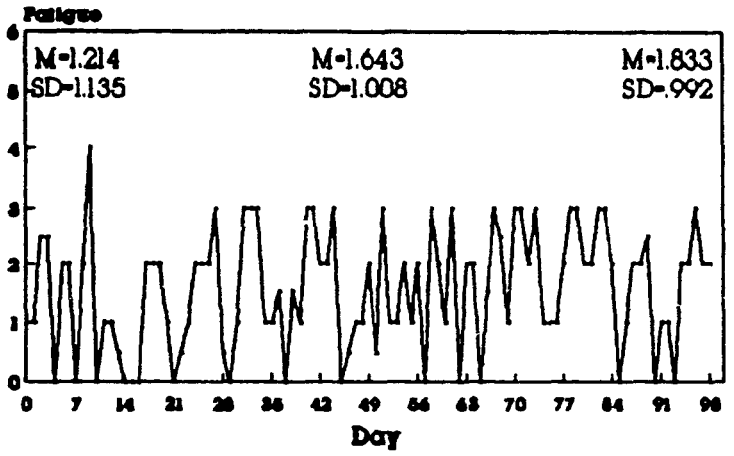

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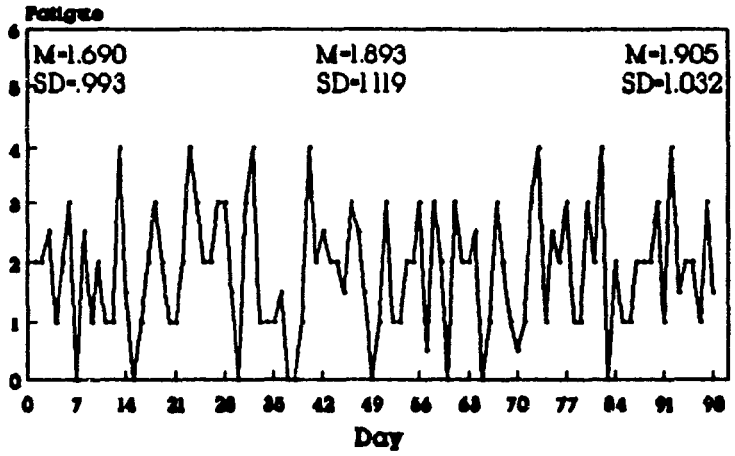

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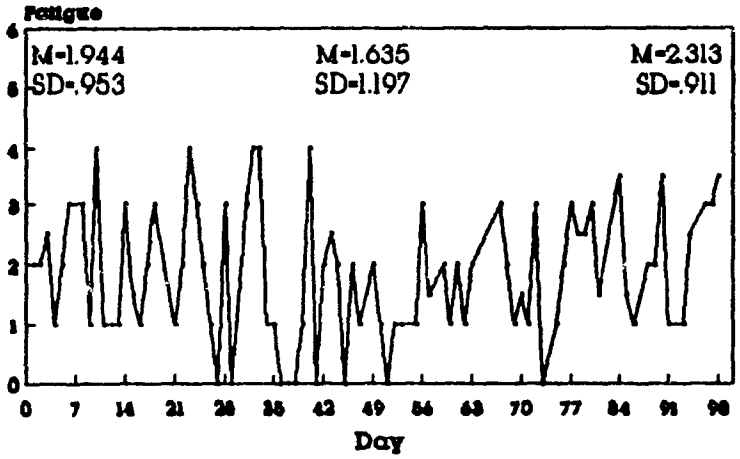

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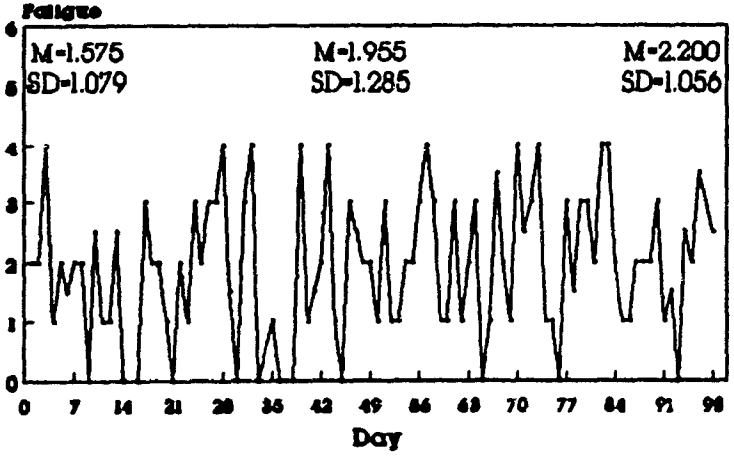

