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Interactive and Higher-Order Effects of Social Influences on Drug Use

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The study of moderators and higher-order effects of social influences on drug use has many implications for theories of health behavior. In the present study, we investigated the longitudinal predictive effects of some of the prominent moderator variables that represent forms of susceptibility toward social influence in teenage drug use. We also studied the possibility that social influence may predict drug use in nonlinear (quadratic) forms, consistent with theories proposing that threshold or decelerating effects may occur in social influences on normatively sanctioned behaviors. Results showed that several of the interactive and quadratic predictive effects were significant. The findings supported the views that certain moderator variables act as buffers, which either protect the individual from social pressures to use drugs, or make the individual more susceptible to such pressures. In addition, two of the obtained quadratic effects of social influence lent support to the application of social impact theory to drug use. Overall, our findings suggest that interactive and nonlinear approaches to social influences on drug use provide a unique and viable theoretical perspective from which to construe this problem health behavior.

Most theories of health behavior in adolescence have emphasized the critical importance of social influences during this developmental period, though empirical investigations of these theories often have differed in the choice of social influence constructs emphasized. Some of the most influential theories of social influences on health behavior have focused on the predictors of various forms of licit and illicit drug use (Jessor et al. 1968). Empirically, the importance of social influences on drug use, such as peer drug use behavior and its normative implications, has been documented in a variety of prospective studies investigating a wide range of different drugs of abuse (Chassin et al. 1984; Collins et al. 1987; Jessor and Jessor 1977; Lau, Quadrel and Hartman 1990). It is useful to summarize first the two general approaches to social influence and drug use that have been emphasized in previous research. Subsequently, we describe two less studied approaches, which are the focus of the present investigation.

PREVIOUS RESEARCH

Theories of social influence and drug use typically have emphasized either direct or indirect (mediational) effects of social influence (Akers et al. 1979; Kaplan, Martin and Robbins 1984; Lau et al. 1990). In most theories, social influences on drug use primarily are seen as normative pressures that correspond to social approval/disapproval or behavioral patterns of relevant reference

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groups regarding the use of drugs. Such influences usually are examined for their additive and linear associations with drug use. When other potential influences on drug use have been considered in conjunction with social influences, most commonly they also have been incorporated as additive, linear effects on drug use (Collins et al. 1987; Kaplan et al. 1984).

Direct-Effect Models

Linear associations investigated in direct-effect models imply a particular class of theoretical model in which the only systematic association between social influence and behavior is described by a straight line. For example, most theories and investigations of peer influence on drug use assume implicitly that exposure to peers who smoke cigarettes affects adolescent smoking linearly, such that the effects of peer exposure remain constant at each level of peer exposure. Said another way, the effects of peer exposure on adolescent drug use do not decrease, level off, increase, or otherwise change at different levels of peer exposure. These direct, linear effects also can be described as additive, rather than interactive, effects. That is, the effects of social influence on drug use in direct-effect models are investigated without assuming that some other variable (e.g., susceptibility to social influence) may moderate the effects of social influence. However, alternative theoretical perspectives do exist, in which social influence processes are explained in part by nonadditive and nonlinear associations. The specific form and theoretical basis of these classes of effects will be outlined later.

Mediational Models

Mediational models of social influences on drug use are more complex theoretically than direct-effect models, but these models still rely primarily on additive and linear associations. One of the prominent investigations of mediational effects of social influences on drug use involves the study of *susceptibility toward social influence*. From a sociological perspective, Krohn and his associates (Krohn et al. 1986) have treated susceptibility as a *mediated*, rather than direct effect. Krohn et al. suggested that susceptibility, in the form of social disaffection, leads adolescents to associate with peers who smoke which, in turn, provides an increased risk of encountering social pressures to smoke. Greater exposure to social pressure to engage in this behavior then increases the probability of smoking. A similar analysis has been offered by Kaplan (Kaplan 1985), who has suggested that self-derogation may lead to an increased association with deviant (drug-using) peer groups, which promote drug use through social conformity pressures. Because mediational and direct-effect models of social influence and drug use already have been studied fairly extensively, our study focuses on two other theoretically-relevant classes of effects.

STUDY FOCUSES

One focus of our study is the interactive (moderating) effects of social influence on drug use; these effects also have been referred to as synergistic or nonadditive effects. The incorporation of this class of effect into theories of social influences on drug use is an approach to susceptibility that differs markedly from mediational or direct-effect theories, yet this framework has rarely received attention (Chassin, Presson and Sherman 1987; McAlister, Krosnick and Milburn 1984; Stacy et al. 1992). From a social psychological perspective, a wide range of susceptibility variables have been hypothesized to *moderate*, or interact with, the effects of social influences on behavior generally (McGuire 1968). Because this perspective has much potential for the refinement of theories of social influences on drug use, we emphasize this framework in the present study. In McGuire's (1968) framework, attitude or behavior change through social influence is in large part a result of individual differences in susceptibility to social influences. In this perspective, behavior is strongly affected by social influence factors primarily among individuals who are highly susceptible to such influence; the behavior of individuals with low susceptibility will not be affected strongly by social influence pressures. One way to elaborate the form of this interactive model is to think of susceptibility variables as *buffers* that either protect individuals from social pressure or make them more suscepti-

ble to such pressure. An analogous line of reasoning has been used to describe interactions between stress and social support, in which social support acts as a buffer on the negative effects of stress on health (Cohen and Wills 1985). Other analogies can be found in more traditional medical phenomena. For example, the effects of Salmonella infection from eating contaminated food will be very different depending on whether the individual has an immune deficient (susceptible) response or a normal (resistant) immune system. Although both types of individuals are equally likely to be exposed to the Salmonella bacteria from eating spoiled food (i.e., differences in immune responses probably do not predict ingestion of the bacteria), they will vary in their degree of illness (e.g., from minor gastrointestinal irritation to possible death).

