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# The Psycho-Economic Model of Ecstasy Consumption and Related Consequences: A multi-site study with community samples

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# THE PSYCHO-ECONOMIC MODEL

# OF ECSTASY CONSUMPTION AND RELATED CONSEQUENCES:

# A MULTI-SITE STUDY WITH COMMUNITY SAMPLES

by

Arbi Ben Abdallah

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## ABSTRACT OF THE DISSERTATION

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The consumption of mind-altering drugs is well recognized as a complex behavior entailing many different etiological precursors. To understand its complexity, drug use has to be considered from multiple perspectives. Over time, numerous theories have been advanced to explain drug use, the pattern of its use, and its related consequences. Because they approach such a behavior from slightly different vantage points, these theories offer unique explanations with different take on its genetic, physiological, psychological, and environment risk factors. A substantial body of research suggests that there exist multiple perspectives on psychological precursors to drug abuse; however, the same literature also implicates economic measures that can explain drug etiology. Economic models of consumption suggest that "market forces" adequately explain the use of drugs. Market forces alone are however necessary but not sufficient to account for drug consumption. Other

factors that appear involved include psychological motivation and other intra-individual characteristics (i.e., depression and risk-taking) that also explain use and problems arising from drug use. Until now, the confluence of both economic and psychological theories has not been tested empirically. The present study used latent-variable Structural equation modeling to examine the influence of both economic (social anomie, monetary price, opportunity cost) and psychological risk factors (motivation, depression, and risk-taking) on self-reported Ecstasy use and its related consequences, referred to as dependence. Data used in this research were obtained from 640 recreational Ecstasy users between 2002 and 2005 in three sites in the United States and Australia participating in a NIDA-funded nosological study examining trends in club drug use. The sample was mainly Caucasian (62%), male (58%), and young [mean age =23years (SD=5.01)]. All the hypothesized latent constructs were statistically reliable and correlated in the expected direction. A Full "saturated" model indicated that, among the three key economic measures, monetary and opportunity cost, but not income, significantly predicted Ecstasy consumption. On the other hand, among the psychological measures, motivational cues were the strongest predictors of both consumption and dependence. Dependence was also impacted by depression and sex-risk. Inclusion of demographic measures (gender, age, race, and education) and site location did not appreciably alter the final model parameters. Findings are discussed with regard to incorporating the role of economic and psychological factors in shaping a more refined understanding of Ecstasy consumption and its consequences.

## DEDICATION

In loving memory of my mother and father,

whose inspiration and love taught me that the greatest value of life is determined by your own resolve and commitment.

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There are several advantages one gains from working fastidiously on a doctoral degree at a later point in life. The most important of these advantages is the research experience one gains from years of earnestly hard work and empirical inquiry. Added to this devotion, the long road one travels in a graduate school is peppered with incredible support of collaborators, colleagues, and friends. Given the road I traveled, a road paved with tremendous insight and mentorship, I am indebted to many people to whom I would like to express my sincere appreciation.

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# CHAPTER I: INTRODUCTION

Throughout history, mankind has sought ways to alter its consciousness with the use of natural herbal products and derivatives of native plants. The most common parts of plants used to create medicinal potions and concoctions have been leaves, roots, and seeds. Even without knowing their medicinal properties or their pharmacological action, many ancient societies used a variety of plants for their soothing effects, inducing relaxation, and even their psychotropic effects. Some of the more popular forms of native plants that possess mind-altering properties include cannabis, coca, datura, ergot, khat, mescal, opium, and peyote.

With time, and advances made primarily through pharmacology, chemists were able to figure out the structural properties corresponding to the "active ingredients" of native plants that cause altered states of consciousness. Within a short period of time, laboratory advances provided a means to synthesize the active ingredients that conveyed psychoactive properties from plant derivatives. Common examples encountered in the literature include the coca leaf, which can be ground into a milky white paste or refined into a more pure form of powdered cocaine. Likewise, scoring the opium poppy produces the discharge of a thick viscous, pasty, tar-like resin that can eventually be processed as street grade heroin. In 1804 the opiate analgesic morphine was first of several plant alkaloids extracted from the opium plant; it was eventually marketed by the pharmaceutical company Merck (1827) as a

major pain reliever. As scientists have become more familiar with the behavioral and psychological effects of numerous plant alkaloids, and particularly their narcotic and analgesic effects, emphasis has been placed on delineating whether they cause addiction.

One of the first steps in the process of understanding the psychoactive properties for all mind altering substances (i.e., all kind of drugs, including native plants, known to alter mood, perception, and behavior) was to classify them according to their addictive potential. In 1970, the United States (U.S.) Congress enacted the Controlled Substance Act, part of the "Comprehensive Drug Abuse Prevention and Control Act of 1970," to provide the Drug Enforcement Administration (DEA) a mechanism to classify all chemical substances into categories, also known as drug schedules or classes.[1] Today, the scheduling (or classification) of drugs encompasses a wide range of illicit drugs including marijuana, cocaine (both powder and crack that can be manufactured in crystalline form), opioids (morphine, heroin, and any derivatives of plant alkaloids in chemical form such as Hydrocodone, Oxycontin, or codeine), and methamphetamines. The classification system has also been extended to include legal substances, such as

[1]For more details on this law and a complete description of these drug schedules, visit U.S. DEA website: http://www.usdoj.gov/dea/index.htm, last retrieved on December 12, 2010.

nicotine, alcohol, and prescription medications.[2] When consumed for recreational purposes to achieve a certain altered state of consciousness [e.g., to promote instant rush (euphoria), induce hallucinations, or to get "high"], these psychoactive drugs have a great potential for abuse and can lead to addiction and are responsible for causing a wide range of adverse medical (physical and/or mental health) and other consequences (Chen & Lin, 2009; Rehm et al., 2006).

The consumption of mind-altering substances by individuals of all socio-economic strata and age groups, including adolescents and young adults, continues to be a matter of public health concern and represents a tremendous social problem. This is because continued use of these drugs can lead to serious physical as well as mental health problems, including death by overdose (CDC, 2010). The costs (monetary and otherwise) of drug use and addiction are enormous to society, including financial outlays for treatment, loss of economic productivity, disruption to the family, and legal incarceration for manufacturing, distribution, possession, and/or consumption. Importantly, increasing rates of individuals seeking treatment for drug addiction [Based on data from the Substance Abuse and Mental Health Services Administration (SAMHSA) National Survey on Drug Use & Health (NSDUH) 2010 and Treatment Episode Data set (TEDS) 2009] coupled with a relatively high rate of illicit drug use

[2]There is yet an ongoing debate as to whether other legal natural-substances, such as sugar, coffee, and chocolate; as well as activities, such as binge eating, gambling, TV viewing, internet surfing, playing video games and even having sex, can be addictive. For additional discussion on this continuing debate, see for example, Black (1996), Brown (1993), Clark (2006), Harpaz & Snir (2003), Mule (1981), and Song, Larose, Eastin & Lin (2004).

among some segments of our nation's secondary school students (Johnston et al., 2010a & 2010b) underscore an urgent need for improving efforts at prevention and treatment. Developing effective programs for both drug prevention and drug treatment requires, however, a deeper understanding of the various developmental risk processes underlying drug etiology and likewise involves obtaining a more refined understanding of individual differences in susceptibility to drug use and the processes leading to addiction.

Clinical and epidemiological research on the causes of drug use and abuse have helped scientists gain a better understanding of the genetic, physiological, psychosocial, and environmental dimensions of both the beginning stages of drug use and the more protracted abuse, and even addiction. Lately, economic theories of rational choice and consumer behavior have also been used to account for drug etiology and the various pathways to addiction (Chaloupka & Grossman, 1996; Godfrey & Maynard, 1989; Marvel & Hartmann, 1986; Stigler & Becker, 1977). Economic theories, however, have not been considered mainstream with regard to the dominant psychological explanations of drug use and thus are less widely accepted (Bridges, 1999; Rachlin, 2003). Nonetheless, the economic explanation of behavior has become markedly more prominent, especially as consumerism in the U.S. and abroad has risen and more companies compete worldwide for scarce resources and market share. Understanding the decision-making rationale that leads to product selection has received increasing interest not only for its commercial implications but

also for its application in other fields such as drug use and addiction. In the case of drug abuse, consumer behavior emphasizes the acquisition and consumption of psychoactive products, which are associated with an array of medical, psychological, and social problems.

## 1. **Statement of the Problem**

The concept of addiction is difficult to pin down. There is also some theoretical confusion when discussing "addiction" because of its diverse etiology, multiple outcomes, and numerous ways to discuss the activity that underlies drug taking and drug seeking behaviors. Even the process of becoming addicted is complex with many pathways and courses. Individual addicts each have their own story, painting a detailed picture describing the myriad of ways their life became entangled with an overwhelming sense of urgency, craving, and desire for drug consumption. Added to this, there are developmental considerations that come into play. It is unquestionable that individuals do not become addicted overnight but that addiction results from a prolonged involvement with a drug, and even this basic understanding must consider a wide range of environmental, social, physical, and economic cues that stimulate drug taking. At its earliest stages, addiction begins with experimental or recreational drug use, where an individual smokes a joint, sips a drink of alcohol, takes a pill, or ingests some plant derivative (psilocybin or mescaline) for the first time. Most cigarette smokers state their first cigarette made them cough, and they felt nauseous and sickly. Many say cocaine makes them feel

"racy" and their heart beat uncontrollably. Others smoke marijuana and feel their head "buzz" and they quickly crave food. However, within a short period of time, drug users wish to relive the euphoric "high" they experienced, seeking to consume more of the drug in question, in larger quantities and more frequently, inevitably leading to abuse or addiction.

During the past few decades, a large number of competing theories have been advanced to explain drug-taking as well as individual susceptibility to addiction. Focusing on somewhat different aspects of the problem, these various psychological, sociological, economic, and more recently neurological theories offer unique explanations of the drug addiction process. Because they approach drug consumption and addiction from slightly different vantage points, these theories suggest different social policies and interventions. While each theoretical approach provides some empirical support attesting to its validity, the different explanatory models proposed also possess certain limitations in their ability to account for the diverse facets of use, abuse, and addictive behavior.

One limitation, in particular, has been the failure to integrate across diverse theoretical views producing a "myopic" focus within each theory; each one struggling to develop a satisfactory explanatory model of drug consumption. This has created diffuse and often contradictory explanations of drug use and abuse. Psychological theories of addiction, for instance, because of their emphasis on individual differences, fail to integrate larger macro or structural forces, including the role of

environmental and community influences. Sociological explanations, on the other hand, attend to the dynamics of larger institutions including the family, but fail to include micro-forces that may involve genetic explanations. To explain drug use and the addiction process, economists focus on familiar economic factors, assuming that psychological and sociological factors can be held "constant." This narrowness in perspective is particularly startling given that most current models of drug use and addiction agree that the use, misuse, and addiction to drugs is the result of a complex interaction of many contributing factors at multiple levels of influence. Recognizing that drug addiction is etiologically complex and multi-faceted is generally regarded as a more realistic view of the behavior. Support for a multi-factorial approach comes also from the observation that no single theory can sufficiently account for the full spectrum of drug addiction and even more so from the fact that no intervention program based on a single theoretical model has ever been shown to be consistently effective, especially in the long run (Burke, 2002; West & O'Neal., 2004). The complexity of human behavior, in general, and addiction, more specifically, requires a more encompassing and theoretically rich model that incorporates a multi-disciplinary and more "ecologically" sound approach (Brewer, 2000; Scheier et al., 2010).

In recent years, two models of drug use and addiction, one derived from psychology and the other from economics, have generated considerable debate and empirical research. Although models based on economic theory have focused

attention on external or market-based factors, such as income, market prices, and opportunity costs; psychological models of human behavior have emphasized internal cues, such as emotional self-regulation, cognitive functioning, and motivation, all of which regulate an individual's intention to consume psychoactive drugs. Each theory offers important insights into the complexity of drug use and addiction. However, very few empirical studies have fully integrated these competing explanations.[3] The integration of economic and psychological factors into a comprehensive model of addiction is not only essential for a better understanding of addictive behavior, but also represents an important step towards developing scientifically rational and more effective prevention efforts and treatment strategies (Montoya et al., 2000).