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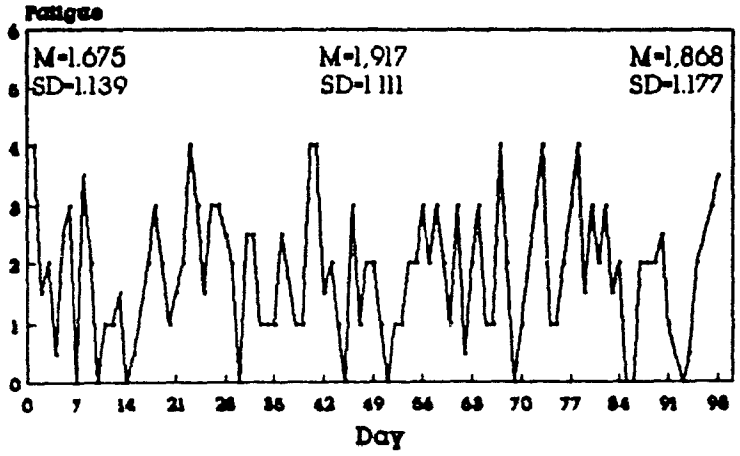
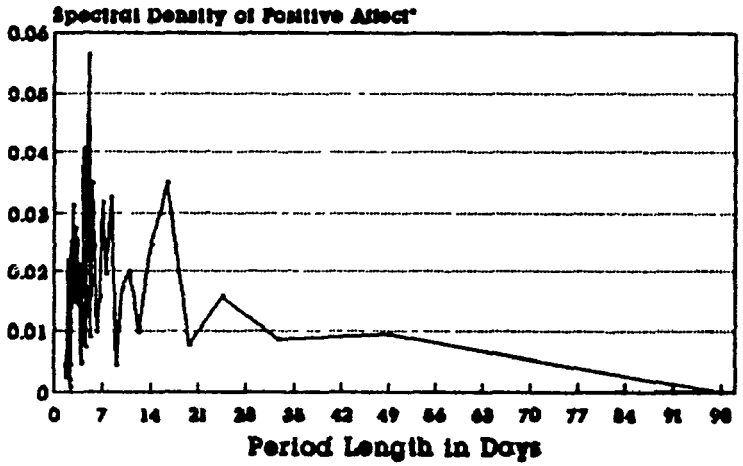


Figure Caption

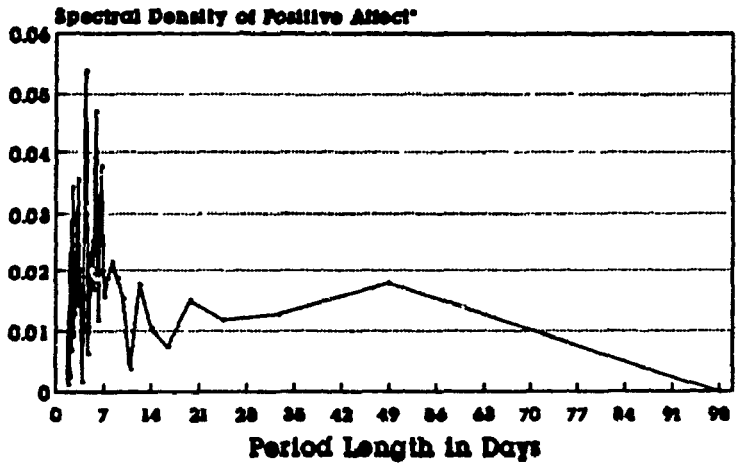
Figure 8. Plots of the spectral density function of positive affect for 13 male bodybuilders.