As implied above, the present interactional framework is one in which the *effects* of social pressure are thought to be integrally related to the susceptibility of the person toward such pressure. That is, the effect of social pressure is a *contingent* (nonadditive) effect that depends on other factors for its specific manifestation, strength, or weakness. This theoretical model is fully compatible with the sense of meaning connoted by the examples provided above, as well as by the typical forms of statistical models used to test for interactions (Cohen and Cohen 1983); however, this type of contingent effect should be distinguished from other definitions of "interaction." For example, in some instances theories of reciprocal or bidirectional associations among variables have been described as a type of interactional model (Lerner 1987, 1991; Newcomb 1990). Though we believe reciprocal models of adolescent development are quite useful theoretically, such models are beyond the scope of the present framework and empirical investigation.

As part of an ongoing longitudinal study on drug use, we obtained prospective data on a number of potential susceptibility moderators of social influences of friends' drug behavior on subjects' drug use. The moderator variables covered several domains of susceptibility, including social conformity, personality characteristics and self-acceptance, quality of peer relations, and gender. Specific moderator effects within these domains, and the likely theoretical processes they represent, will now be outlined.

Specific Interactive Effects of Susceptibility and Social Influence

A variety of personality characteristics related to social interaction styles may moderate the effects of social pressures to use drugs. Four personality constructs available in the present study were seen as plausible moderators: self-esteem, interpersonal vulnerability, leadership preferences, and extraversion. Self-esteem is expected to moderate the effects of social influence because persons lower in self-esteem may give more credence to the opinions and behavioral choices of others than to themselves (see McGuire 1968). Interpersonal vulnerability in our study reflected the extent to which individuals are easily hurt or upset by social criticism. This sensitivity may result in a greater desire to avoid the potential disapproval of friends by engaging in behaviors congruent with friends' actions. Our measurement of leadership preferences assessed the degree to which individuals preferred to engage in leader or follower roles in social interaction. Individuals preferring the follower role are anticipated to show greater susceptibility to influence from friends' level of drug use. Extraversion also has the potential to moderate social influence, though previous research suggests that moderating effects of extraversion may be situation-specific, rather than general (for review, see Wilson 1981). Some research suggests that persons higher in extraversion are more susceptible to social rewards (Wilson 1977), but it is also possible that extroverts take control of social situations rather than act as passive recipients of influence, buffering themselves from social pressures to conform. Although the personality variables just mentioned may operate as direct effect predictors of drug use as well as moderators of social influence, we focus primarily on the moderating effects of personality and other susceptibility variables. Direct and mediational effects of many of these types of variables have been addressed previously (for self-derogation, see Kaplan 1985; for extraversion, see Wilson 1981).

Our study also investigated different indicators of social conforming tendencies as potential moderators of social influence. Three variables—religious commitment, law abidance, and liberalism-conservatism—have been used effectively as indicators of social conformity in previous research on drug use

(Newcomb and Bentler 1988b). On the one hand, some socially conforming tendencies (e.g., religious commitment, law abidance) may be seen as reflections of an attitudinal buffer that dampens the potential social influence of friends' nonconforming behavior, such as drug use, perhaps by providing a readily available negative evaluation of behaviors proscribed in the larger culture. In this interactional effect, greater social conformity would lead to a decrease in the influence of friends' drug use on behavior. On the other hand, other social conforming tendencies (e.g., conservatism, or low liberalism as measured in our study) may not necessarily converge with dominant cultural norms. Instead, they may reflect a predisposition toward adherence to the status quo of whatever reference group is predominant; in adolescence, predominant reference groups are likely to be friendship groups. In this interactional effect, if the majority of individuals in a primary reference group (e.g., friends) use a drug, social conforming tendencies would lead to greater conformity with the drug use norm.

Relations with peers and the gender of respondents were the final moderator variables examined. Relations with peers assessed the quality of peer friendships, primarily in terms of satisfaction and ability to self-disclose. Relations with peers could moderate the influence of friends' drug use in several alternative ways. On the one hand, good peer relationships may imply that the individual is more susceptible to the sanctions of his or her peer social network, as shown in an increased effect of friends' drug use as the quality of peer relations increases. Alternatively, good relations may imply that conformity with any single behavioral norm is not necessary to acquire or maintain relationships, reflected in less influence of friends' drug use on one's behavior as the individual increases in good peer relations. This latter direction of the interactive effect also would be consistent with an increased effect of peer influence as peer relations become poorer, in which the importance of compliance may be increased. The potential moderating effects of gender on social influences on drug use may agree with previous research on gender differences (for review, see Eagly 1983). This suggests that women are slightly more susceptible to social influence than are men. However, it is difficult to know if this line of research, based on behaviors other than drug use, will be applicable to our present concerns.

A second focus of our study is the investigation of a class of nonlinear effects of social influence on drug use. Social influences may show not only linear or interactive effects on drug use, but in some instances may show an accelerated (concave upward) effect on behavior as social pressure to use drugs is increased. Such an effect is consistent with theories suggesting that threshold effects may occur in social influence, for example, when the extent of departure from dominant cultural norms among one's friends does not strongly affect behavior until a certain proportion of friends exhibit normative departure (e.g., drug use). Cross-sectional support for this type of effect was found in a recent study of social influences on smoking (Stacy et al. forthcoming), in which both linear and quadratic predictive effects of social influence were significant and positive in direction. This form of quadratic effect may be likely only when behaviors are predominantly negatively sanctioned by the dominant culture, as smoking appears to have become and harder drugs have been for some time.

It is possible that drug use that is less generally negatively sanctioned, such as alcohol use, will either show no quadratic effects of friends' social influence or may show a negative (concave downward, decelerating) quadratic trend, accompanied by a linear trend. In this latter possibility, friends' social influence effects may be roughly linear at low to moderate levels of influence, because of the relative absence or ambiguity of inhibiting cultural norms. The weakness of countervailing norms may imply that the effects of social influence reach a ceiling or asymptote at moderate levels of social influence, because the amount of social pressures required to disinhibit behavior is fairly minimal. This functional form is similar to that proposed in social impact theory (Latané 1981), which suggests that the linear effect of social pressure in a variety of domains decreases or decelerates as the number of social sources of pressure increases. Social impact theory is not specific regarding the exact process through which social influence processes operate (Lantané 1981), but rather delineates the general form that characterizes social influence across a diversity of domains. Nevertheless, even a

descriptive theory can be quite useful. Our notion about how friends' social influence regarding alcohol use may level off in its effect on alcohol consumption provides only one of the possible preliminary explanations of quadratic effects of social influence consistent with social impact theory. Complete explanatory theories of such effects need development. To encourage such development, our study investigated the empirical existence and alternative forms of quadratic effects of social influences on drug use. In addition, the analyses of quadratic trends in the present study helped control for certain confounds in the evaluation of interactive effects (Lubinski and Humphreys 1990).