## 2. **Purpose of the Study**

The purpose of this dissertation is to develop, for the first time, a "hybrid" model that effectively combines select components of both economic and psychological theories to predict drug consumption and its related consequences. The model is not designed to test the utility of these theoretical frameworks; rather, it aims essentially to: (1) assess the theoretical importance of combining economic

[3]An earlier example of such confluence between economic theory and psychology can be found in Edwards' (1954), who provides a scholarly dissection of the particular components of individual decision-making that overlaps quite nicely with some of the main tenets of economic rationality [see also, Camerer (1995), for a excellent discussion of decision making from an economic perspective]. Also, Rabin (2002) presents an excellent discourse on the potential cross-fertilization (i.e., a merger) between psychology and economics, which he terms "behavioral economics." A good deal of Rabin's writing highlights the need for psychological realism in economic theory, lest we forget that people do not always act "sanely," i.e., rationally.

models of consumption with existing psychosocial theories of addiction; and (2) estimate the unique influence of economic factors on drug consumption in the presence of psychological constructs. The methodology used also advances previous attempts in this direction by using latent-variable Structural Equation Modeling (SEM), a multivariate statistical technique appropriate for theory testing (Bentler, 1978; Nachtigall et al., 2003).

More specifically, this dissertation proposes a novel "psycho-economic" model of addiction, simultaneously combining and testing the unique influence of key economic indicators along with psychosocial risk factors on a specific type of substance that has become popular among youth and young adults.[4] The proposed model represents an outgrowth and further refinement of an earlier, preliminary study published in *Substance Use & Misuse* (Ben Abdallah et al., 2007). In the current dissertation study, the main research questions address: 1) whether specific economic indicators remain statistically and significantly associated with substance use behaviors in the presence of psychosocial influences and more importantly 2) whether a combined "psycho-economic" model is "ecologically" valid. The question of ecological validity has been neglected in the literature despite its inherent

[4]Actually, Cameron's (2000) "psycho-economic" model of cigarette consumption was first to suggest the confluence of psychological and economic factors to account for drug behaviors. However, while the author did not completely dismiss the role of economic factors, such as drug prices and income, his work emphasized how "the psychopharmacological addictive properties of cigarette smoking influences demand" (p. 212).

relevance to the design, implementation, and evaluation of drug prevention and treatment programs (Brewer, 2000).

3. **Significance of the Study**

There are several other unique features worth noting to the present study. First, the study weaves together competing behavioral science disciplines to explain human behavior. Additionally, the study offers a number of significant contributions to the field of behavioral economics in general and drug abuse in particular, emphasizing several theoretical and methodological concerns that have yet to be addressed in the literature. One of the more striking concerns is that prior empirical studies have focused on at most one or two domains of influence as putative risk factors for drug use and abuse. The exclusion of important domains of influence that could explain drug use and even the more harmful course of addiction is likely to increase the risk of spuriousness and foster erroneous inferences. To address this concern, the present study models a wider array of economic indicators, including measures of income, opportunity and monetary cost along with measures of psychological functioning, health risks, and behaviors related to drug abuse. Inclusion of these diverse sets of economic and psychosocial influences in a single comprehensive model should help advance the field of behavioral economics, in particular, toward constructing an ecologically sound and valid model of drug use.

Second, numerous studies of drug use are characterized by the absence of reliable measures assessing different putative domains of risk. The use of at most one

or two items to characterize a broad range of inter- or intra-personal functioning runs the risk of model misspecification and introduces some degree of unreliability into the model. To address this concern, the present study relies on a state-of-the-art diagnostic and risk factor assessment, including measures with excellent psychometric properties; measures that were designed and repeatedly tested in diverse settings by investigators at Washington University with a world-wide reputation for developing diagnostic assessments with clinical and research significance (Cottler et al., 2010).

Related to this point, the analyses used in this study incorporate latent-variable Confirmatory Factor Analysis (CFA) to adjust for unreliability in the putative risk factors. This approach is ideal for assessments that contain multiple indicators of an underlying behavior or risk factor (Bollen, 2002). Briefly, with a CFA or measurement model, the moderate association among several observed manifest indicators is hypothesized to be statistically caused by some underlying latent or unobserved "factor." This is a common approach used when modeling psychological processes, many of which are latent or unobserved behavioral tendencies. Estimation of latent-variable constructs is based on classic psychometric theory, which disaggregates error variance from the true variance component of an observed measure. The more reliable, common or shared variation between multiple measures tapping a single construct is then modeled to reflect predictive variance in the model or as an endogenous factor influenced by other model terms. With the CFA

model in hand, a second step in the theory development involves testing predictive or structural relations among hypothesized constructs and other exogenous covariates. This multivariate approach, known as structural equation modeling (SEM), provides a more rigorous and parsimonious analytic framework to address simultaneous influences within a single specified model (Nachtigall et al., 2003).

A third concern rests with the homogeneous nature of data collection used in past studies. Sampling drug users from at most one or two geographic locales runs the risk of creating a limited view of drug use cultures or drug markets specific to a region or country of interest. In the present study, drug users were recruited simultaneously from three racially and culturally heterogeneous sites located in St. Louis, Missouri; Miami, Florida; and Sydney, Australia. Significant cultural and geographic variation should help furnish new information on patterns and trends in drug use as well as open doors to testing differences in economic factors as they may vary across sites and therefore have different influences on drug user's behavior.

The large cross-site community samples also provided a unique chance to examine patterns of consumption among Ecstasy users and investigate a drug surging in popularity among various age groups particularly during the time of the present study was conducted.

A fourth concern is that the economic model, which has been advanced in the literature, has primarily been tested with licit drugs. Thus, relatively little is known whether a model accentuating market factors can account for illicit drug

consumption. To address these and related concerns, the present study uses "nosological"[5] data obtained from the "Tri-City Study of Club Drug Use, Abuse and Dependence" [a National Institute on Drug Abuse (NIDA) funded study (DA14854-01, PI: Dr. Linda B. Cottler), referred to as CDSLAM]. Access to the CDSLAM tri-city sample provided a rare opportunity to test a psycho-economic model of drug use with the largest to date out-of-treatment sample of Ecstasy users.

Ecstasy/MDMA and its effects --- Ecstasy,[6] otherwise identified by its pharmacological name as 3,4 methylenedioxymethamphetamine (or MDMA for short), is a Schedule I drug (i.e., an illegal, controlled substance, in the same drug category that includes heroin, cocaine, and LSD), with no substantiated therapeutic value, and extreme potential for abuse. It is one of several drugs belonging to a group called "club drugs."[7] Although the emergence of MDMA was first reported in the U.S. in the late 1980's by NIDA's Community Epidemiology Work Group (CEWG), information on its consumption and its effects (both short-term side effects and the

[5]Nosology refers generally to the classification of diseases. A "nosological" study in drug addiction deals with the classification of psychoactive substances based on their pharmacological, behavioral, affective, and cognitive properties.

[6]Other street names for Ecstasy are Adam, E, eve, decadence, M&M, X, and XTC.

[7]Club drugs are also referred to as "party drugs" or "Recreational drugs" because, when first popularized, they were commonly used for "recreation" at dance parties or clubs. MDMA (or Ecstasy) is probably the most common of all the recreational drugs used at those parties. Other club drugs also used at dance or "rave" parties include Rohypnol (also called Roophies, Roche, Forget-me Pill), GHB [γ-hydroxybutyrate] (liquid Ecstasy, Georgia Home Boy), and Ketamine (special K, Cat Valiums) (Cohen, 1998).

possible long-term consequences) are still quite limited (NIDA, 2006b).[8] In fact, "each of these [club] drugs has very different pharmacological, psychological, and physiological properties" and the literature documents profound differences in the patterns of use, risk profiles and characteristics of users (Maxwell, 2004, p. 1).

MDMA is a synthetic hallucinogenic, psychoactive stimulant, which is usually consumed in a pill (tablet or capsule) form (NIDA, 2006a). During the time period (2002-2005) coinciding with the parent study (CDSLAM), street buy-back and ethnographic information yielded estimates of a market prices ranging from $20 to $40 per tablet.[9] Early studies of club drug users also created the impression that this "designer drug", MDMA (again, commonly known on the street as Ecstasy), was a "safe drug" with few and minor negative health effects (Beck & Rosenbaum, 1994; Moore, 1993; Peroutka et al., 1988; Solowij et al. 1992). Additionally, sporadic reports and clinical vignettes confirm that psychotherapists in the U.S. have used Ecstasy to facilitate psychotherapy sessions with patients suffering from psychiatric disorders, including post-traumatic stress disorder (PTSD) (Greer & Tolbert, 1998;

[8]MDMA was first synthesized and patented as "diet aid" in 1914 by a German pharmaceutical company that eventually became Merck & Co. (see Grinspoon & Bakalar, 1986, for details on the history of MDMA before its criminalization in the U.S.). MDMA was not, however, marketed at that time nor utilized for any purpose till the 1950's when it was used in animal studies supported by the U.S. Army to investigate new approaches to "brainwashing, espionage and mind-control" in the 1950s during the Cold War (for more details on these studies, see Hardman et al., 1973). In the early 1980's, MDMA began to be used for non-medical purpose (as a recreational drug) in the U.S. under its street name Ecstasy (Rosenbaum, 2002).

[9]The price per Ecstasy pill has gone down since then and became relatively cheaper due to its abundance through black market channels and illicit drug manufactures.

Ruse et al., 2010). However, the criminalization of MDMA use in 1985 eliminated physicians' ability to prescribe or even use it for any medical purpose.[10] Nevertheless, users describe Ecstasy as being a popular recreational drug used in nightclubs or all-night dance parties, called also "raves" or "trance events,"[11] especially for its ability to produce the "feelings of increasing energy" and to promote "euphoric sensations of well-being," "heightened sensory awareness", and "interpersonal feeling of closeness" to others (Baylen & Rosenberg, 2006; Parrott, 2001).

As clinical data became available from controlled laboratory trials and epidemiological information was obtained from survey research, it has become clear that Ecstasy consumption induces both stimulant and hallucinogen-like effects with deleterious consequences.[12] Several reports have described numerous medical complications and fatalities associated with Ecstasy use (Henry et al., 1992; Lee,

[10]Recently, however, the U.S. Food and Drug Administration (FDA), with approval from the Drug Enforcement Administration (DEA), has given permission to a limited number of investigators from medical institutions (the University of South Carolina in Charleston, Harvard, and the University of San Francisco medical schools), to conduct clinical trials with Ecstasy. These studies involve the use of MDMA-assisted psychotherapy for subjects with treatment-resistant PTSD, for anxiety and depression in advanced-stage cancer patients (Doblin, 2002; Sessa & Nutt, 2007).

[11]While under its influence, Ecstasy users report feelings of happiness, energy, and greater acceptance of others. This allows them to party and dance for an extended period of time, hence the name party- or club-drug (Davison & Parrott, 1997).

[12]Stimulant-like effects include increases in energy, euphoria, and cognitive improvement, and hallucinogen-like effects include changes in perception, some dysphoria, changes in thought process, and reduced concentration (Harris et al. 2002; Hernandez-Lopez et al. 2002; Tancer & Johanson, 2001).

1994; Maxwell et al., 1993; CDC, 2010), owing perhaps to extreme hyperthermia, dehydration, high blood pressure, cardiac and even renal failure (Mathias, 1999). Frequent use can also cause long-lasting damage to areas of the brain underlying memory (Casco et al., 2005; Ricaurte et al., 2002). After the reported "high" subsides, Ecstasy users often feel depressed, irritable, and experience drug craving, leading them to take more drugs to extend the high and/or offset withdrawal (Baggott et al., 2001; Jerome 2005; Parrott, 2007; Scholey et al., 2004). Ecstasy users also report using, at the same time, other substances such as alcohol, marijuana, cocaine and opiates to relieve the post-stimulant effects, which may even put them at a higher risk for adverse health issues (Cottler et al., 2001, 2009; Degenhardt et al., 2010; Leung & Cottler, 2008; Parrott & Lasky, 1998; Topp et al., 1999).

Recent studies suggest that Ecstasy use is no longer limited to "party goers" characterized as young adults between the ages of 18 and 25. National prevalence data gathered from representative samples of secondary school students (i.e., Monitoring the Future (MTF): Johnston et al., 2010b), households (i.e., National Survey on Drug Use and Health (NUSDUH): SAMHSA, 2010b), and medical information based on drug-related emergency department visits [i.e., Drug Abuse Warning Network (DAWN): SAMHSA, 2009 & 2010a], all indicate that the use of MDMA is spreading to the rest of the population, including adolescents.