Subject #1



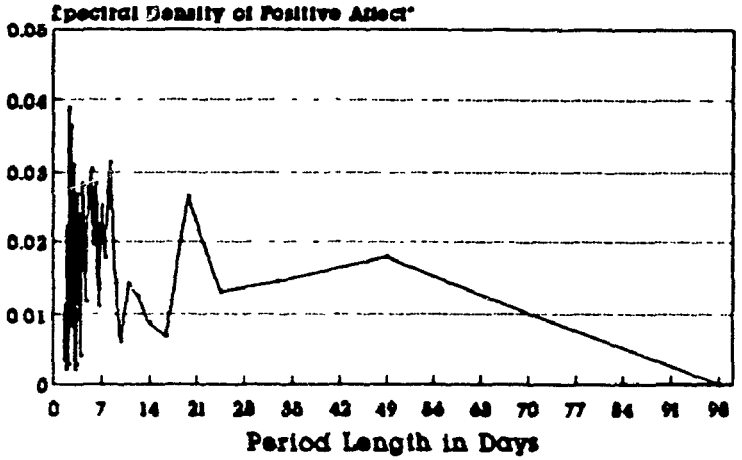
* Proportion of Variance

Subject #2



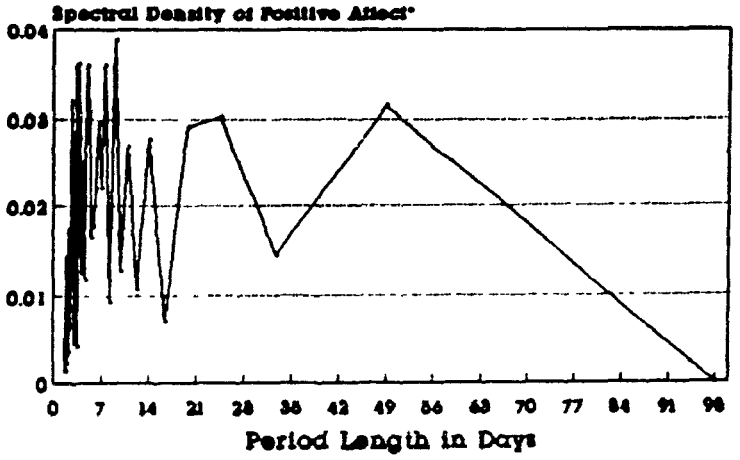
* Proportion of Variance

Subject #3



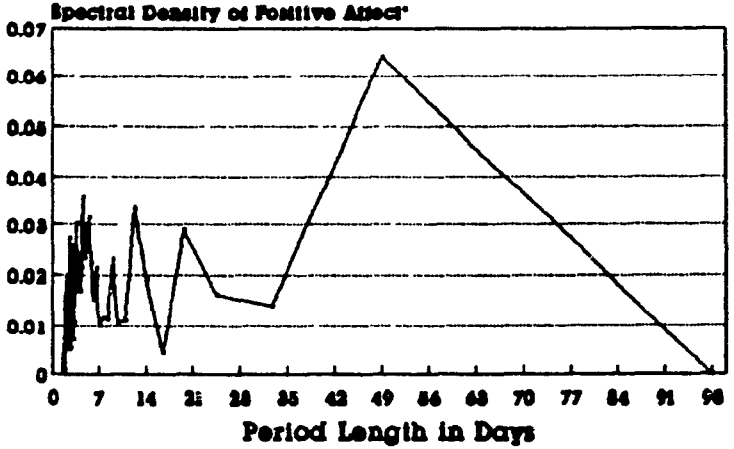
* Proportion of Variance

Subject #4



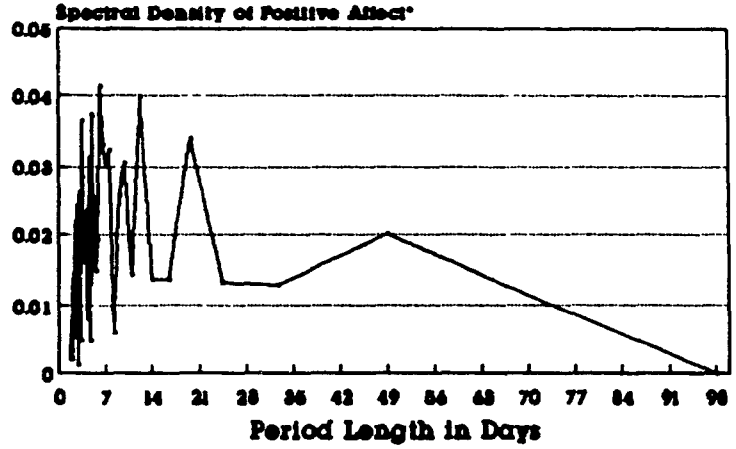
* Proportion of Variance

Subject #5