METHOD

The primary concerns of the present study were to evaluate prospectively the hypothesized interactive associations of susceptibility and social influence (friends' drug use), as well as the hypotheses based on curvilinear trends. As suggested earlier, the investigation of these two classes of predictive effects has implications for both general theoretical frameworks that emphasize nonadditive, nonlinear social influences and the specific theoretical propositions consistent with these influences.

Subjects and Procedure

The subjects were 847 participants in a larger, longitudinal investigation of drug use etiology and consequences (Newcomb 1992; Newcomb and Bentler 1988a, 1988b; Stacy et al. 1992). Measures were obtained from a confidential questionnaire administered six times over a 12-year period. Measures for the present study were collected only in the third (T1 in this article) and fourth (T2 in this article) assessments, separated by a one-year interval. During these assessments, subjects voluntarily completed self-administered questionnaires. Subjects had been recruited several years earlier for participation in the study from junior high schools sampled to be representative of schools in Los Angeles County (Newcomb and Bentler 1988a). The predominantly White, middle-class sample was 67 percent female, with a mean age of 17.95 at T1.

There has been a greater number of women than men in the study since it was initiated. As reported previously in extensive attrition analyses (Newcomb, Maddahian, and Bentler 1986), subject loss was only slightly systematic and should not modify the interpretation of the data in the present study. The percent of variance in attrition, as accounted for by a large set of personality and drug use variables, was less than 4 percent.

Measures

Predictor variables assessed at T1 included three sets of measures: variables that may act as susceptibility moderators of social influence; friends' drug use; and the drug use of respondents. Dependent variables at T2 were respondents' use of five different classes of drugs.

Susceptibility Moderator Variables. Each of these scales was a sum of four 5-point, bipolar items from the Bentler Personality Inventory (BPI; Stein, Newcomb, and Bentler 1986). One of the personality susceptibility variables was self-acceptance. Self-acceptance was used as an indicator of self-esteem, as in previous research (Newcomb 1990; Stein, Newcomb, and Bentler 1987); self-acceptance appears to measure the central aspect of Coopersmith's (1967) definition of this concept. On these bipolar scales, subjects were asked the extent to which they were happy or unhappy with themselves; were discouraged or pleased with themselves; liked or disliked themselves; and regarded themselves as a failure or a success. Other susceptibility variables were measured in an identical way, with the same bipolar 5-point scale format and summation of four items, but different end-anchors were used to reflect different concepts (Stein et al. 1986). The other personality susceptibility variables were interpersonal vulnerability (for example, with end-anchors of *realize teasing is in fun* versus *take teasing too seriously*), leadership preferences (e.g., *follower* versus *leader*), and extraversion (e.g., *loud or noisy* versus *rarely do much talking*). The three social conformity susceptibility variables were law abidance (e.g., *might shoplift* versus *wouldn't want to shoplift*), liberalism (e.g., *support women's liberation* versus *don't feel women need liberation*), and religiosity (e.g., *am a religious person* versus *am not religious*). A

final susceptibility variable, quality of peer relations (Newcomb and Bentler 1986), assessed the degree of social support experienced from peers (e.g., *don't have friends I can talk to about personal things* versus *have friends I can talk to about personal things*).

Social Influence Variables. Social influence toward drug use was represented by five scales measuring the perceived proportion of friends who used different drugs. Friends' cigarette smoking, cocaine use, and marijuana use were each assessed with single 5-point items, ranging from 1 (no friends used) to 5 (all friends used). Friends' alcohol use was measured with two items (sum of friends' beer or wine use and friends' liquor use), and friends' hard drug use was measured by four items (sum of friends' use of illicit pills, heroin, PCP, and glue). Each of the individual items in these latter two scales was rated on the same 5-point response format just described. Although social influence variables of this type may be influenced by sources of self-report method bias (for discussion, see Stacy et al. 1985), the possible effects of these biases can be minimized in prospective research. The peer selection or perceptual biases most likely to influence reports of one's friends' use are likely to share a considerable proportion of variance with reports of one's own use (Urberg, Shyu, and Liang 1990). When the effects of these latter self-reports are controlled in longitudinal regression analyses, the prospective associations between friends' and self drug use should be relatively unbiased.

Drug Use Variables. Drug use at both T1 and T2 was assessed with five subscales, each of which assessed the frequency of use of particular classes of drugs in the last six months on 7-point scales ranging from *never* (1) to *more than once a day* (7). The five drug use subscales were cigarette use (one item), alcohol use (sum of beer, wine, liquor), marijuana use (sum of marijuana and hashish), cocaine use (one item), and hard drug use (sum of 14 items, including stimulants, tranquilizers, hallucinogens, PCP, heroin, and other drugs).

Analytical Procedure

The interactive associations of the potential moderators of friends' drug use and the quadratic trends of friends' drug use and susceptibility variables were assessed using hierarchical multiple regression procedures (Cohen and Cohen 1983; Lubinski and Humphreys 1990). Scales were converted to deviation scores by subtracting the mean before forming cross-product terms and before running the regressions, to reduce the possible effects of multicollinearity (Dunlap and Kemery 1987; Jaccard, Turrisi, and Wan 1990). All predictive effects were evaluated prospectively, in which T1 variables predicted T2 drug use. Interactions and quadratic trends were evaluated in separate regressions for each possible moderator and for each possible class of drug using a procedure that helps evaluate the possibility of spurious moderator effects (Lubinski and Humphreys 1990). In these procedures, main effects are entered first into the regression equation; following this *a priori* entry, a *stepwise* regression procedure is followed to evaluate the order of entry of the product-term representing the target two-way interaction (e.g., susceptibility X friends' drug use) and possible quadratic trends of the variables in this interaction. Our only modification of this procedure is the entry a priori of the main effects of gender and previous (T1) drug use as control variables. It should be emphasized that we considered all effects in these models as "predictive effects," in the statistical sense of the term. Although the statistical significance of a predictive effect can be considered either consistent or inconsistent with an hypothesized causal effect, strong inferences of causality are not implied.