In particular, drug surveillance surveys show estimates of past year initiates of Ecstasy use among Americans aged 12 or older peaking between 2001-2002

(reaching 1.2 million in 2002), followed by a three-year period of decline, which was then followed by a period of significant increase from 2006 onwards (reaching 1.1 million in 2009; SAMHSA, 2010b). At the same time, between 2005 and 2009, past-year use of Ecstasy increased among 12th-graders from 3.0% to 4.3%; and among 10th-graders from 2.6% to 3.7%; while past-year use among 8th-graders showed a modest decline from 1.7% to 1.3% (Johnston et al., 2010b). Despite these differences in rates, the prevalence of self-reported Ecstasy use among 8th, 10th, and 12th graders surveyed in schools across America is determined to be comparatively higher than that for cocaine, heroin, and LSD; almost making it seem as if Ecstasy has replaced these "older" illicit drugs as the drug of popular choice (Johnston et al., 2010a).

Adding to these compelling statistics, emergency department (ED) statistics show that Ecstasy mentions for critical and/or traumatic care have steadily increased since 1994 (from 253 to 5,542 in 2001), only slightly decreasing in 2002 (4,026, a non-significant change), then rising significantly every year to reach 17,865 in 2008 (DAWN: SAMHSA, 2009). Further, since 2004, there has been a continuous drop in perceived risk of harm associated with Ecstasy use among adolescents, suggesting few barriers to their future use (DAWN: SAMHSA, 2009). The high prevalence of Ecstasy use among secondary school students, coupled with the medical and psychological problems reported after both recreational and prolonged use, argue for increased research attention to this drug (Cottler et al., 2001; Degenhardt et al., 2009, 2010; Leung & Cottler, 2008).

More importantly, rising prevalence rates and knowledge of existing cost structures suggest that regular Ecstasy users may not be sensitive to economic factors. Shedding light on this important research question, in itself, makes the contribution of the psycho-economic model even more compelling for empirical study.

### 4. **Organization of the Study**

This dissertation is structured as follows: Chapter II provides a brief theoretical background of drug use and abuse with further discussion of addiction as it relates to the current research. This material is not meant to represent an exhaustive review of all existing addiction theories per se, but rather a fairly comprehensive overview of the major models of substance use and addiction, including the key economic and psychological models, and an evaluative review of the factors highlighted in the recent literature that are pertinent to the argument being made in this thesis. The conceptual model and hypotheses of this dissertation are elaborated and also presented in Chapter II. Next, Chapter III describes in detail the study data and methods, including the derivation and construction of measures used in the psycho-economic model as well as the statistical modeling procedures utilized to test the specific research hypotheses. Chapter IV presents the study results based on a series of latent-variable structural equation models, testing the unique and combined influence of economic and psychosocial measures of influence on Ecstasy consumption and related consequences. Finally, Chapter V discusses the study findings in detail, including their relevance to previous work, with specific attention

paid to the implications of joining theoretical models and the limitations of the study. This last chapter also elaborates the application of the findings for drug prevention as well as treatment, and provides directions for future research.

# CHAPTER II: BACKGROUND

## 1. **Introduction**

Over four decades of concentrated studies indicate that there are multiple pathways to substance use and misuse. These pathways involve a host of risk factors, mechanisms, and contexts that foster the early stages of drug consumption. Many of the same risk factors, mechanisms, and contexts are also implicated in the processes leading to addiction. The same research literature shows that no one particular etiological factor provides the best explanatory mechanism overall to account for behavior. There is historical context for the varied arguments why people take drugs with family, cultural, and environmental factors that seem to contribute to the use and abuse of drugs.

At different times in history the reasons for drug use have included the "devil," a "rotten society," and even "dormant intra-psychic conflict" (Johnson, 1999). Although a significant focus of empirical research has emphasized the "causes" of drug use, studies of the consequences of drug use and abuse have been just as varied with numerous outcomes used to justify policy initiatives to deter use. For instance, public concern with drug use has emphasized cognitive and physical impairment, loss of productivity in the workforce, and negative social consequences stemming from continued use of drugs (NIDA, 2007). Overall, the effects of drug use can have ruinous effects on the family, community and even society as a whole.

Despite continued use during adolescence and sometimes even continuing into young adulthood, most people eventually "mature out" and relinquish their drug-using behaviors (Jochman & Fromme, 2009; Robins et al., 1974; Robins, 1980, 1993). However, for some individuals continued drug use eventually propels them into a downward spiral of addiction. Clinical case studies indicate that for every person who becomes addicted there is a unique story that captures the slow drift into his/her compulsive drug-taking. As a result, there has been a proliferation of theories to account not only for early and more problematic drug use but also for addiction, linking different stages of etiology, maintenance, and even relapse.[13]

This chapter provides a brief overview of the literature examining drug use and abuse in order to provide a more complete picture of the different prevailing etiological theories. Etiology concerns root causes and in this respect details the myriad of reasons why people engage in drug use, the processes resulting in abuse, and the manifest ways this can lead to addiction (Scheier et al., 2010). The overview presented here provides a theoretical backdrop for the psycho-economic model proposed in this study. The chapter begins with a brief historical perspective of what are generally considered to be relevant models of addiction.[14] The materials

[13]For a review of the most relevant drug addiction theories, see Addiction, Supplement-2, 2000; Addiction, Supplement-1, 2001; and Addiction, no. 4, 2002.

[14]Although a model can present a more detailed description or explanation of why and how something happens, it is usually based on a theory with specified axioms, postulates and syntax. Absent specific details, both a model and theory can be framed as means to account for reality. For the present purpose, both theory and model will be used interchangeably throughout this chapter.

presented clarify how the addiction field has changed conceptually over time, marking the transition from the "moral" view to the traditional medical model, and more recently introducing the biopsychosocial and behavioral-disorder perspective.

Following this brief introduction the chapter introduces the two theoretical models currently used in the field to account for drug addiction: one clarifying the role of psychological factors and the other highlighting economic measures that presage consumption. A substantial body of research suggests that there exist multiple perspectives on psychological precursors to drug abuse; however, the same rich literature also implicates economic measures that can explain drug etiology. This review is by no means exhaustive, but rather meant to evaluate the strengths of each perspective and provide a means to acquire a more refined picture regarding the unique contributions that each theory provides regarding the processes leading to drug use, abuse, and even addiction. In this respect, this review focuses on causal factors in each theory that are thought to play a role in shaping a person's decisions to use drugs and their eventual course to addiction. Next, the psycho-economic model is discussed in terms of other pertinent literature reviews. Finally, a conceptual model and the hypotheses of this research study are outlined as a prelude to the empirical models that are presented in the subsequent chapter.

## 2. **A Historical Perspective of Addiction Theories**

From the earliest recorded history of antiquity and even stretching into the early 20$^{th}$ century, drunkenness and intoxication from alcoholic beverages and

"getting high" on drugs was regarded as largely a voluntary behavior and therefore the result of personal misconducts, bad and even "sinful decisions" (Keller, 1972). Society regarded the inability to control one's temptations as a character flaw providing a basis for the "moral" view of addiction. Adherents of this position relied on the philosophical position of "free will," postulating that people are in control of their own actions and thus free to behave in any way they choose. Accordingly, consumption of addictive substances results from choosing a shameful lifestyle for which those consumed by addiction are to blame because it is a matter of choice; they control their own destiny and are in charge of their own actions. Only people with "poor moral standards" and "low willpower" or "self-control" would therefore choose to indulge in "demon's behaviors" (Bobgan & Bobgan, 1990; Levine, 1978; Room, 1983). As a consequence, addiction was depicted as "punishment for sinful habits" that can only be overcome through complete abstinence. The process of ridding oneself of the demons of alcohol requires a "spiritual awakening" and a devout "commitment to religious beliefs." Despite the popularity of this view and its foothold in the treatment community during the 18th and 19th centuries, the "moral" or "puritanical" view of drug use and addiction contributed very little to our understanding of why people initiate and continue to use psychoactive substances.

Within a short period of time, scholars and influential public leaders realized that the moral view offered no credible scientific evidence that could help fuel the development of effective prevention strategies or contribute to viable treatment

options. Although this position was plagued by limited utility, adoption of the moral view was responsible for many of the anti-drug legislative activities that took place in the early 20th century. For instance, pointing the finger at a moral deficiency in the addict's personality or a character flaw renders the use of addictive substances strictly a sin and/or led to legislation criminalizing drug consumption. This view eventually acted as stimulus for the prohibition policy era in the U.S. (1920-1933), a constitutional "faux pas" that inevitably increased alcohol consumption, stimulated corruption, and increased crime (Health, Education & Welfare, 1968). Although certain aspects reminiscent of the moral approach continue to be invoked,[15] scientific research has long challenged this philosophical position by showing that addiction is not the result of a character defect or a moral weakness.

Introduction of the Disease Model --- Shortly after the repeal of Prohibition, a new approach to drug addiction became popular and grew rapidly, based on advances that took place in medicine and a growing body of scientific knowledge (McMurran, 1994). According to this perspective, alcoholism and addiction, in general, are defined as "chronic and progressive conditions" or "diseases" (like other medical conditions including, for example, asthma, hypertension or diabetes) caused by the prolonged effects of the substance used. Moreover, other factors, some often ascribed

[15]The influence of this view can still be found, though to a lesser degree, in the 12-step program of the Narcotics Anonymous (NA). The NA requires each member "to confess" out loud during group meetings their addiction and that they lost control over their drug use. Also, the 'war on drugs' policy of the 1980's represented an anti-drug policy to some degree based on shame, guilt, and personal character weakness.

as common sense, helped derail the moral view. For instance, although many people use alcohol and/or drugs, not all individuals lose control over their use. Furthermore, the moral view was not encompassing and its adherents regarded as myopic and somewhat reluctant to consider alternative views to account for addiction. Within the new approach, however, drug addiction became rooted in a medical condition like any other common physical malady or disease. Many in the scientific community also argued that the undesirable behaviors associated with addiction are only the symptoms of the substance user's ailment. The user shows progressive worsening in terms of loss of control over the drug taken, as his/her body physiologically adapts to the presence or absence of the drug of choice (Leshner, 1997).

The addiction disease-theory as it became known was introduced formally in the late 1940's and early 1950's by E. M. Jellinek (1946, 1952). His view entailed essentially five considerations: (1) addiction reflects an illness and should not be characterized as "the demon's act," (2) denial is usually a common feature of this disease, (3) addiction is a progressive, irreversible condition characterized mostly by the "loss of control" or compulsion over the intake of a substance, (4) addiction cannot be cured, but can be controlled through abstinence and some form of medical intervention or treatment that extends over the rest of the drug user's lifetime, and (5)

addiction to alcohol and other drugs can lead to other problems in the user's life such as health problems, mental illnesses, and relationship problems.[16]

The "conventional" disease concept of addiction was quickly embraced for both its personal as well as social utility. Many viewed it as a superior approach to the moral model because it removed blame and stigma from the addicts and offered them new hope (White, 2001a; 2001b). Wrapped up inside this hope is the possibility for treatment instead of punishment (Spicer, 1993). The disease concept also provided "an organizing construct, which makes it easier for society as a whole to understand, accept and deal with" (White, 2001a, p. 43).

Over the years, numerous social sciences and medical studies provided credible support for the addiction disease concept. Perhaps some of the strongest evidence for the disease model thus far has come from the biological studies of gene-environment (GE) interactions. According to the biological view, addiction is caused by physical characteristics that can lead certain individuals to abuse drugs to the point that they lose control. In fact, there is now convincing evidence that factors related to genetic, prenatal and early childhood experiences predispose individuals to develop alcohol and/or drug addiction. Numerous proband and twin studies drawing from the strengths of biologically related individuals have investigated the full extent of genetic influences. The biological closeness between twins raised separately or

[16]A detailed discussion of these assumptions can be found in White, Kurtz & Aker as part of a literature review available on the web at: http://www.bhrm.org/papers/addpapers.htm, last accessed February 15, 2011.

together as well as parent-offspring combinations enables researchers to provide estimates of the relative contributions of genes and environmental influences to alcoholism and drug addiction (Cloninger et al., 1981; Cloninger, 1987; Heath, 1989). In particular, behavioral transmission studies have shown an increased propensity among children of addicted parents to become addicted themselves. These family history studies have confirmed that to some degree "addiction runs in families" and have been able to identify familial components associated with addiction.[17]

Additionally, genetic heritability studies using twins and adopted children have also confirmed that the risk for addiction is greater for twins with addicted than with non-addicted biological parents even when the twins have been separated at birth or adopted and were unaware of their natural parent's condition (Cadoret et al., 1995; Goodwin et al., 1977; Heath et al., 1998; Kendler et al., 2000; Tsuang et al., 2001). Estimates from these studies suggest that the genetic makeup explains about 40% to 60% of people's overall vulnerability to alcoholism and, to a lesser extent,

[17]Several genes have, in fact, been identified as causing or at least linked to alcoholism and drug addiction. In particular, the D2 dopamine receptor A1 gene, for example, has been found to be more common in alcoholics and cocaine addicts (Comings et al. 1994). Researchers believe that as many as seven out of ten alcoholics carry this so-called "alcoholism gene," compared to only one in five (or two out of ten) in the general population (Hyman, 2001; Pandey, 2004; Uhl, 1999 & 2004; Uhl & Grow, 2004; Wang et al., 2004).

drug addiction (Kendler et al., 2000; Prescott & Kendler, 1999; Tsuang et al., 2001).[18]

Scientists engaged in research on biological marker have argued that genetic and bio-physiological factors play an essential role in drug abuse. Most experts in the field initially believed that reward or pleasure centers of the brain [part of the central nervous system (CNS)] may be genetically predisposed, in certain individuals, to be especially sensitive to alcohol and other psychoactive drugs, making substance use particularly pleasant and more rewarding. In contrast, for others lacking a genetic vulnerability, the effects of drugs might not be as pleasant; such individuals are not likely to become addicted to or even seek drugs. In other words, biologists have emphasized that CNS sensitivity at a cellular or molecular level determines the brain's sensitivity to psychoactive substances and this "susceptibility" has been offered as the reason why some people are particularly prone to addiction more than others (Mathias, 1995).