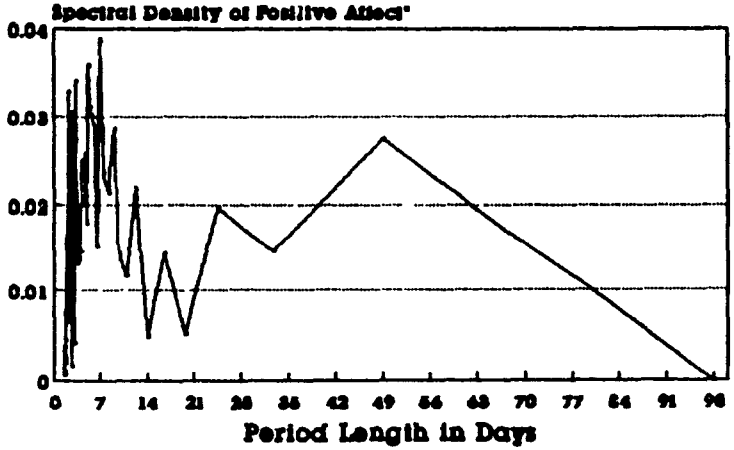
* Proportion of Variance

Subject #6



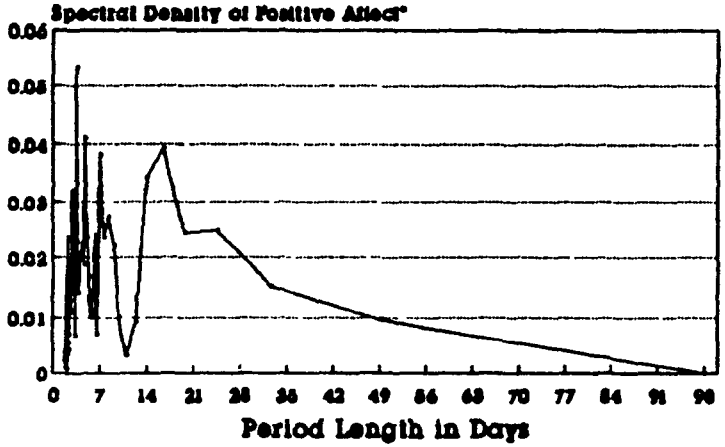
* Proportion of Variance

Subject #7



* Proportion of Variance

Subject #8



* Proportion of Variance

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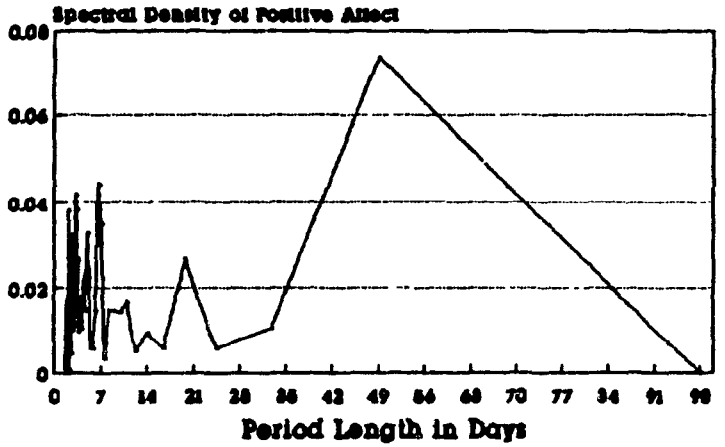
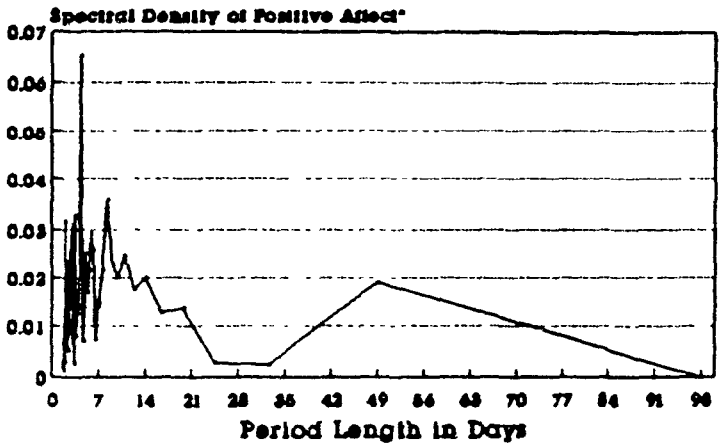