Five separate sets of regression analyses were performed, one set for each of the drug use dependent variables (use of alcohol, cigarettes, cocaine, marijuana, and hard drugs). Within each set of regressions, nine specific regression models were run, one for each of the susceptibility variables (self-esteem, interpersonal vulnerability, leadership preferences, extraversion, religiosity, law abidance, liberalism-conservatism, gender, and peer relations). Separate regressions were run because the evaluation of a very large number of regression effects in a single analysis is likely to reduce the power to detect any single predictive effect (e.g., Cohen and Cohen 1983).

The specific order of the *a priori* component in each of the regressions was as follows. First, all main effects were entered in order of gender, previous drug use (T1),

friends' drug use (T1), and one of the target susceptibility variables (e.g., self-esteem). After the entry of the set of main effects, the *stepwise* procedure of Lubinski and Humphreys (1990) was followed. The quadratic effect of the target susceptibility variable, the quadratic effect of friends' drug use, and the two-way interaction between friends' drug use and susceptibility were allowed to enter in a stepwise, forward selection fashion. This procedure was followed for each regression except for those in which gender was used as the susceptibility moderator variable. In these instances, the procedure was modified only by not estimating the quadratic effect of gender, which was not possible.

The significance of the two-way interactions and quadratic trends was assessed by evaluating whether these predictive effects contributed significantly to the prospective prediction of drug use, following the entry of the four main effects. Because of the need to control for multiple comparisons in the stepwise analyses, we used an adjusted probability level to decide whether to emphasize obtained interactive and quadratic effects. Thus, although we report significance tests of interactive and quadratic effects at a conventional probability level ($p<.05$), we also indicate which of these predictive effects are significant only on the basis of a Bonferonni correction for multiple comparisons on each of the susceptibility variables. The Bonferonni correction was used within the set of interactive and quadratic effects for each susceptibility variable, such that 15 possible stepwise effects were used to compute a corrected probability level of .003 for each effect tested for a given susceptibility variable. We considered this probability level highly significant statistically and adequately conservative, given the control of the predictive effects of potentially very strong covariates in the model (e.g., previous drug use) and the large potential for Type II error (failure to reject the null hypothesis when it is false) in tests of interactions and quadratic trends (Busemeyer and Jones 1983). An alternative Bonferonni adjustment based on every test in the entire analysis would have been unrealistically conservative, and would have led to the acceptance of the null hypothesis even when predictive effects were strong. As Cohen and Cohen (1983) have argued, it is important to consider both Type I and Type II errors in the evaluation of regression effects. We emphasized the hypothesized interactive and quadratic effects in the interpretation only if they were significant at the stringent, but not unrealistic, probability level of .003.

Although the signs of the beta weights from the interaction terms in the regressions revealed the directions that interactions took, highly significant predictive effects were plotted and checked to see if interactions were disordinal (cross-over) or ordinal in form (Jaccard et al. 1990). In addition, highly significant quadratic effects were plotted to see if they were in the hypothesized forms.

RESULTS

Gender as a Moderator

For each of the five different drug variables, gender did not interact significantly with friends' drug use variables in the prediction of later drug use. These interactions did not reach the $p<.05$ level of significance. The size and significance of the main effects of gender, previous drug use, and friends' drug use in these regressions were identical to the main effects shown in Tables 1 and 2, in which the remaining interactive effects are also reported.

Social Conformity Moderators

Table 1 provides results from the regressions, using the three social conformity indicators as susceptibility variable moderators of social influences on drug use. The only interactive effects that met the stringent significance criterion were the interactive effects among liberalism and different forms of friends' drug use. In two instances these interactions were highly significant, including the liberalism X friends' cocaine use ($\beta = -.09$) and liberalism X friends' marijuana use ($\beta = -.08$) interactions. In two other instances, social conformity and drug use variables interacted at conventional levels of significance (see Table 1), but did not meet our stringent significance criterion. These predictive effects were the law abidance X friends' marijuana use ($\beta = .06$) and religiosity X friends' hard drug use ($\beta = .08$) interactions.

TABLE 1. Increments in Variance Explained (R^2) in T2 Drug Use by T1 Social Conformity Effects

T1 Effect	T2 Dependent Variables				
	Cigarettes	Alcohol	Marijuana	Cocaine	Hard Drugs
Control Main Effects Common to All Regressions					
Gender	.005*	ns	ns	ns	ns
T1 drug use	.498***	.416***	.522***	.254***	.309***
T1 friends' drug use	ns	.015***	.008***	.091***	.005*
Law Abidance and Higher Order Effects					
Main effect of law abidance	.015***	.012***	.004**	.016***	.017***
Law abidance X friends' drug use	ne	ne	.003*	ne	ne
Law abidance quadratic effect	ne	ne	ne	ne	ne
Friends' drug use quadratic effect	ne	.007***	ne	ne	.015***
Religiosity and Higher Order Effects					
Main effect of religiosity	ns	.003*	ns	ns	.004*
Religiosity X friends' drug use	ne	ne	ne	ne	.005**[b]
Religiosity quadratic effect	ne	ne	ne	ne	ne
Friends' drug use quadratic effect	ne	.007***	ne	ne	.019***[a]
Liberalism and Higher Order Effects					
Main effect of liberalism	ns	ns	ns	ns	.004*
Liberalism X friends' drug use	ne	ne	.006***	.008***	ne
Liberalism quadratic effect	ne	ne	ne	ne	ne
Friends' drug use quadratic effect	ne	.009***	ne	ne	.019***

Note: Results from five separate hierarchical regressions are listed, in which the control main effects were entered in the a priori order specified in each regression, followed by the main effect of a particular social conformity indicator. After the main effect of a social conformity indicator was entered, quadratic and interactive effects of the indicator and friends' drug use were entered in a forward selection, stepwise regression. Incremental R^2 values for effects are listed only if the effect significantly increased the prediction of explained variance beyond that accounted for by previously entered effects.