The strength of genetic arguments is highlighted by the tremendous emphasis in the scientific community to identify gene "markers." With all of the supporting genetic and neurobiological evidence, the "brain disease" approach to substance use and addiction (also referred to as the "biological," "medical" or simply "biomedical"

[18]Some still argue however, that, although genetic predisposition or biological markers are associated with alcoholism and drug addiction, current research has not been yet helpful in discovering direct gene effects, i.e., people's inheritance vulnerability to addictive substances (Reich et al., 1998). In other words, researchers have yet to explain how genetic factors inevitably cause drinking or lead to the consumption of drugs (Uhl & Grow, 2004).

model" (Gordis, 2001; White, 2002) has increasingly gained professional as well as public acceptance and support over time in the U.S. as well as by the larger international drug abuse scientific community. The 1990s was, in fact, proclaimed as the "Brain Decade," a period highly regarded for its numerous advances in brain-imaging technologies. Three advances in particular that have had an indelible impact on the field include the discovery of Positron Emission Tomography (PET), Magnetic Resonance Imaging (MRI), and then later on Functional Magnetic Resonance Imaging (fMRI) techniques. Since the inception of these neuro-imaging techniques, researchers and clinicians have been able to gain a more acute picture of the brain activity as it parallels the actual physical craving and consumption of psychoactive substances. The visual interface and close analysis of the underlying anatomical structure of the brain helped provide a more accurate picture supporting biological theories of drug addiction (Goldstein & Volkow, 2002).

In particular, neuroimaging studies of the "brain on drugs" have demonstrated that psychoactive substances have, without doubt, physiological effects on the brain "reward circuits," a mechanism through which "electrical impulses" (i.e., signals in the form of action potentials) are transported from one area of the brain to another. These signals are the basis for information flow in the brain and connected to the underlying capacity for thought, memory, perception and sensation. Specifically, brain imaging studies suggest that psychoactive drugs enhance the pleasure centers of the brain by causing a massive and rapid release of the neurotransmitter, dopamine

(DA).[19,20] The pleasurable feelings created, referred to as rewards, have been construed as "positive-reinforcers" that induce the individual to continue using the drugs responsible for initiating the central DA release (Robinson & Berridge, 1993).

Another advanced reason for the self-motivation view of drug use was that the brain cells become sensitized to the presence of neurotransmitters such as DA and this may be responsible for the underlying "craving" when brain levels return to their normal state and are no longer elevated (Robinson & Berridge, 1993). This "negative-reinforcer" role has been implicated as important in maintaining drug use and the development of addiction. As a result, positive (achieving a "pleasurable high" or euphoric state) as well as negative (avoiding the unpleasant feelings of withdrawal and craving) reinforcement contingencies have been suggested as the main reason for continued and even compulsive use of psychoactive substances.[21] This explanation

[19]The brain reward circuits, known anatomically as the "mesolimbic dopamine system" (MDS), involve important parts of the midbrain regions, primarily the "ventral tegmental area" (VTA) and the "nucleus accumbens" (NAc) among other forebrain areas (such as amygdala and hippocampus). These two central neuroanatomical regions are heavily implicated in the reward process: The VTA responds to the presence of drugs by releasing DA into the NAc, inducing a pleasurable experience (Bespalov et al. 1999).

[20]Although there are many neurotransmitters involved in the brain reward circuits, such as opioid peptides (endorphins), glutamate, serotonin, and gamma-aminobutyric acid (GABA), dopamine is the neurochemical transmitter most directly implicated in the reinforcement effects of all addictive substances (Tomkins & Sellers, 2001).

[21]It has also been suggested that this same brain DA system is also involved in mediating reward behavior and motivational aspects of "natural" activities such as feeding and sexual interaction, among others (Berridge & Robinson, 1998).

(referred to as the "dopamine-reward hypothesis") led to the development of a number of "reinforcement models" of drug use and addiction (Wise, 1996, 2002).

Starting in the early 1950s, several organizations, including the World Health Organization (WHO) and the American Psychiatric Association (APA), began to formally acknowledge that addiction is a disease of the brain and these influential scientific bodies endorsed the medical model of addiction (Room, 1983). Both of these highly respected professional organizations have also made important contributions to the disease model by (1) providing operational definitions and therefore "modernizing" the addiction disease concept and (2) providing standardized diagnostic criteria (a "nomenclature") for the different disorders that result from the use and misuse of drugs.

The APA, in particular, started this process by establishing a workgroup, referred to as the "Work Force on Nomenclature and Statistics," to analyze and synthesize major addiction research findings. Since 1980, the APA Work Force has also developed and continued to revise and publish a manual called "Diagnostic and Statistical Manual of Mental Disorders" (DSM) that is widely used as a guide by clinicians and researchers for the diagnosis of various forms of addiction and other mental health disorders (APA, 1994).[22] The APA began formulating the criteria with

[22]A similar diagnostic classification system has also been established by the World Health Organization (WHO) in 1951, which led to the publication of similar clinical manual referred to as the International Classification of Diseases, or ICD for short.

the DSM-I and II early on; although those initial compendia were works in progress and not considered complete. The DSM- III became widely used in 1980; it was later revised in 1987 with the DSM-III-R criteria, and again in 1994, with DSM-IV.

The current DSM-IV defines addiction as a "maladaptive pattern of substance use" (APA, 1994, p. 181) that can best be conceptualized as existing on a "behavioral continuum" ranging from "normal to pathological." When diagnosed clinically, any alcohol or drug user may fall anywhere along this continuum of severity. The generic DSM diagnosis of "substance-use related disorders" was however categorized into no diagnosis (negative), abuse, and dependence, based on a specific set of criteria[23] (each criterion defined by a specific aggregation or cluster of symptoms).

In this "hierarchical diagnostic classification scheme," drug dependence, a term often used interchangeably with the term addiction, indicates an advanced stage of drug-consumption; characterized mainly by "impaired control" over the consumption of a "drug-of-choice," craving, increased tolerance and/or withdrawal,

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The WHO ICD is currently in its 10th version (WHO, 2004), while the Current DSM manual is in its fourth edition (referred to as DSM-IV), published in 1994. There is also a recent text-revised version of the DSM (DSM-IV-TR), published in 2000.

Both the WHO and APA are currently in the process of developing newer revised and updated versions of their respective manuals. More likely, these manuals will be referred to as ICD-11 and DSM-V, respectively (Saunders & Cottler, 2007).

[23]The two categories of abuse and dependence are defined as independent substance use states, but the former can only be diagnosed if the threshold criterion for the latter state is not met. In other words, this "condition" has been made into a "conventional rule" stated commonly as "dependence takes precedence over abuse." This implies that dependence can be present with or without abuse (APA, 1994).

and continued use despite the physical, emotional and social consequences.[24] When conceived of in this manner and as a "disorder syndrome," this problematic state of drug use (defined as drug dependence or addiction) is usually specified as being with or without specific psychological and/or physiological aspects of dependence, the latter evidenced by the presence or absence of tolerance and/or withdrawal symptoms (APA, 1994). Drug dependence can therefore manifest itself with features of either psychological and/or physical symptoms or neither (Edwards & Gross, 1976).

Drug abuse, on the other hand, is essentially regarded as a level of drug use causing persistent or recurrent personal problems, such as role impairment or multiple legal problems.[25] Overall, the detailed classification of abuse and dependence provided by the DSM nomenclature added great value to the field of addiction research and gave researchers as well as clinicians useful and practical information in their attempt to understand and treat alcoholism and drug addiction. The diagnostic or nosological view is referred to as the "Symptomatic Theory of Addiction" (Lindstrom, 1992).

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[24]The DSM-IV defines seven possible criteria for the diagnosis of drug dependence (APA, 1994, pp. 176-181). The threshold to make a positive drug dependence diagnosis requires that three or more dependence criteria must be endorsed and that those criteria must occur within the same 12-months period.

[25]There are four possible DSM-IV criteria for the diagnosis of drug abuse (APA, 1994, pp. 176-181). Abuse has a simple threshold: At least one of the four criteria must be endorsed in order to make a positive diagnosis. A drug abusing person may report, however, all four criteria.

In spite of its benefits and widespread acceptance, the brain disease (or biological) model of addiction has experienced numerous challenges over the years (White, 2001a; 2001b). One challenge in particular tests that the disease model created more of the same problems it allegedly tried to resolve (Peele, 2003; Schaler, 2002). The "no-fault disease" approach, while stripping addicts from any personal responsibility, discourages them from seeking help. Furthermore, the disease model does not in fact provide an adequate framework for prevention (Peele, 1990). Addiction, according to this view, is primarily a "voluntary choice" or specifically a behavioral problem that is influenced in part by the user's biological constitution. As such, opponents of the medical model argue that addictive behavior can best be justified by the psychological, social, situational or environmental factors contributing to the drug addicted person's decision to use drugs (Schaler, 2002; Vuchinich & Heather, 2003).

Other opponents to the unavoidable disease concept debate whether the medical model is able to adequately account for the full spectrum of behaviors that are symptomatic of drug abuse and even addiction (Milkman & Shaffer, 1985). Epidemiological data lends some support for this view, suggesting, for instance, that not everyone who is a long-term "chipper," "weekend" or recreational drinker and/or drug user (also referred to as a "weekender") becomes necessarily addicted [Satel and colleagues (1998, 2001), citing national prevalence rates from the Epidemiologic Catchment Area study]. Chippers, in fact, stymie many drug abuse researchers

because they are chronic in their consumption patterns, but still able to function at high levels in society, in essence, staving off many of the negative problems that are frequently hallmark characteristics of addiction. Others cite cases of "natural recovery" from drug addiction or "maturing out" without treatment [Fingarette (1989), citing the study findings from Schuckit (1984) and Fillmore (1988); and Heyman (1996), citing Robins et al. (1974 & 1980) well-known seminal findings regarding Vietnam veterans returning stateside and naturally relinquishing their addiction to heroin]. The disease model, despite all these challenges, continues to be regarded as the "conventional wisdom" in most present day addiction treatment programs (White, 2002).

3. **Contemporary Addiction Theories**

While the brain disease model gained a significant foothold in the academic community, there has been a substantial amount of research to refine this position and provide a more detailed causal explanation of addiction in terms of brain mechanisms. This effort has managed to shift the focus away from the conventional "biological disease" (or purely medical) explanation, towards a more elaborate view of addiction, depicting it as a complex "neuro-behavioral" disorder. In these terms, addiction is not just a chronic medical disease but more importantly a neurological disorder that involves higher brain functions; including "cognitive processes," such as attention and memory as well as deficits in learning and motivation; which are

essential to the addictive decision-making processes (Mauron, 2003; Nestler & Malenka, 2004).