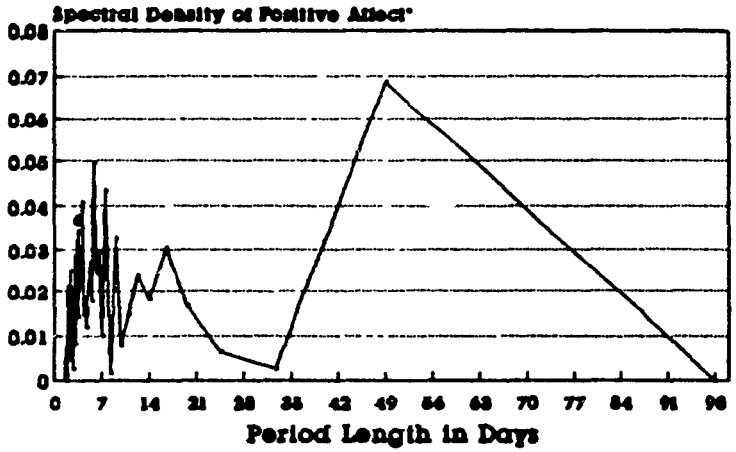
* Proportion of Variance

Subject #10



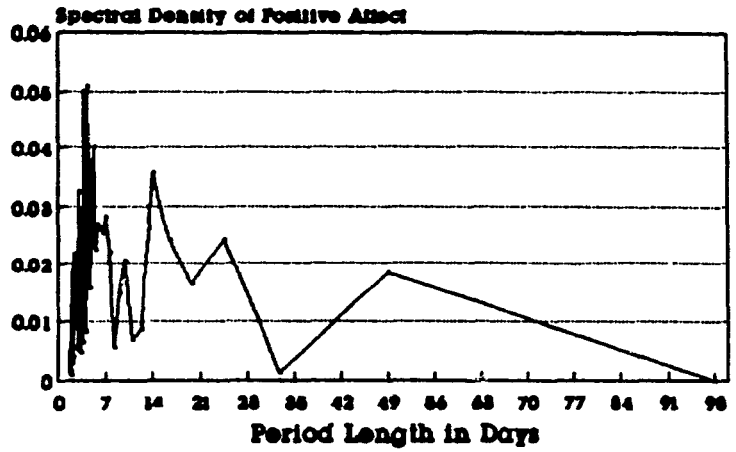
* Proportion of Variance

Subject #11



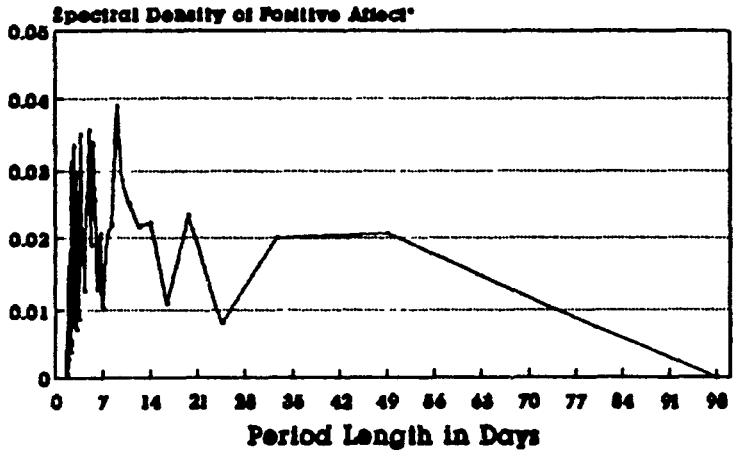
* Proportion of Variance

Subject #12



* Proportion of Variance

Subject #13

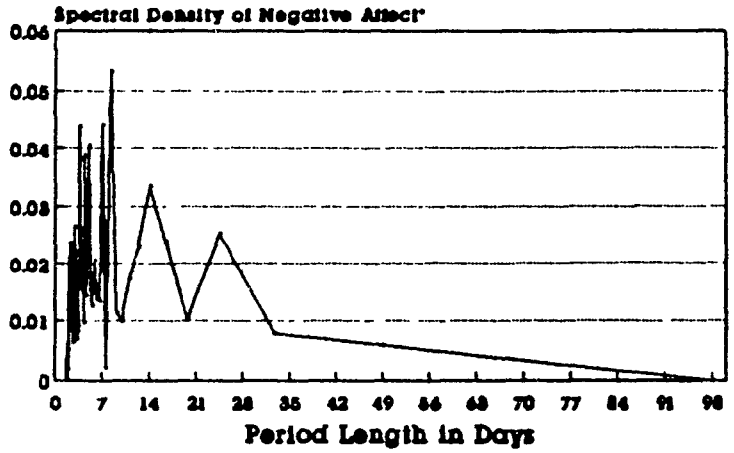


* Proportion of Variance

Figure Caption

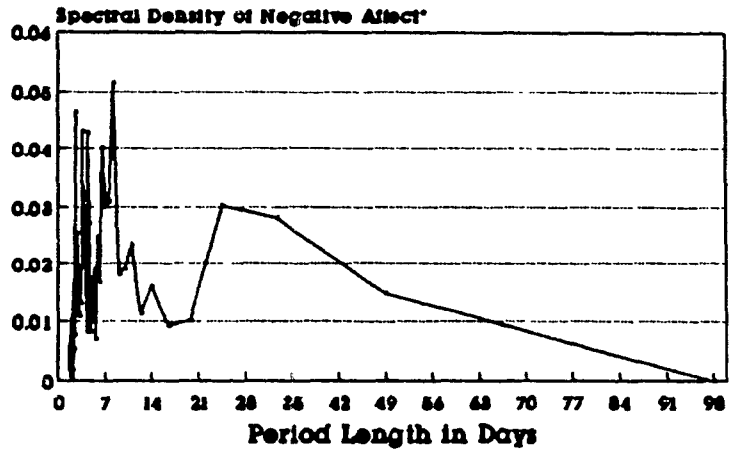
Figure 9. Plots of the spectral density function of negative affect for 13 male bodybuilders.