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .003$.

[a] Entered first in stepwise regression.

[b] Entered second in stepwise regression.

ns = nonsignificant in *a priori* regression.

ne = nonsignificant and thus not entered in stepwise regression.

Personality and Social Support Moderator Effects

Table 2 provides results from the regressions using the indicators of personality and social support as susceptibility variable moderators of social influences on drug use. Two of these interactive effects met the stringent criteria for emphasis; these predictive effects were the self-acceptance X friends' hard drug use ($\beta = -.12$) and extraversion X friends' cocaine use ($\beta = .09$) interactions. Two additional interactive effects were significant only at conventional levels (see Table 2). These predictive effects were the leadership X friends' cocaine use ($\beta = .07$) and leadership X friends' hard drug use ($\beta = -.07$) interactions.[1]

Quadratic Effects

Quadratic effects of friends' drug use were investigated to evaluate the alternative theoretical propositions outlined earlier, as well as to help control for the possibility of spurious moderator effects. In each regression involving alcohol use and hard drug use (see Tables 1 and 2), the quadratic effect of the respective friends' drug use variable (friends' alcohol use, friends' hard drug use) was significant at a stringent probability level. Quadratic trends of friends' drug use were not significant at even conventional levels for the evaluation of these trends on cigarette, marijuana, and cocaine use. This pattern of significance of quadratic effects of friends' drug use was consistent across each of the regressions reported in Tables 1 and 2.

Quadratic effects of susceptibility variables also were evaluated. Although these predictive effects were not part of our theoretical comparisons, they were used to help control for spurious moderator effects. None of the quadratic trends of the susceptibility variables were significant according to the stringent criterion.

Plots of Interactions

The interactive effects significant according to our stringent criterion were plotted and

TABLE 2. Increments in Variance Explained (R^2) in T2 Drug Use by T1 Personality and Social Support Effects

	T2 Dependent Variables				
T1 Effect	Cigarettes	Alcohol	Marijuana	Cocaine	Hard Drugs
Control Main Effects Common to All Regressions					
Gender	.005*	ns	ns	ns	ns
T1 drug use	.498***	.416***	.522***	.254***	.309***
T1 friends' drug use	ns	.015***	.008***	.091***	.005*
Self-acceptance and Higher Order Effects					
Main effect of self-acceptance	ns	ns	ns	ns	.007**
Self-acceptance X friends' drug use	ne	ne	ne	ne	.015**[b]
Self-acceptance quadratic effect	ne	ne	ne	ne	ne
Friends' drug use quadratic effect	ne	.007***	ne	ne	.019***[a]
Social Vulnerability and Higher Order Effects					
Main effect of social vulnerability	ns	ns	ns	ns	ns
Social vulnerability X friends' drug use	ne	ne	ne	ne	ne
Social vulnerability quadratic effect	ne	ne	ne	ne	.004*[b]
Friends' drug use quadratic effect	ne	.007***	ne	ne	.02***[a]
Leadership and Higher Order Effects					
Main effect of leadership	ns	.003*	ns	.004*	ns
Leadership X friends' drug use	ne	ne	ne	.005*	.004*[b]
Leadership quadratic effect	ne	.004*[b]	.002*	ne	ne
Friends' drug use quadratic effect	ne	.006***[a]	ne	ne	.022***[a]
Extraversion and Higher Order Effects					
Main effect of extraversion	ns	ns	ns	.004*	.004*
Extraversion X friends' drug use	ne	ne	ne	.008***	ne
Extraversion quadratic effect	ne	ne	ne	ne	ne
Friends' drug use quadratic effect	ne	.009***	ne	ne	.019***
Peer Support and Higher Order Effects					
Main effect of peer support	.007**	ns	ns	ns	ns
Peer support X friends' drug use	ne	ne	ne	ne	ne
Peer support quadratic effect	ne	ne	ne	ne	ne
Friends' drug use quadratic effect	ne	.008***	ne	ne	.021***

Note: Results from five separate hierarchical regressions are listed, in which the control main effects were entered in the a priori order specified in each regression, followed by the main effect of a particular susceptibility indicator. After the main effect of a susceptibility indicator was entered, quadratic and interactive effects of the indicator and friends' drug use were entered in a forward selection, stepwise regression. Incremental R^2 values for effects are listed only if the effect significantly increased the prediction of explained variance beyond that accounted for by previously entered effects.

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .003$.

[a] Entered first in stepwise regression.

[b] Entered second in stepwise regression.

ns = nonsignificant in *a priori* regression.

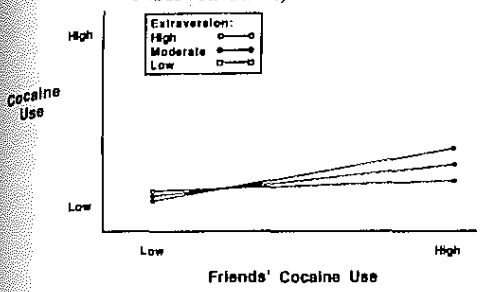
ne = nonsignificant and thus not entered in stepwise regression.

checked to see if they were disordinal (cross-over) or ordinal in form. The recommendations of Jaccard et al. (1990) and Aiken and West (1991) were followed in plotting interactions and checking for cross-over points. Interactions were plotted only within the range of observed scores actually present in the data. For the purpose of plotting the interaction forms at different levels of the moderator, scores on the moderator variable in each plot were defined as *moderate* (mean of moderator), *low* (1 *sd* below mean), and *high* (1 *sd* above mean). Friends' drug use and subject drug use were retained as continuous variables, which are labelled as ranging from low to high in the plots.