Proponents of this view cast some doubt on dopamine's (DA) causal role in reward mechanisms.[26] As stated earlier, the projection of dopaminergic neurons in the nucleus accumbens (NAc) has been thought for many years to be implicated in the hedonic (feeling of pleasure) and motivational (rewarding) characteristic of drugs (Wise, 1996). Again, the "hedonia hypothesis" was originally presented as strong evidence that addiction is a "reward-motivated" disorder characterized by numerous symptoms including the compulsive urge or need (craving) to consume the drug. In other words, the "liking" of a drug, caused by mimicking the brain's "natural reward system," was thought to promote the motivation (intrinsic reasons) for its use, which, in turn, was thought to promote addiction with its concomitant harmful consequences. Thus, the DA reward mechanism was thought to encourage the addict's vigorous drug-seeking and drug-taking behaviors. Support for this "pleasure" theory of addiction has been challenged within the past 10 to 15 years based on evidence from sophisticated "*in vivo*" laboratory animal studies (Shippenberg & Koob, 2002). Although this challenge does not discount the hedonic effects of drugs, the findings of several studies have been used as evidence that the brain DA activity is not necessarily sufficient, as a reward motivation per se, to account for the persistent and

[26]For a thorough review of the recent debate over the role of the dopaminergic neurons process in the brain reward system, see Salamone et al., 1975; Berridge, 2007, and Di Chiara & Bassareo, 2007.

compulsive pattern in the drug addict's behavior (Garris et al, 1999). This point of departure opens the door to consider alternative hypotheses explaining the DA functional role in the drug addiction process. Among these at least three competing theories have evolved.

One such theory holds that addiction is a "dopamine-dependent associative learning disorder" (Di Chiara, 1999). According to this theory, psychoactive drugs activate the brain motivational systems by continually "tricking" it into responding as if the drugs are biologically needed. In addition to their reinforcing or rewarding properties, addictive drugs alter the brain learning and memory processes by forming an association between the drug-rewards value ("the high") and the drug-related environmental cues [environment where drugs were taken previously, places and people associated with drugs, and sight of objects such as drug paraphernalia (e.g. syringes or smoking devices)]. This is caused by the sustained increase of DA induced by drugs and the brain's lack of "habituation" to external stimuli (Di Chiara, 2002; Wise 2002). Through this reward "associative conditioning" process, the motivation for drugs is strengthened with each repeated exposure; causing the overwhelming desire or craving that can evolve into compulsive patterns of drug acquisition and consumption habits. In light of these neural and behavioral mechanisms, addiction is hypothesized as a "disease of learning and memory" (Hyman, 2005), resulting from the impact on the addict's behavior by the midbrain DA "stimulant role" acquired by the "conditioned stimuli" or reinforcing properties.

Schultz and colleagues (Schultz et al., 1997; Schultz, 1998) advanced another theory for the DA neuron function, conceptualizing addiction as the outcome of a compulsive "trial and error" process to obtain the best future reward.[27] In this "reward-dependent" learning theory, the drug-induced midbrain-DA activity is hypothesized to reflect the anticipation ("prediction error") of drug rewards and not its actual "euphorogenic" or hedonic effects (experience of pleasure). According to this "reward-prediction-error" hypothesis, the computational role of DA firing is driven by the unpredictability of the drug reward value (i.e. "high"): The burst of neurons signals a surprising reward (positive prediction error), while the pause signals an expected reward (no difference between received and anticipated rewards). Consequently, these phasic bursts and pauses of electrical activity, which are naturally used to maximize future rewards, play a motivational role in the pathological reward-seeking behaviors typical of long-term drug users' behavior (Berke & Hyman, 2000; Di Chiara & Bassareo, 2007; Schultz, 2002).

Finally, an alternative theory of the dopaminergic function proposes that the primary role of the DA released into the mesocorticolimbic dopamine system (MCDS) is to mediate the "incentive salience" (or "noticeableness") of rewards, that reflects different motivational value for drugs than the traditional hedonic "liking" (Robinson & Berridge, 1993, 2000, 2003). Incentive salience is a characteristic of a

[27] This "trial and error" concept is taken from computational theory of "reinforcement learning", originally developed by Andrew Barto. For more details, see Sutton & Barto, 1990.

stimulus that makes the drug rewards associated with it more noticeable or important (i.e., attention grabbing), and, therefore, desirable (Berridge, 2003, 2006). This hypothesis emphasizes that extended or excessive use of psychoactive drugs can act directly as well as indirectly on the DA receptors, which may have long-lasting (and possibly permanent) effects on the brain's anatomical substrate and cellular molecular biology responsible for attributing significance to environmental stimuli (i.e., memory).

Specifically, the neurological actions of drugs on the brain's biochemistry and neuronal activity have been shown to deplete the DA from the reward pathways (the NAc, in particular), which may cause "natural rewards" (like food and water) to lose their motivational importance (referred to as motivational toxicity). At the same time, the chronic exposure to drugs is hypothesized to "sensitize" the MCDS to environmental cues or stimuli, so that the incentive salience of the perceived drug-rewards becomes pathologically exaggerated, causing the external stimulus to trigger a strong psychological motivational state of "wanting" for the drug rewards and thus the typical addict's compulsive habits (Robinson & Berridge, 2003; Ranaldi & Wise, 2002). In other words, the "incentive-sensitization" theory posits that the midbrain DA activity interferes with the "normal" decision making process by falsely enhancing the incentive-motivational properties of the drug rewards and therefore influencing the drug-user' behavior. This view suggests that the DA may be involved in the "wanting" (desire) rather than in the "liking" (pleasure) of drugs. The

psychological distinction between the concept of "wanting" and "liking" was advanced as a better explanation of why addicts continue to seek and consume drugs aggressively despite the continued threat of enormous adverse consequences (Hobbs et al., 2004).

Although the debate continues over the precise causal contribution made by the midbrain DA activity to the addiction process (Berridge, 2007), two common themes have already emerged from the three advanced "neurochemical" models or theories of addiction. First, the experimental evidence behind these theories has strengthened the view that the neurotransmitter DA is more involved in the behavioral motivation and decision of procuring and consuming drugs than just mediating their euphoric feelings. While its specific involvement is much less clear; DA activity has been found to play a key role in explaining drug addiction from the initiation of use to the end-stage of addiction, including craving and relapse even after a long period of abstinence (WHO, 2004). It is therefore quite possible that all the above theories about the role of DA are correct, they may however explain different stages in the addiction process (Volkow et al., 2003).

The second common theme to surface across the three theories of DA neuron function is their shared conceptual view of addiction. For all three theories, drug addiction is not just a "disease," but rather a complex neuro-behavioral disorder that occurs in some individuals from their chronic use of psychoactive substances. These addictive drugs have been shown to affect, one way or the other, the "normal" brain

functions, including emotions and motivations, which directly influence thought and behavior. According to this perspective, drug addiction is viewed as "an extension of normal behavioral processes" that results from the ability of psychoactive substances to influence the brain mechanism involved in decision making and behavior. Addiction manifests itself as an excessive pattern of "reward-seeking" that continues over time at the expense of most other functional activities. In other words, all three DA theories agree that addiction can best be viewed as an extreme case of drug-use habits with a behavioral control problem caused by a neurobiological alteration of the brain motivational systems.

Based on these new complex brain-behavioral models of addiction, diverse risk factors have been advanced to account for the causes of drug addiction and their variation among users. Clearly, the reinforcement properties of the psychoactive drug involved, together with the user's own genetic predispositions and other biological factors play some role in this process. There is, however, consensus that neither the drug itself nor the genes alone can generally initiate the cycle of addiction. Addicts have to decide voluntarily to initiate taking drugs and continue acquiring them. Moreover, most addiction theories agree that the desire to use psychoactive drugs and the process of addiction depend a great deal on the individual's emotional make-up as well as other contextual or environmental factors, such as the availability of the drug and its cost. These arguments come from addiction models based on two dominant social science theories: psychology and economics. Thus, in the next section, these

two approaches are presented and discussion ensues as to how each perspective informs the other.

Economic Models --- Economists have always considered behavior to be the result of an individual-based, cognitive, decision process based on an informed choice between options that are subject to specific budget constraints (or limitations). Within this framework, rationality is defined as the pursuit of happiness. Any individual "economic actor" is assumed, therefore, to behave rationally if he/she does things expecting maximum personal benefits (or utility, i.e., satisfaction derived) and he/she is aware and willing to accept any adverse consequences of such a behavior.

In the past, economists generally downplayed the study of drug use and addiction or treated it specifically as an impulsive and irrational behavior, therefore not suitable for conventional economic analysis (Schelling, 1984). Over time, however, several economic models have been proposed that offer a unique view depicting drug users as "rational," guided by his/her own self-interest. Chaloupka, Tauras, and Grossman (2000) identified three types of economic models that define addiction as myopic, imperfectly rational, or a fully rational process.[28] Within the group of rational choice models (Vuchinich & Heather, 2003), Becker's Rational Addiction Model (RAM) is often regarded as the gold standard with respect to

[28]All three models owe their foundation to the original behavioral theory of choice, the matching law (Herrnstein, 1970), which postulates that the value of drug use is a function of the relative cost/benefit ratio of its consumption. The three models differ however in their assumptions about the extent of rationality among substance users.

microeconomic theories.[29] It is frequently used to explain addictive behavior as an "intertemporal, rational process" compelling the pursuit of the best self-interest or happiness (Becker, 1962, 1993; Becker & Murphy, 1988; Stigler & Becker, 1977).[30]

Based on Rational Choice Theory (RCT), the RAM asserts that drug use, like other rational choices, is part of a solution to the consumer's expected lifetime "utility" (satisfaction) maximization. Accordingly, drug users are motivated, like all consumers who purchase a wide variety of goods, by the satisfaction or long-term happiness caused by the induced pleasure from drug consumption. In this respect, "satisfaction" (i.e., utility) is controlled or dependent on market-based economic criteria. To date, successful applications of the RAM have largely included prediction of cigarette smoking (Becker, Grossman, & Murphy, 1991, 1994; Cameron, 2000; Chaloupka, 1991; Suranovic, Goldfarb, & Leonard, 1999) and consumption of alcoholic beverages (Grossman et al., 1995; Waters & Sloan, 1995). Further extensions have included models to account for drug initiation (e.g., Saffer & Chaloupka, 1999) and for patterns as well as levels of consumption of marijuana,

[29]Becker and Murphy (1988) actually claim that the RAM has important antecedents in the literature, including the work by Ryder and Heal (1973), Boyer (1978, 1983) and Iannaccone (1986).

[30]In the RAM, addiction is not limited to drug consumption. The model can be applied to a wide range of addictive products and behaviors, such as coffee drinking (Olekalns & Bardsley, 1996), gambling, and watching TV/movies (Cameron, 1999).

cocaine, and/or heroin (e.g., Bretteville-Jensen & Biørn, 2003; Grossman & Chaloupka, 1998; Jofre-Bonet & Petry 2004; Pacula, et al., 2000).[31]

The RAM is clearly distinguished from other economic models because it regards addictive behavior as forward-looking[32] and consistent over time. What this means is that the rational component of Becker's model derives from consumer awareness of future implications of continued product selection and the weight of this awareness on current consumption decisions (i.e., rational behavior conveys forward thinking and is based on salient market information). As informed decision-makers, drug users are assumed to recognize that their addictive behavior has negative long-term consequences; however, weighing both the present and future into their consumption decision, they judge that the benefits outweigh the costs. According to Becker's model, drug users who think only in terms of present consumption (i.e., current satisfaction) are 'myopic' (or impulsive) because they do not consider the future or reflect on the potential adverse consequences of their current behavior. Discounting future implications of current consumption also underscores the fact that drug users are risk-takers, as they are willing to consume psychoactive drugs in spite

[31]Despite using different economic measures, relying on diverse samples, and applying different methodologies, these studies have provided empirical support for the RAM. In all of the examples provided, estimated models showed significant effects for price as well as past and future consumption, highlighting the basic notion that economic principles guide drug user's thoughts and actions (Caulkins & Nicosia, 2010).

[32]This feature of Becker's RAM represents a distinct departure from previous economic models; especially those based on a myopic view of addiction, where the user does not fully consider the future consequences of his/her present use of drugs.

of the detrimental consequences, and they do so because they expect the "highs" (satisfaction) to outweigh the "lows" (harm). Elaborating further on the rational process of addiction in Becker's model, Orphanides and Zervos (1995) argued that drug users do not wish to become addicts; that would in fact be entirely irrational. Drug users might not even recognize their implicit susceptibility to addiction or they simply choose to ignore it. In either case, addicts are regarded as consumers who lost a "rational gamble."

Another important feature of the economic approach to drug addiction concerns the core idea supporting the mainstream economic concept of a "rational economic man." In economic RCT, everyone is assumed to have a given set of personal tastes and preferences, referred to as a utility function (a measure of satisfaction derived from the consumption of commodities and based on the individual tastes and preferences). The model also assumes that everyone's choices are limited by the level of income or wealth accumulated, referred to as budget constraints (a measure of purchasing power). To act rationally, the "economic man" has to choose a course of action that maximizes his/her own utility function subject to whatever monetary constraints he/she faces; i.e., the "economic man" makes the best of his/her situation. Becker's RAM postulates that drug users are also rational (or competitive) as they are forward-looking people who constantly maximize their satisfaction within the limitations of their personal preferences, given their lifetime

budget, and being fully aware of the future implications of their decision (Becker & Murphy, 1988).