Subject #1



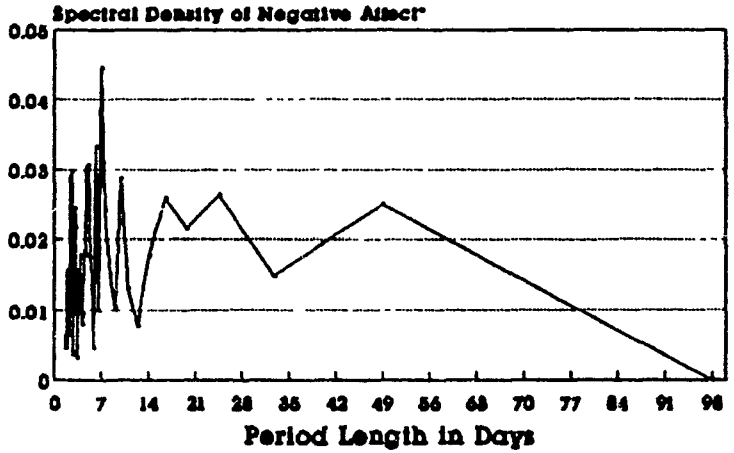
* Proportion of Variance

Subject #2



* Proportion of Variance

Subject #3



* Proportion of Variance

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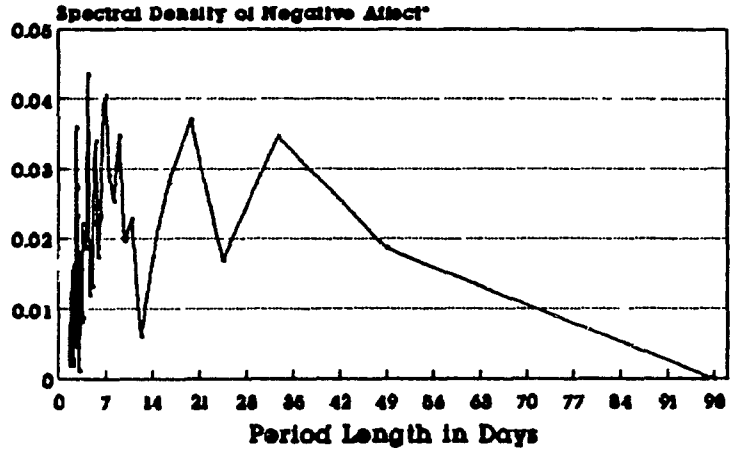
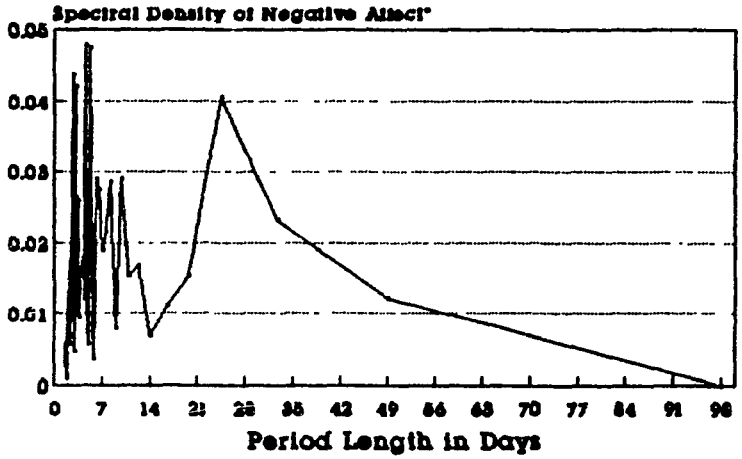