The friends' cocaine use X extraversion interaction is plotted in Figure 1. This interaction is disordinal in form (i.e., it is a cross-over interaction). The form of this interaction, as well as the positive sign of the beta weight reported earlier, suggest that as extraversion increased, the prediction of later cocaine use by friends' cocaine use increased.

The friends' marijuana use X liberalism interaction is plotted in Figure 2. This interaction is also disordinal in form and suggested that as liberalism decreased, the predictive effects of friends' marijuana use on later marijuana use increased. Because the form of the interaction was almost identical to the plot just described for marijuana use, the

FIGURE 1. **Interaction Between Friends' Cocaine Use and Extraversion. (Extraversion is used as a moderator of the predictive effect of friends' cocaine use on respondents' cocaine use. The data are plotted only within the bounds of the observed data.)**



friends' cocaine use X liberalism interaction also is plotted in Figure 2. Again, the interaction is disordinal in form. The form of this interaction, as well as the negative sign of the beta weight reported earlier, suggest that as liberalism decreased, the predictive effects of friends' cocaine use on later cocaine use increased.

The friends' hard drug use X self-acceptance interaction is plotted in Figure 3. Because this interaction also was accompanied by a quadratic trend of friends' hard drug use, it was necessary to consider the quadratic component in the regression equation (Aiken and West 1991). By including this predictive effect, Figure 3 illustrates simultaneously the interactive and quadratic effects. As shown in this figure, there was some indication of an inverted-U shape to the prediction of hard drug use by friends' hard drug use. However, the predominant feature of the interaction is that subjects low in self-acceptance show an increased linear prediction of hard drug use by friends' hard drug use, compared to those moderate or high in self-acceptance. This predictive effect decelerates in accord with the quadratic trend. Subjects moderate or high in self-acceptance do not show a strong predictive effect of friends' hard drug use. The downward component of the trend at each level of self-acceptance does not characterize most of the curve within the observed values of the data we obtained, except that subjects high in self-acceptance and relatively high in the proportion of friends who use hard drugs show a small negative predictive effect of friends' hard drug use on their own hard drug use. This interaction did not cross-over within the range of observed values.

FIGURE 2. **Interaction Between Friends' Marijuana or Cocaine Use and One Indicator of Social Conformity (Liberalism). (Liberalism is used as a moderator of the predictive effect of friends' marijuana or cocaine use on respondents' marijuana or cocaine use. As with the other regressions, separate regressions were run for both cocaine and marijuana use, but the plots of the present interactions were nearly identical and thus are represented in the single figure. The data are plotted only within the bounds of the observed data.)**

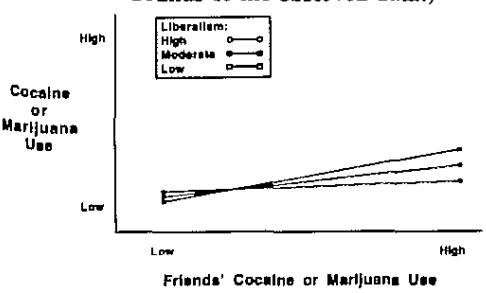
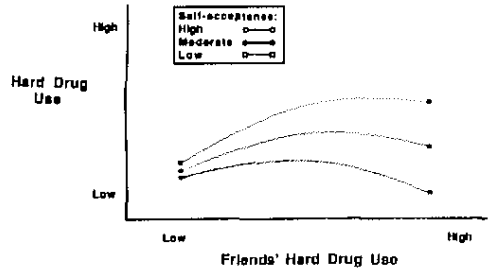


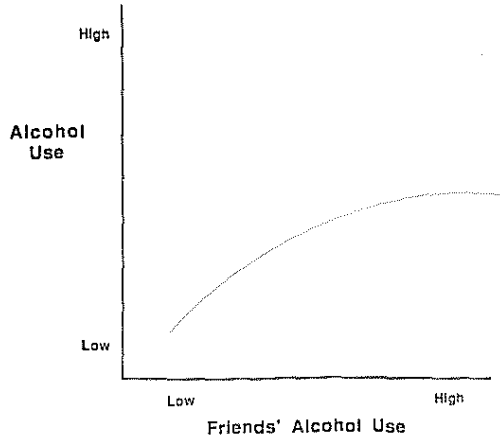
FIGURE 3. **Interaction Between Friends' Hard Drug Use and Self-acceptance, Including the Quadratic Trend of Friends' Hard Drug Use. (Self-acceptance is used as a moderator of the predictive effect of friends' hard drug use on respondents' hard drug use. The data are plotted only within the bounds of the observed data.)**



Form of Quadratic Effect for Alcohol Use

The quadratic trend for alcohol use was not accompanied by any significant interactions. The form of this trend was plotted on the basis of the recommendations of Jaccard et al. (1990). The quadratic trend for friends' alcohol use (see Figure 4) shows that this

FIGURE 4. Quadratic Trend of Friends' Alcohol Use on Respondents' Alcohol Use. (The data were plotted only within the bounds of the observed data.)



predictive effect decelerates in accordance with its negative beta weight. The estimation of the maximum of the curve, where the first derivative is equal to zero, reveals that the curve maximum is very close to the maximum value of friends' alcohol use. This implies that the curve basically decelerates without turning downward, as it would in an inverted-U shape.

DISCUSSION

Interactive approaches to social influence suggest that social influences act differentially on individuals with varying degrees of susceptibility toward these forces. Several of the proposed interactive effects in the present study were in accord with this expectation, though most interactive effects did not reach the Bonferonni-adjusted criterion for significance. These results suggest that theories which emphasize interactive effects of susceptibility and social influence have some potential in specific instances, but may not provide a broad or general explanatory principle that generalizes across all types of drug use. However, the study of this class of predictive effect has been rare in drug use research, and several characteristics of the present study may have limited our ability to detect some of the interactive effects. Before discussing these issues and their implications for the interactive framework in social influence, we address the theoretical implications of the specific interactive effects that were significant.