Yet another essential feature of the rational economic-approach to drug addiction involves the formulation of certain constructs, such as the concept of "stock of addictive capital." In the RAM, Becker assumed that, in order to become addicted, a drug user must have consumed the drug and thus reached a certain "critical level" of past drug habits or "stock of consumption capital" (i.e., addictive level based on past drug use). This concept of addictive stock is introduced in the RAM in terms of an investment function form. As a "human capital," this construct of stock of past drug use plays a critical role in the drug user's rational decision-making process. Indeed, addiction is assumed in this model to involve reinforcement and tolerance, which are mediated via the stock effect of past consumption. An increase in past addiction stock fuels the craving for present consumption because of the adjacent complementarily nature of psychoactive drugs [i.e., the marginal utility of drug use increases with experience due to its reinforcing effects (Becker & Murphy, 1988, p. 677)]. At the same time, the satisfaction from present consumption is lower when past consumption is greater due to the harmful addictive effects of drugs [i.e., negative marginal utility (Becker & Murphy, 1988, p. 682)]. Under the RAM assumptions, drug users seek to maximize their own satisfaction and, therefore, constantly compare the negative (future harm) with the positive (current satisfaction) effects of an increase in their addictive stock due to an increase in current use. The

rational decision to consume drugs requires that the marginal increase in pleasure from an increase in current consumption exceeds future harmful effects from a higher stock. In other words, the reinforcement effect must outweigh the tolerance effect (Becker, Grossman, & Murphy, 1991).

Another key concept built into Becker's model of rational behavior is the discounting of the monetary utility of drug consumption based on the idea of stable or consistent rational preferences. The RAM parameterization is based on the assumptions of perfect information regarding the potential dangerous effects of drugs and time consistency in the drug user's preferences. Taken together, these two assumptions lead to the formulation of an additive discounted value (utility) function over the lifetime stream of drug consumption with a higher weight on immediate use of drugs and a lower weight on future consumption. The assumptions behind the formulation of this exponential discount function in the RAM have recently been called into question [West, 2006 (Chapter 7)]. The end result is an alternative option to improve the model allowing for flexible preferences (e.g., Winston, 1980), hyperbolic discounting (Skog, 1999), and imperfect information to take into account the possible future regret and learning from past choices (e.g., Orphanides & Zervos, 1995). Although the more recent refinements have provided useful insights into explaining some aspects of addictive behavior, they ultimately represent "simple" modifications and/or extensions of Becker's original model (i.e., the RAM). As such these refinements maintain the assumption that drug users are forward-looking

consumers who make rational choices based on the constrained maximization of their utility function.

Through this constrained maximization, economic theory suggests that drug users pay attention to the price of drugs (as a cost measure) and that income (a measure of "purchasing power" introduced via the "budget constraints") weighs heavily in their individual decision to acquire and to use drugs. Depending on the magnitude of reinforcement and the strength of a drug's addictive properties, the actual market fluctuations in costs determine consumption patterns as a downward-sloping demand schedule (Becker, Grossman, & Murphy, 1991; Chaloupka, Emery, & Liang, 2003). This framework suggests that if the price of a drug increases, while holding income constant, demand for the drug will fall. Economists call the relationship between market fluctuations in unit price and consumption patterns 'price elasticity' (a measure of responsiveness of consumption to changes in price). In their empirical studies of smoking initiation and cessation, Chaloupka and colleagues showed that young smoking initiates, for example, attend to current market fluctuations in price (i.e., they are price sensitive), whereas older smokers decide to quit based on future cigarette prices (Chaloupka & Grossman, 1996; Chaloupka & Wechsler, 1997). Overall, economists suggest that young people and individuals with less income pay less attention to the future and heavily discount or ignore future events (including health). As a result, their economic reality is heavily based on current price (Becker, 1990). Price sensitivity among young people may be tied to

their lack of disposable income. On the other hand, older adults, especially those contemplating (or attempting) to quit smoking, may find resolve and support for quitting based on future pricing for cigarettes (i.e., they justify quitting based on the share of their income allotted to cigarette purchases).

Economists use a broad definition of price that covers not only monetary value of a product (or market unit price), but also the value of time and other costs associated with acquiring and consuming a product. Rich or poor, people must spend time to procure a product and consume it. Such time is therefore considered as an investment in 'human capital.' Given this broad definition of price, neo-classical economists suggest that 'opportunity cost,' as measured by the amount of time spent searching for goods or services and their consumption, is a reflection of market transactions related to price. In the case of drugs, time spent searching and consuming them must therefore be considered as part of the total cost of substance use given that it takes time away from other activities including work, family, or other leisure activities. It is also easy to see how 'rationality' requires a measure of opportunity cost to be incorporated into the economic explanation of drug use, even when drugs are easily accessible.

This complex economic model of addiction, involving opportunity cost and its manifest influence on behavior, can easily be illustrated. Consider that it is lunchtime on a Friday and an individual decides to purchase a drug to "enhance" their weekend activities (i.e., getting high). Also consider that the dealer is located far from the

buyer's place of employment. The buyer, needing the drug for the weekend, has to make a decision whether or not it is worth traveling across town and perhaps running the risk of returning late to work. The individual becomes torn, so to speak, by the choice of being late to work and getting chastised by their boss as opposed to procuring the drug so they can get high and party with friends over the weekend. Rationality, in this case, captures the intricate decision tree used to evaluate the various 'costs' associated with drug use and juxtaposes these anticipated costs against the perceived benefits (i.e., the high) from acquiring and consuming the drug.

In sum, the RAM is the "gold standard" of behavioral-economic model of addiction, treating drug consumption as a perfectly rational behavior, positing that drug users are assumed to be fully aware of their options and make their decision based uniquely on the maximization of their personal utility function that discounts their future pay-offs and consequences from their current drug consumption. As a result, economists believe that drug addiction responds to economic factors (e.g., monetary price, opportunity cost, and income) like any other commercial product. While many regard the RAM as a mathematically elegant economic explanation of human behavior, it has been criticized by social scientists because it fails to consider other important factors that affect drug users' decision-making processes and the context in which they make their decisions (e.g., Archer & Tritter, 2000; Elster, 1993; Rogeberg, 2003). A number of economists also argue that a rational choice does not necessarily have to be economically rational (Zafirovski, 2003). To these economists,

rational choice theory does not explain adequately how drug users actually behave in the real world or how they justify their actions (Legrenzi, Girotto, & Johnson-Laird, 1993, p. 38). In fact, an individual's decision-making process is often influenced by a range of factors that are not "utility driven" (Rachlin, 2007). Psychologists, in particular, believe that people maintain inner motivations (other than maximizing welfare) like attitudes and beliefs that influence behavior. Proponents of this view argue that motives are usually needed as incentives or reasons to carry out a desired course of action or behavior, including drug use (Miller & Rollnick, 1991).

Psychological Models --- Psychologists have had a profound influence on addiction research and treatment. Their influence began to take shape in the early 1950s around the time the American Psychological Association endorsed the disease concept of addiction (Room, 1983). Historically, numerous schools of thought in psychology proposed different theories to account for substance use problems, focusing mainly on the individual mental process that leads to behavior. Prevalent themes emphasized: (1) Personality processes, involving certain individual pre-drug use traits or characteristics such as novelty seeking, harm avoidance, and reward dependence (Conway et al., 2003); (2) Associative-learning theories, focusing on the idea that all behaviors are acquired mainly through operant conditioning (Schwartz & Lacy, 1982); and (3) Intrinsic-motivation theories, taking into account the internal states (or cognitive aspects) of the drug user such as feelings, emotions, motivations

and their influence on the decision-making process to explain behavior (Arnkoff & Glass, 1992).

Most of the psychological theories assumed people are goal-oriented and their individual behavior is seen as the pursuit and enjoyment of their goals (Klinger & Cox, 2004). Based on this common assumption, psychologists offered numerous models to address the wide range of attentional, emotional, expectance and other cognitive processes involved in choosing and pursuing personal goals.

In the case of drug addiction, it is conceivable that economists and psychologists examine the same behavior merely from different viewpoints. For instance, marginal utility, satisfaction, discounting, stock of addictive capital are all economic terms used to characterize the many factors used by an individual as they weigh or evaluate whether they will consume a product (behavioral motivation). Likewise, psychological theories use value expectancy models in which the individual weighs or evaluates the pros and cons of whether to engage in behavior. The Theory of Reasoned Action (TRA) suggests that the determining factor in behavioral choice and action is intention (Ajzen & Fishbein, 1980). Intention is assumed to be based on the combined effects of personal attitudes (subjective evaluations of importance and pleasantness), beliefs (or behavioral expectations) an individual holds about the consequences of the behavior as well as the perception of its social acceptance (i.e., normative climate). According to the TRA, the intention to act is formed when a person weighs the pros and cons (values) about the outcome

(expectancy) associated with the behavior. The attitude toward a behavior is determined by the overall expectancy-value of the behavior (Fishbein & Ajzen, 1974).

Furthermore, psychologists argue that although behavior can reliably be predicted by intention, it may not be performed unless the person is motivated to act (Coon, 2006). Motivation influences and directs behavior toward achieving the intended goal. According to Miller and Rollnick (1991), "motivation is not [however] a stable trait that exists within the person." For drug users, motivation can take two forms: a personal enjoyment or an escape from negative feelings (e.g., self-medication hypothesis (Cohen & Baum, 1995; Khantzian, 1985). Either way, the nature of drug users' motivation makes their preferences endogenous to their internal states (Bickel & Marsch, 2001). Thus, although psychologists and economists agree that drug use is a personal "choice" based on "self-interest," they approach crafting the factors that influence the drug user's choice quite differently (Vuchinich & Heather, 2003). While economists posit that drug consumption is a rational choice based on external factors such as prices and income, psychologists put forth the notion that such a choice is based on internal motivations and could be irrational or at least not completely under individual rational control [West, 2006 (Chapter 7)]. Rather than price, utility, and other market factors, psychologists propose that individuals make decisions whether to engage in behavior based on perceived behavioral sanctions from "referent others" (norms regarding what other important people regard as acceptable) and "behavioral expectancies" (perceived benefits of

behavior). In this respect, addictive behavior needs to be understood in terms of the constraints and limitations of the drug user's cognitions. According to psychologists, only those "inner limitations" can explain why drug addicts frequently behave in certain ways that might not be rational (Baron, 2000).

Bandura's Social Learning Theory (Bandura, 1977; 1997; 1999) goes one step further and offers a more complete social-cognitive framework describing human behavior. According to Bandura, intention or behavioral belief is not enough to explain behavior; in fact, intention alone cannot differentiate performance. Rather, an individual's decision to engage in a behavior, his/her relative level of persistence, and energy expend on that behavior are based on a self-efficacy formulation. Fundamentally, self-efficacy represents a cognitive schema or "impetus" that captures whether an individual perceives that he/she has the skills to cope with the situation and to engage in the behavior in question. Self-efficacy comes from past performance linked with response contingencies and is motivational because individual engages a task after evaluating their efficacy.

These and other dominant psychological theories argue that cognitive representations inside a person's head that take shape as "motivations" are responsible for an individual's behavioral activity and choice. In the psychological literature, the construct "motivation" has received a good deal of attention with respect to drug use (e.g., Cox & Klinger, 1988; Mook, 1996), primarily highlighting the role of affect regulation (e.g., Cooper et al., 1995), psycho-biological factors (e.g.,

Baker, Morse, & Sherman, 1987), and expectancy models (e.g., Mann, Chassin, & Sher, 1987; Smith, 1994; Stacy, Widaman, & Marlatt, 1990). According to expectancy theory, people drink alcoholic beverages, for example, because they believe the effects of drinking alcohol will be positive both now and in the future.

As we can see, the construct 'motivation' takes on a slightly different meaning for psychologists and economists. Economists believe that lack of income combined with drug price and opportunity cost might encourage users to network with other users in order to reduce or minimize cost and time spent procuring drugs in order to maximize happiness. Economists also believe that frequenting places where drugs are readily available results in reduced economic costs associated with a drug-abusing lifestyle (i.e., attending rave parties where there is an abundance of Ecstasy). Bars and restaurants, for instance, that make alcohol readily available during "happy hour," essentially offer a product at reduced monetary as well as opportunity costs.