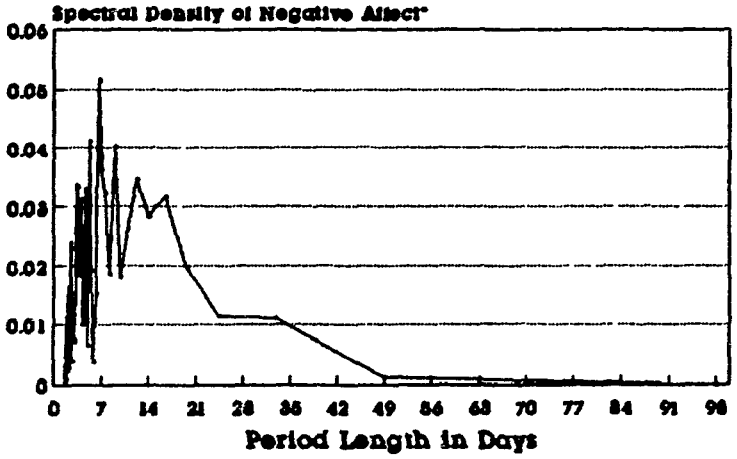
* Proportion of Variance

Subject #5



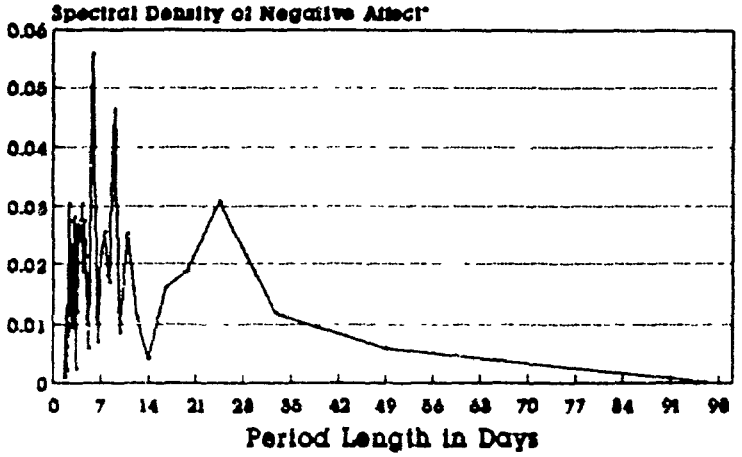
* Proportion of Variance

Subject #6



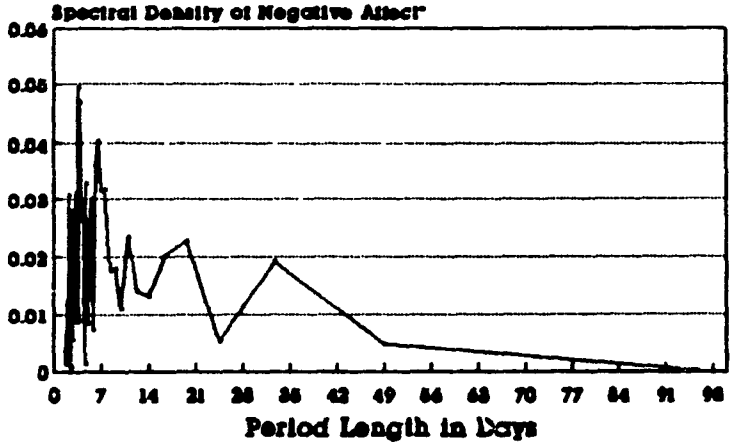
* Proportion of Variance

Subject #7



* Proportion of Variance

Subject #8



* Proportion of Variance

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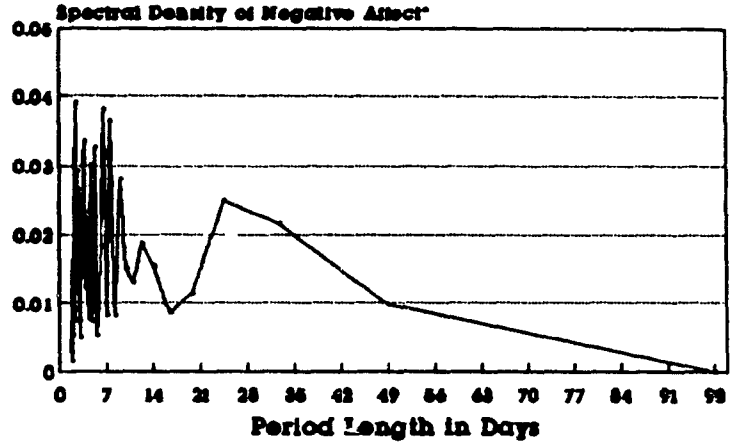

* Proportion of Variance

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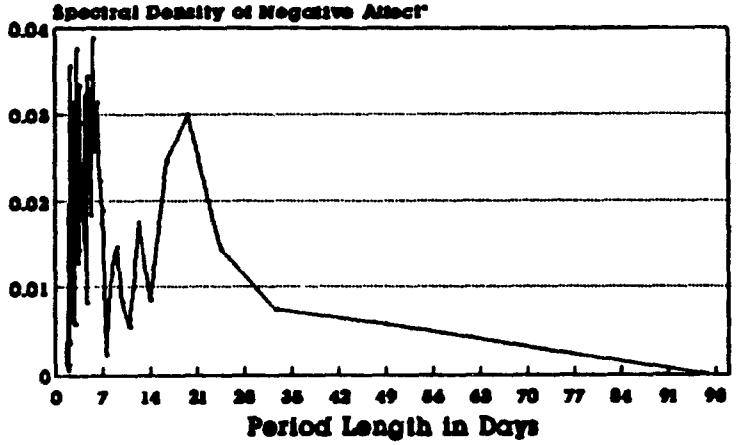

* Proportion of Variance

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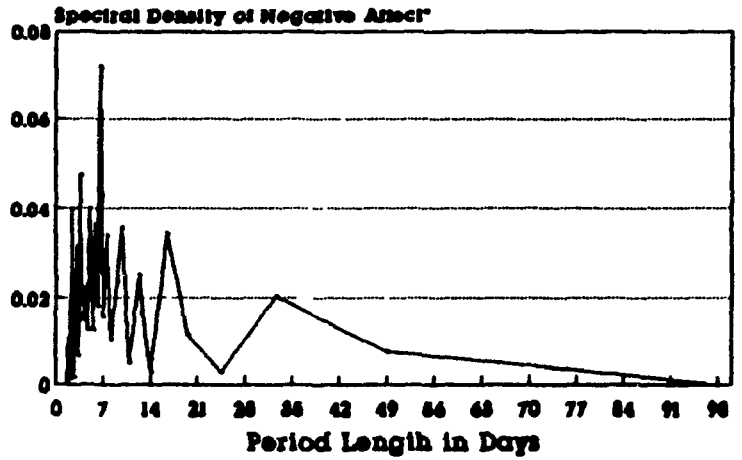

* Proportion of Variance

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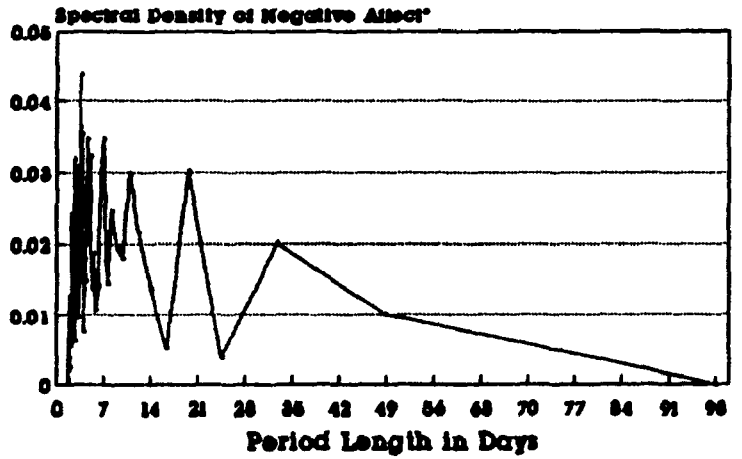