Specific Interactive Effects

Several interactive effects met our statistical criterion for emphasis and were consistent with certain theoretical interpretations. In two instances, liberalism significantly moderated the predictive effect of social influence on drug use, in which cocaine and marijuana use served as the drug use dependent variables. This predictive effect was in the negative direction, such that as liberalism increased, the predictive effects of social influence on drug use decreased. As outlined earlier, a more liberal orientation toward social conformity may imply less adherence to the status quo of whatever reference group predominates in normative influence. In adolescence, the predominant reference group is constituted by peers. Increased liberalism appeared to act as a buffer against the influences of peer drug use, at least for cocaine and marijuana use.

The absence of this interactive effect on the three other forms of drug use is not totally understood, but several possibilities exist. The absence of an interactive effect of liberalism on cigarette use may be explained by the absence of *any* social influence effect on this form of drug use. It is likely that the absence of these predictive effects in the present study reflects the highly addictive properties of nicotine and the onset of tobacco use in early adolescence. In other words, the predictive effects of social influences and their moderators on cigarette use were likely to operate at an earlier age group than the one we investigated.

The absence of interactive effects of liberalism on alcohol and hard drug use may be explained tentatively by differences in the ambiguity of normative sanctions accompanying different forms of drug use. Perhaps the moderating effects of liberalism do not become operative when dominant cultural norms are relatively unambiguous, either in a positive or negative direction. Use of alcohol, which is generally less addictive than tobacco use, was probably accompanied by many positive social sanctions in the dominant culture and few explicit negative sanctions during the time period of this study. Use of hard drugs was probably accompanied mostly

by negative sanctions in the dominant culture. However, it is possible that use of marijuana and cocaine during the historical period of this study (1979–1980) was associated with relatively more ambivalent, or contradictory, norms in the dominant culture. That is, use of marijuana or cocaine among youth may have been relatively more intermediate in the ratio of positive to negative social sanctions, even though attitudes and disapproval toward cocaine and marijuana use have since become much more negative (Bachman, Johnson, and O'Malley 1990). This interpretation is consistent with the historical trends noted by Bachman et al. (1990). A variety of other predictive effects of contradictory or heterogeneous norms on drug use has been reviewed in earlier work (Jessor et al. 1968).

Perhaps the moderating effects of liberalism appear only when dominant cultural norms are sufficiently ambiguous or contradictory not to provide a clear or unitary guide to behavior. Under such conditions, susceptibility variables that moderate behavioral consistency with the status quo of one's immediate reference group may become operational. Of course, further research is needed to corroborate this interpretation.

Two additional interactive effects were significant at the criterion level. Self-acceptance significantly moderated the predictive effect of social influence on hard drug use, such that greater self-acceptance acted as a buffer apparently protecting individuals from social pressures to use hard drugs. Individuals low in self-acceptance or self-esteem may be more susceptible to peer social influences for several reasons. First, such individuals may not trust their own opinions or choices and may look to peers to a greater extent as an informational guide in making behavioral choices. Also, such individuals may have a greater need for peer social approval, and thus may be more likely to act in accord with normative pressures exerted by the peer group, whether implicit or explicit in nature. Although it is also likely that persons low in self-acceptance seek out deviant peer-group associations (Kaplan et al. 1984), people with greater self-acceptance may be relatively more resistant to social pressures to use hard drugs, even if they are enmeshed predominantly in a single, relatively deviant social group. Future research may be able to integrate empirically our interactional approach to self-acceptance with mediational and direct-effect theories of related constructs, such as self-derogation (Kaplan et al. 1984). Such an integration is beyond the scope of the present study.

Extraversion significantly moderated the predictive effect of social influences on cocaine use, such that higher extraversion led to a greater predictive effect of social influence on cocaine use. The direction of this predictive effect was in accord with previous research suggesting that extroverts are more generally susceptible to suggestion when social rewards or excitement act as incentives (Wilson 1977). This finding is inconsistent with the notion that extroverts may be resistant to social influence because of their relative dominance in social interaction. Although both the self-acceptance and extraversion predictive effects just described were only significant for one of the five drug types evaluated, their high level of statistical significance implies that replication is likely. Nevertheless, we had no *a priori* reasons to believe that these predictive effects would occur for only one type of drug.

Quadratic Effects

The second class of social influence effect emphasized in our study was the quadratic trend of friends' drug use. For two of the drug types investigated (alcohol and hard drugs), this quadratic effect was significant at the criterion level. For alcohol use, the significant quadratic trend showed that the predictive effect of friends' alcohol use decelerated as the proportion of friends who drank increased. Other possible forms of this trend (e.g., U-shaped, inverted-U) were not evident. Hard drug use exhibited both a quadratic trend of friends' hard drug use and an interaction, as specified earlier. As the interaction indicated, the greatest predictive impact of friends' hard drug use was at low levels of self-acceptance. At this level of self-acceptance, the quadratic trend indicated that prediction of hard drug use by friends' hard drug use decelerated in a form similar to that summarized for alcohol use. The forms of the trends just mentioned are generally consistent with the primary proposition of social impact theory (Latané 1981; Latané and Wolf 1981), which states that there is a marginally decreasing effect of an increased supply of people exerting social pressure on

the performance of a behavior. In social impact theory, then, changes in behavior are greater as social pressures increase from slight to moderate than from moderate to strong. This principle has not been applied previously to social influence in drug use, but the present results for alcohol use suggest that the approach has merit in this domain.

The absence of quadratic trends in the other drug use domains may be explained by differences in other correlates of use of different types of drugs. In most age groups and most levels of use, alcohol use remains a highly social activity that is associated with a variety of perceived social rewards (Brown et al. 1980). On the basis of some of the more exhaustive epidemiological surveys, alcohol dependence appears to occur in only a minority of individuals (for males, 8–10%; for females, 1–2%; Helzer, 1987) at any given time period in their lives. The likelihood that social factors play a large role in alcohol use suggests that alcohol use may be analogous to many other forms of social behavior, in which the functional form of social influence is in accord with the predictions of social impact theory. Cigarette use onset appears to be controlled largely by social influences only in early adolescence, but by the age group examined in the present study is probably controlled primarily by level of addiction or habit. It is worth noting that friends' cigarette use did not even have a small linear predictive effect on this age group in the present study, though studies of earlier ages show a number of predictive effects of social influence on cigarette use (Stacy et al. 1992).