Despite the relative strength of these economic and psychological arguments in studies of alcohol use, applications of these concepts together to study drug use have rarely been attempted. This suggests a tremendous need to combine these theoretical models and examine the relative influence of economic as well as psychological motivational factors in the prediction of drug user's behavior.

4. **Conceptualizing a Psycho-Economic Model of Ecstasy Use**

As mentioned in Chapter I, Ecstasy is one of several "club drugs" that has recently witnessed increased use by adolescents and young adults. The drug itself is

known to be both a stimulant and a hallucinogen, and its effects are potentially life-threatening. However, users claim that Ecstasy produces an altered state of consciousness with sensual euphoria and heightened feelings of self-awareness. It has also been associated with sexual activity and other drug use.[33] In particular, numerous studies have documented close associations between high-risk sexual activity (e.g., lack of protection, multiple partners, sexual activity while under the influence) and Ecstasy use, pointing toward evidence of causality or shared common factors, such as risk-taking, compulsivity and/or vulnerability (Cooper, Peirce, & Huselid, 1994; Justin, Finn, & Steinmetz, 2000; MacDonald, Zanna, & Fong, 1998; Schafer, Blanchard, & Fals-Stewart, 1994; Tapert et al., 2001). Increasingly, these relations are more commonly observed among adolescents (e.g., Graves, 1995; Lowry, Holtzman, Truman et al., 1994; Mezzich, Tarter, Giancola et al., 1997; Strunin & Hingson, 1992) and young adult populations (e.g., Castillo, Barrio, Belza, & De la Fuente, 1999). As with many drugs, the attractiveness of immediate gain and feelings of euphoria overshadows potential negative consequences that may be experienced down the road. This view has often had an effect on drug users' decisions in general and their addictive behavior in particular.

Sexual risk-taking and drug use are associated, due to intoxication leading to "disinhibition" or "impairment in judgment" that prompts increased sexual risk-

[33]More details on the subject can be found in Nicholas Saunders book "E for Ecstasy" published in 1993 and made available on the web at: http://www.ecstasy.org/books/e4x/e4x.ch.04.html, last accessed February 16, 2011.

taking (Murphy, Monahan, & Miller, 1998). Economic views suggest that lack of buying power and the absence of wealth may prompt drug users to trade sex acts for drugs (or for money to buy drugs of their choice), thus increasing the likelihood users can acquire drugs at minimal cost to maximize their benefit or "high."

One other area of concern revolves around linkages between psychiatric disorders and substance use. Psychoactive drugs may also be consumed to escape negative physical and/or psychological feelings. A great deal has been written about substance use as a means of regulating affective distress, its role as a palliative coping mechanism, or form of self-medication for physical and mental health issues. In particular, drugs such as cocaine and marijuana, among other substances, have been associated with depression (e.g., Johnson & Kaplan, 1990; Swaim, Oetting, Edwards, & Beauvais, 1989). In many respects, the euphoric qualities associated with Ecstasy may help mask affective disturbance or ameliorate disturbing self-referent thoughts. The possibility of third-variable alternatives including depression and/or sexual risk as valid explanations of Ecstasy use and dependence makes it essential to control for these and other motivational measures.

To summarize, the present study weaves together hallmark components representing both economic and psychological theories of addiction to account for Ecstasy use. Using external market-based factors including price and income departs significantly from the more traditional psychological views of addiction that showcase the strengths of internal characteristics and motivation (e.g., control, self-

efficacy, and reasoned action to name a few) to account for addictive processes. The common or shared conceptual underpinnings hold that individuals make choices regarding consumption based on self-interest. In psychology, the Theory of Reasoned Action, and likewise in economics, Rational Choice Theory, identify reinforcement as critical in understanding drug use and abuse (in addition both disciplines regard tolerance as important components necessary to understand addiction). Reinforcement, in economic terms, expresses the link between past and current drug use in terms of perceived utility. Increases in the addiction stock lead to increases in the utility (i.e., satisfaction) of current consumption and consequently tolerance. Because of diminishing return (due in part to tolerance to the drug), current consumption fuels future consumption. The nature of reinforcement in this decision tree (and the suggested learning mechanism that is not too distant from what psychologists' term reinforcement) considers the weight given to current consumption, future costs, and the discounting process. In psychology, reinforcement plays a prominent role in linking external activity with internal cognitive processes and ultimately expression of behavior (e.g., Bolles, 1972). Where these two approaches depart is that psychologists herald the importance of internal (unobservable) processes as a fundamental part of the decision tree, whereas economists place greater emphasis on external (observable) market indicators beyond the immediate control of the individual as influential in consumption decisions (e.g., Montoya, Atkinson, & Trevino, 2000). It goes without saying that, for a

comprehensive and adequate understanding of such a complex behavior, the confluence of both economic and psychological theories is necessary. The combination of both theoretical views might shed additional light on our understanding of drug addictive behavior bringing into scrutiny at the same time both external and internal factors. This was the objective of the psycho-economic model.

## 5. **The Proposed Psycho-Economic Model and Research Hypotheses**

Based on the above review of the most dominant theories of drug addiction, a structural equation model of Ecstasy use and its consequences was developed and tested. Figure 1 graphically depicts the conceptual framework underlying the proposed psycho-economic model. As depicted, the two major domains of influence included psychological (defined mainly by motivation to use drugs) and economic measures (income and monetary as well as opportunity costs), which are hypothesized to influence the designated outcomes of Ecstasy use (or Consumption) and Dependence (included in oval frames).[34] A third domain of influence, referred to as "Other Risk Factors," entailed personality characteristics (Risk Taking) and

[34]There is no precise definition of addiction, per se, albeit many consider "compulsive use" as a singular defining feature. There are other ways to conceptualize addiction including based on problems from continued use, which by necessity occur from consumption. "Problems from drug use" were categorized by the American Psychiatric Association "Diagnostic and Statistical Manual" (DSM) into "Abuse" and "Dependence," representing two different facets of addiction. The latter measure was chosen for two reasons, (1) dependence captures more serious consumption level, and (2) dependence problems are directly associated with the motivational strength (due to the craving and/or tolerance) that characterizes drug users compulsive behavior to procure and consume a drug. Dependence provides a viable behavioral analog to consumption by measuring the severity of the individual's drug use practices.

psychological status (Depression). Additionally, other individual characteristics (i.e., demographics) were included in a separate domain to assess the broader implications of whether immutable factors such as gender, race, age, and education would enhance the explanatory power of the model. Because variables forming each domain might measure common constructs, latent-variable methods were used in the actual model. Specifically, the psycho-economic model was hypothesized to include four latent constructs (Ecstasy Use, Dependence, Motivation, and Depression), several observed measures (income, price, opportunity cost, and risk-taking), and demographics.

In Figure 1, a straight line with a single-headed arrow indicates a causal process where one variable or construct directly influences another. A curved line with a double-headed arrow indicates a correlation, or statistical association. Thus, the relationship between Dependence and Consumption is posited as a covariance (correlation) because causal relations between these two measures are at best complex. It is common to think of using more drugs as causing more problems, or that consumption will "drive" the dependence on the drug. It is also possible that by becoming dependent, which includes physiological indicators of tolerance and withdrawal, the individual increases his/her consumption to diminish or forestall these effects, i.e., Dependence fuels Consumption. Another criterion for Dependence is continued use despite psychological problems, leading to the same interpretation. A person’s continued drug use increases their dependence but also increases their psychological problems.

Based on this theory-driven conceptual model, the following hypotheses were tested: Hypothesis 1. Economic factors such as price and income will directly influence Ecstasy consumption, controlling for psychosocial factors and other control measures.

Hypothesis 2. The psychological measures (e.g., motivation) and other intra-individual characteristics (i.e., depression and risk-taking) will influence both Ecstasy Consumption and Dependence, controlling for economic factors and other control measures.

Hypothesis 3. The combination of adding psychological and economic measures into a model of drug consumption will increase significantly the overall proportion of variance accounted for by the full set of measures.

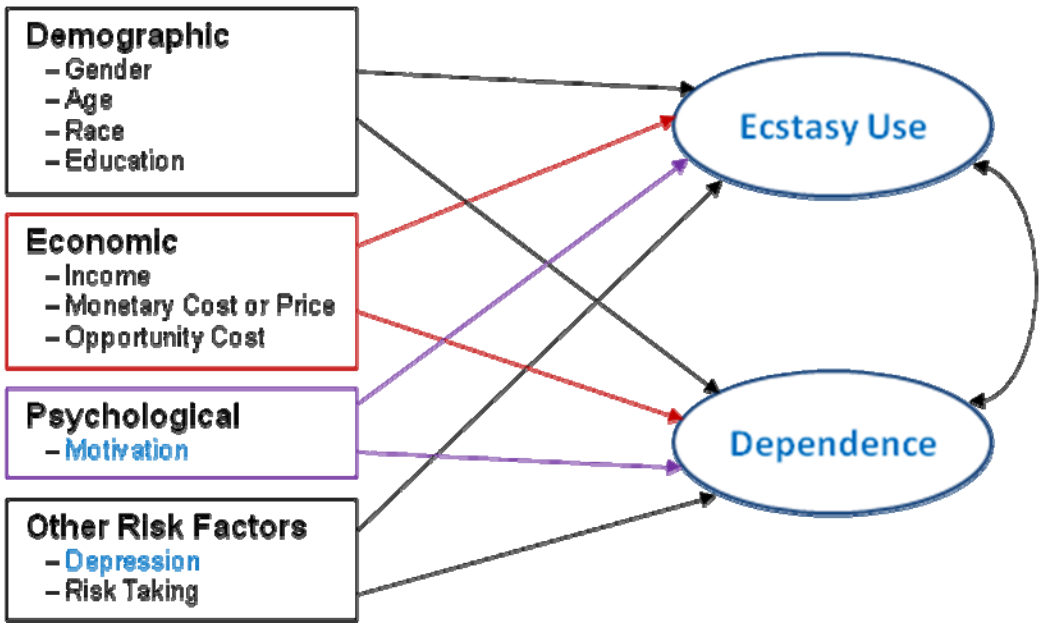



**Figure 2.1**. A Conceptual Psycho-Economic Model of Ecstasy Use and Dependence

# CHAPTER III: RESEARCH METHODOLOGY

This chapter outlines the study design and methodology used to test the specific research hypotheses addressing the proposed psycho-economic model for Ecstasy consumption and dependence. It describes the data collection procedures, assessment strategy and interview methods, sample characteristics, and measures utilized as well as their psychometric properties. The chapter then provides a brief overview of the specific parameter estimation and statistical modeling procedures used to test the study formulated hypotheses.

Like most secondary data analyses, where data has been already collected to address specific research questions, the present study faced certain challenges. Hence, the chapter begins with a discussion of several pressing methodological concerns, outlining the strategies used to address them. This is followed by a detailed description of the secondary data sources utilized, the measures available to define the economic and psychological concepts included in the model. The chapter concludes with a brief introduction to the latent-variable Structural Equation Modeling (SEM) procedure employed to estimate the model parameters. This last section also includes a discussion of the statistical indices used to gauge model fit as well as the strengths and weaknesses of SEM for theory testing.

1. **Overview**: *Study implementation challenges and their resolution*

A central challenge in testing the proposed psycho-economic model was to locate an appropriate data source that provided suitable information on drug users' consumption patterns, economic measures, and the necessary psychological measures linked etiologically with drug use behavior. Underscoring the difficulties inherent in studying drug use, Harrison (1997, p. 17) noted, "Drug use is an illegal activity and illicit drugs are illegal commodities; therefore, {drug} use cannot be measured by normal marketing procedures."

As a consequence of the potential legal consequences if caught, illicit drug users are generally inaccessible for direct inquiry regarding their drug involvement. Information regarding the use of controlled substances and related activities therefore must be obtained from alternative sources including archival records. Examples of useful official record sources include information culled from police reports about drug arrests and narcotic seizures, drug-use treatment admissions, and drug-related medical emergencies.

Information abstracted from official records offers several advantages, including immediate accessibility to the data, the potential quality of information that could be available, the unobtrusive nature of the data collection (extraction) method, and its relative cost-effectiveness. However, there are a number of limitations with this type of data source that can restrict its utility for research. In particular, information from official records may not always be entirely satisfactory and/or error

free. The accuracy of such information depends mainly on the consistency of record keeping, which may be questionable (van Kerckvoorde, 1995).