* Proportion of Variance

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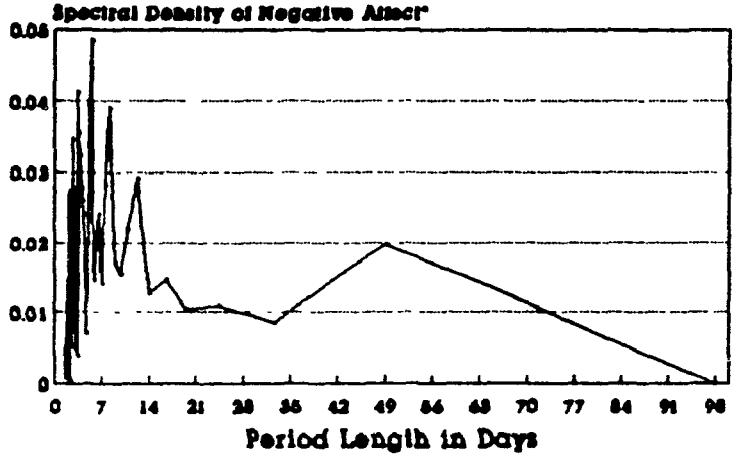

* Proportion of Variance

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APPENDICES

Appendix A

ESM Questionnaire

Day:_____ Time:_____

Steroid phase: _____On _____Off

Please focus on the feelings that you have experienced over the past several hours and indicate, using the scales below, how you are feeling (or felt):

		0	1	2	3	4	5	6
		Not at all						Extremely much
1.	Angry/hostile	0	1	2	3	4	5	6
2.	Happy	0	1	2	3	4	5	6
3.	Depressed/ blue	0	1	2	3	4	5	6
4.	Pleased	0	1	2	3	4	5	6
5.	Frustrated	0	1	2	3	4	5	6
6.	Joyful	0	1	2	3	4	5	6
7.	Worried/ anxious	0	1	2	3	4	5	6
8.	Enjoyment/ fun	0	1	2	3	4	5	6
9.	Unhappy	0	1	2	3	4	5	6
10.	Confident/ outgoing	0	1	2	3	4	5	6
11.	Tired/ fatigued	0	1	2	3	4	5	6
12.	Aggressive	0	1	2	3	4	5	6

Appendix B

Personal Data Form

Subject #: _____

Sex: _____

Weight: _____

Height: _____

Age: _____

How long have you been using anabolic steroids? _____

How long is your usual cycle? _____

_____

In what form do you presently take your anabolic steroid(s)?

Oral _____

Injection _____

Both _____

What kind of anabolic steroid(s) will you be using and at what dosage?

_____

_____

_____

Appendix C

Computation of Composite Mood Scores

BASIC COMPUTATIONS

$$\text{POSITIVE AFFECT/DAY} = \frac{\text{Sum of positive scales}}{4} \quad \text{or} \quad \frac{\text{Sum of positive scales}}{(\text{\# of samples/day}) \times 4}$$

$$\text{NEGATIVE AFFECT/DAY} = \frac{\text{Sum of negative scales}}{5} \quad \text{or} \quad \frac{\text{Sum of negative scales}}{(\text{\# of samples/day}) \times 5}$$

DAILY HEDONIC TONE = (Positive affect - Negative affect)

If PA is larger than NA, then its a HAPPY day.

If NA is larger than NA, than its an UNHAPPY day.

FREQUENCY OF POSITIVE AND NEGATIVE AFFECT

$$\text{FREQUENCY OF POSITIVE AFFECT} = \frac{\text{\# of Happy days}}{\text{Total days sampled}}$$

$$\text{FREQUENCY OF NEGATIVE AFFECT} = \frac{\text{\# of Unhappy days}}{\text{Total days sampled}}$$

INTENSITY OF POSITIVE AND NEGATIVE AFFECT

$$\text{INTENSITY OF POSITIVE AFFECT} = \frac{\text{Sum of Mean PA on Happy days}}{\text{Total number of Happy days}}$$

$$\text{INTENSITY OF NEGATIVE AFFECT} = \frac{\text{Sum of Mean NA on Unhappy days}}{\text{Total number of Unhappy days}}$$

Appendix D

Consent Form

Project Title: A prospective study of the relationship between androgenic-anabolic steroids and mood.

Investigators:

John Spence, B.A.	Lise Gauvin, Ph.D.
Graduate Student	Assistant Professor
McGill University	Concordia University

The purpose of this study is to examine the relationship between anabolic steroids and daily moods.

Your participation in this study involves filling out a short paper and pencil questionnaire, twice a day, throughout a complete steroid cycle (approximately 12 weeks). You are also required to record the type and dosage of steroids you use.

The questionnaire, which you will fill out twice a day, requires you to record your mood at the time. The questionnaire requires approximately 1 to 2 minutes to fill out.

The information you will provide will be kept strictly confidential and the results of this study will not be released in any way in which individual subjects can be identified. You are free to discontinue participation at any time.

If any further information is required, the investigators may be contacted at the following numbers 487-6873 (JS) or 848-3321 (LG).

I _____ have read the paragraphs explaining the project conducted by John Spence and Lise Gauvin, and I agree to participate recognizing that I am free to discontinue participation at any time.

Signature:_____ Witness: _____

Date: _____ Date: _____