Use of illicit drugs, such as marijuana, cocaine, and hard drugs, is instigated in later adolescence (Kandel and Logan 1984) and may depend on a more narrow set of circumstances, including nonsocial factors, than for alcohol use in this age period. Use of illicit drugs may be more likely in individuals both highly susceptible to social influences and exposed to friends who use the drugs. In line with this reasoning, we found at least one interactive effect of this type for each of the illicit drugs. This was not found for the licit drugs. Other special circumstances and nonsocial factors may contribute strongly to illicit drug use (Paton, Kessler, and Kandel 1977). These nonsocial factors may combine with social influences in a manner that makes some individuals highly likely to use illicit drugs, through a process not always captured by the functional form predicted in social impact theory.

Type II Error

Our analytic approach to the study of interactions and higher-order predictive effects was fairly conservative. First, we used the regression procedure recommended by Lubinski and Humphreys (1990), in which interactive and quadratic effects compete for entry into the regressions. Second, we interpreted these predictive effects only if they met a rather stringent significance level. Also, we controlled for the predictive effects of previous drug use and examined social influence over a one-year time interval. This interval of time may be relatively insensitive to the detection of social influence processes, such as influence through normative pressure, that are often expected to have a fairly immediate impact. Under such conditions, the power to detect social influence effects, whether interactive, quadratic, or linear, may be minimized. Finally, product terms, such as interactions and quadratic effects in multiple regression, are more prone to Type II error than are direct (main) effects, because errors of measurement are multiplied in such terms (Jaccard et al. 1990). Increased errors of measurement are known to lead to Type II error in both tests of significance and size of regression estimates. However, the available procedures (Kenny and Judd 1984) for adjusting for error of measurement in interactive models are useful only under a limited set of conditions.

Given the likelihood of Type II error and our fairly conservative evaluation of interactive and quadratic effects, the significant predictive effects found in this study seem likely to replicate in future research. Also, it is possible that future research will find significance where we did not. Such instances are especially likely if shorter time intervals are investigated and Type II error is minimized. It should be emphasized that interactive effects in nonexperimental research are notoriously small with respect to variance explained, but that these effects nonetheless often are theoretically important (Chaplin 1991). Because attenuation of interactive effects is manifested in both regression weights and in variance explained (Busem-

eyer and Jones 1983), attenuation probably accounts at least partially for the small amounts of variance explained by interactions in the present study as well as in previous research. Since this type of attenuation influences multiplicative (e.g., interactive and quadratic) effects, but not direct effects, researchers normally should not apply the same standards of "practical" significance or variance explained to both types of effects. An apparently small interactive effect may be quite important, if it is replicable.

Other Limitations

In addition to the possibility of Type II error in the reported analyses, it is also relevant to note that at least one of the more important potential moderators of social influence was not assessed in the present study. Self-efficacy toward resisting social influence has been of growing interest in drug use prevention campaigns, which have typically construed this variable as a *mediator* of program effects. However, Stacy et al. (forthcoming) argued that this construct may be effectively construed as a susceptibility *moderator* of social influence, in line with the general framework we summarized earlier. In a cross-sectional evaluation of susceptibility moderators of social influences on cigarette use, Stacy et al. found that self-efficacy significantly interacted with friends' cigarette use as a predictor of subjects' tendency to smoke. For individuals higher in self-efficacy, friends' smoking behavior was a weaker predictor of smoking. Longitudinal verification of this finding and application to other drugs of abuse is still needed.

SUMMARY

Interactive and quadratic effects of social influence have many implications for theories of social influence and drug use. In one framework, susceptibility toward social influence is seen as an important moderator buffering the effects of social pressure to use drugs. In another framework, social influences are seen as decelerating, such as in social impact theory. The existence of several highly significant interactive and quadratic effects demonstrated that the interaction and social impact frameworks in drug use have merit, at least in specific instances. Given that Type II error probably decreased the ability to detect these predictive effects in the present study, the potential of these approaches may yet be substantial. These classes of effects and their theoretical bases should receive increased attention in future research for the sake of replication as well as further refinement of theories of social influences on health behavior.

NOTE

1. An anonymous reviewer suggested that correlated measurement error between the same drug use measure assessed over time may have biased our results and requested a two-stage least squares analysis of an instance in which a hypothesized interaction was significant and of an instance in which a hypothesized interaction was nonsignificant. To examine this possibility, we performed the two-stage least squares analysis of two regression equations (one predicting hard drug use at T2 and one predicting alcohol use at T2) involving the susceptibility variable of self-acceptance. In the analysis of the first equation, in which hard drug use at T2 was the dependent variable, the first stage of the analysis obtained predicted scores for T1 hard drug use by predicting T1 hard drug use with marijuana use (a strong correlate that was not in the initial equation in Table 2). In the second stage of this analysis, the predicted score of hard drug use at T1, instead of the observed score, was then used as the measure of previous drug use in the regression equation in Table 2 (in which T2 hard drug use was predicted by self-acceptance, its interaction, and each of the other effects described previously). In the analysis of the second equation, in which T2 alcohol use was the dependent variable, an identical procedure was used but in the first stage alcohol use at T1 was predicted by marijuana use (also a strong correlate) and in the second stage the predicted score of alcohol use at T1 replaced the observed score in the regression analysis. In these two sets of analyses, the significance levels of the interactive and quadratic effects in Table 2 did not vary when compared to the original significance levels, and the R^2 values changed by .004 or less. Thus, correlated measurement error did not appear to affect the findings, either in terms of spurious effects (e.g., a possibility in the friends' heroin use X self-acceptance interaction) or in terms of the failure to find significant effects (e.g., a possibility in the absence of a friends' alcohol use X self-acceptance interaction). Simulation research suggests that correlated measurement error

probably does not lead to spurious interactive effects in multiple regression (Evans 1985).

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