In addition to their potential deficiencies, official records on drug arrests are susceptible to administrative and policy changes. McAuliffe et al. (1999 & 2002), among others (e.g., DeFleur, 1975; MacDonald, 2002; Schmidt & Weisner, 2000), suggested that "public pressures," the "quality of leads" from "cooperating arrestees" and other "drug-trade informants," as well as "changes in funding" may exert a huge influence on drug enforcement arrests. The operation of these external forces may bias drug use data, limiting what we truly know about the actual patterns of drug market activities (McAuliffe et al., 2002). Seconding this concern, DeFleur pointed out that "these biases distorted the validity of drug arrest rates as measures of drug use to unknown degrees" (1975, p. 102).

The biggest problem with official records is that they reflect merely the "tip of the iceberg" thus providing only a snapshot of what may really be going on. In other words, official records document occurrences of individuals who came in contact with the criminal justice system or sought treatment. For example, given the fact that the prevalence of treatment is notoriously low among drug users, there is a large and inherent bias resulting from the fact that treatment records reflect only a subset of the large population of drug users.

These concerns suggest that measures of illicit drug use collected from official sources should not be used for research purposes, particularly in etiological

studies of drug use and abuse. In fact, today, more than ever, most drug addiction researchers bypass official agencies and access directly the relevant drug-using population, applying standard self-report and semi-structured interview survey methods to gather information from the drug users themselves.

Survey methods have been used routinely in social and behavioral sciences to gather information about personal, sensitive, and delicate matters, including opinions, attitudes, perceptions, and even behaviors or experiences known only to the respondent. It is obvious, for instance, that questions addressing motivations to use illicit drugs can only be obtained from the drug user. Also, given the clandestine nature of illicit drugs, survey questionnaires provide ideal tools for accessing and engaging out-of-treatment drug users who are usually difficult to reach (Cottler et al., 1996). It is therefore not surprising that self-report surveys are the most widely used means of data collection for exploring drug-users' behavior.

The basic approach to survey methods requires asking questions and recording the respondents' answers. Such a "direct method" of data collection can provide a wealth of information, including patterns of use, risk and protective factors, and consequences of use. Over time, the survey methods have become sophisticated, incorporating various improvements particularly in question design and techniques of administration, expanding its applicability to various sensitive areas such as sexual practices, victimization, and even crime (Hagan, 1993; Thornberry & Krohn, 2000).

Despite the enormous advances made in these techniques and their wide applicability, survey methods have continued to face great skepticism concerning the reliability (consistency of the collected information over time) and validity (accuracy of the data) of information obtained using this approach (Hagan, 1993). In particular, there has always been doubt about whether respondents would voluntarily disclose accurate information about their own drug consumption and reflect accurately on their habits and motivations for drug use. Whether caused by intentional distortion (due to "social desirability" or "fear of repercussions") or simply inaccurate recall (poor introspection), "response biases" associated with survey data can systematically distort and even bias the hypothesized relations between a self-reported measure and other variables of substantive interest. Despite these concerns, careful research has shown that "self-reports of drug users are sufficiently reliable and valid to provide accurate descriptions of drug use, drug-related problems and the natural history of drug use" (Drake, 1998, p. 253).

Beyond the credibility of respondents, there has also been a concern about other sources of measurement error, which may occur at any stage in a survey-based research. These concerns include but are not limited to problems of sample selection, poor questionnaire design, and inadequate survey administration (Pepper, 2001).

Methodological or measurement issues can contaminate the data, which can, in turn, reduce the precision of the models being tested and affect the power of the study. The potential effect of "measurement error" can however be avoided, if not

reduced to a negligible level, by 1) conducting a validation sub-study prior to the actual data collection, using focus groups and pilot studies to help formulate better questions that can improve the precision of responses, 2) selecting an adequate study sample size in order to have sufficient statistical power to address the research questions, 3) implementing stringent study protocols and appropriate data quality control procedures to manage the conditions of the survey administration and eliminate any possibility of interviewer-induced systematic errors in the data, 4) carefully choosing and appropriately training interviewers to improve data quality and minimize the risk to study participants (Ellsberg et al., 2001), 5) replicating the findings with different samples under the same conditions, and 6) accounting for possible residual measurement error by choosing appropriate statistical techniques for data analysis.

The concern over having error-free survey data particularly when dealing with illicit-drug users transcends finding "relevant" information to answer the research questions. It requires a thorough knowledge and solid understanding of the data collection procedures and study protocols used to assemble such information as well as implementation of appropriate statistical data analysis procedures.

Another concern stemming from reliance on secondary data analysis is the challenges of locating an appropriate and comprehensive source of data that incorporate all of the relevant information needed. Toward this end the present dissertation study was facilitated by the oversight provided by Dr. Linda B. Cottler,

Principal Investigator (PI) of the "Tri-City Study of Club Drug use, Abuse and Dependence" (CDSLAM). This federally funded study was conducted by research staff working at the Epidemiology and Prevention Research Group (EPRG), affiliated with the Department of Psychiatry at Washington University, School of Medicine.

Several factors suggest this study provides a unique opportunity for secondary data analysis: The CDSLAM is a multi-site study establishing the reliability and validity of diagnostic criteria for substance use disorders. Furthermore, the study involved specifically examining the suitability of the DSM-IV (APA, 1994) classification of "club drugs," including Ecstasy, which has yet to be classified as a separate drug category in the DSM (Cottler et al., 2001, 2009). The CDSLAM (hereinafter referred to as the "parent study") also included the largest known sample of out-of-treatment Ecstasy users, amassed comprehensive and detailed self-report data, covering most aspects of substance (alcohol and drugs, including Ecstasy) use and related consequences that are central to DSM-IV abuse and dependence criteria. Moreover, self-report data from this study was found to be highly reliable and valid (Cottler et al., 2009; Shacham & Cottler, 2009).

One other concern underscores perhaps the most significant challenge faced in this investigation. Even though the parent study provides a rich resource for developing and testing the model under consideration and answering related research questions, its data were not specifically collected for the purpose of the present investigation. In other words, the CDSLAM measures were not originally designed

with the aim of testing a psycho-economic model of Ecstasy use. For instance, in some cases, the variables of interest for testing a psycho-economic model may have been coded or treated differently than expected. To exemplify this concern, the survey questions pertaining to respondents' income were coded as categorical rather than as continuous measures. Although the categorical levels of an income measure should indeed underlie its continuous dimension, the latter type of measurement is generally more precise and therefore more informative than the former. This does not however invalidate the data in any way, but highlights the problems that may arise from obtaining data through secondary data analyses.

There are other measurement considerations that reinforce similar concerns. Economists have long debated whether current income or earnings provide an "absolute" indicator of the consumer's "purchasing power." Some suggest that other measures of economic status such as "permanent (also known as lifetime) income" or wealth should be given a more prominent role in empirical analyses of the pattern of consumption behavior (Friedman, 1956; Modigliani & Brumbergh, 1955). For drug users, in particular, this matter is even more complicated, as some users may turn to illegal and criminal activities to pay for their drug habits. There is considerable debate whether "financial reward" obtained thorough criminal activities should be considered as part of income. It is common practice, in this situation, to create a composite variable (or multi-item scale) consisting of all available information (encompassing a broad spectrum of survey items) related to potential sources of

income, and using this proxy measure to indicate purchasing power. Such an aggregate measure may require additional data transformation (dichotomizing some variables and/or re-categorizing others) and decisions regarding proper weighting schemes to enhance the formulation of a composite score (Markus, 2008). In certain instances, these same concerns were addressed in the present study through data manipulations to create unit-weighted composite scores that provide the type of information needed (Bentler, 2004; Mentzer & Flint, 1997).

Modern innovations in statistical modeling also influence the way we can test various hypotheses. For example, individuals providing information in this study responded to multiple questions about specific behaviors. As is common when more than one question is used to query a particular behavior, there was some conceptual and empirical overlap between these items, reinforcing shared variance. The moderate associations between multiple items or indicators (scales) are hypothesized to be "statistically caused" by an unobserved latent factor (also called a latent "construct'). This type of latent variable approach is common in psychological research, where researchers often infer a "hypothetical" construct based on the shared association among multiple items or indicators. Depression is one good example and problems from consumption or "dependence" provide another. In the case of depression, a person will report that they are slow to get out of bed; they experience mood swings or sad affect, and also note somatic experiences (i.e., loss of appetite). These items often appear related statistically and they are common features of

"depression." The point is that by itself, depression is not observable but rather inferred from the collection of symptoms reported. In other words, one does not "see" depression, rather one infers that a person is depressed based on a collage of symptoms or behaviors reported by the individual.

The same conceptualization of latent variable methods holds for problems that arise from chronic drug use, which is termed in the extreme form "dependence." Here a drug user taking a survey might report they cannot control their urges, cravings, or desires to use drugs and even indicate that during the day they constantly think about using drugs. The same person might also answer affirmatively that they continue to use drugs even though they experience side effects that impair their normal day-to-day functioning. In this brief example, the "inference" about a drug user's consumption is they may be addicted or dependent again based on the collage of symptoms reported and the strength of empirical association between these items.

As these two examples show, there is a conceptual argument that supports hypothesizing a latent construct, given that symptoms of sad affect, feeling blue, behavioral and somatic complaints, are all signs or markers of depression. There is also an "empirical" side to consider given that inspection of a correlation matrix containing these items would reveal modest overlap or shared variance between these items. Using covariance structure analysis a researcher hypothesizes a latent construct that statistically "causes" the association among the symptoms. In other words, the variation underlying the latent construct is attributed to the close correspondence

between the multiple measures. In the case of depression, the symptoms are observed responses on a survey but the latent construct is inferred based on the statistical association between the symptoms.

Self-report information is not always one hundred percent accurate, suffering from reliability concerns as with any measure. The problem of accuracy in recall or measurement error is just one of the many factors that can influence self-report or interview data at any moment in time. The lack of total reliability introduces measurement error into the model that can be accounted for statistically. The standard approach to deal with these measurement problems is to a) use an appropriate statistical technique that combines information from multiple indicators, b) disaggregate the measurement error using techniques from classic psychometric theory; and c) create hypothesized latent constructs to account for the moderate association among the multiple indicators. Latent-variable Structural Equation Modeling (SEM) is one of several covariance structure techniques that can handle these measurement issues in a unified statistical framework.

As detailed below, the SEM combines the strengths of confirmatory factor analysis (CFA) with multivariate structural regression. The confirmatory factor analysis represents relations between latent constructs and measured or observed indicators in a single measurement model. This portion of the model addresses how well we have conceptualized the latent factors based on the hypothesized model. The CFA provides "error-free" estimates of factor loadings indicating the magnitude of

relations between an observed (manifest) indicator and a hypothesized latent construct. The model is specified in such a way that the factor loading represents true or shared variance (representing the overlap between several items) and a separate variance term indicates the error component. Following estimation of the measurement model, the structural equation portion of the model then provides estimates of the relations between latent constructs and also between measured variables and latent constructs in a single multivariate model.

The structural component is unique in that it can estimate several multiple regressions simultaneously posting both independent predictors and dependent outcome measures (both latent and observed). Combining the measurement and structural portions of the model into a single overarching framework increases the reliability of the model, provides a more parsimonious way to represent the multiple relations, and increases power. For these reasons a latent-variable SEM procedure was used to test a psycho-economic model of drug use and abuse in this study.

Having discussed the conceptual and methodological challenges faced by the current investigation and the appropriate resolutions, the next sections in this chapter present the research data used and the method of statistical analysis used to test a latent-variable psycho-economic model of Ecstasy consumption and addiction.

## 2. **Data Source and Concepts Measurement**

This section begins with a description of the parent study, the "Tri-City Study of Club Drug use, Abuse and Dependence" (CDSLAM). It includes formal discussion

of the study design focusing on participants' eligibility and recruitment, survey instruments, research protocols, and data collection procedures. The section ends with a presentation of the measures used to test the psycho-economic model.

**The CDSLAM Study**: *An Overview*

The CDSLAM is a multi-site study funded in 2001 by the National Institute on Drug Abuse [NIDA, (R01 DA14584)],[35] Generally speaking, the CDSLAM was designed to examine whether club drugs (i.e., Ecstasy, Ketamine, GHB, and Rohypnol) form a separate class of psychoactive drugs, requiring their own set of DSM diagnostic criteria. The DSM or "Diagnostic and Statistical Manual of Mental Disorders" currently in its fourth edition (DSM-IV), contains the official diagnostic nomenclature of the American Psychiatric Association (APA, 1994). Specifically, the CDSLAM was designed to 1) ascertain the utility of using the DSM-IV diagnostic criteria for each specific club drug, including tolerance, withdrawal, loss of control and other social and personal consequences; and 2) assess the reliability and validity of club-drug users' self-reported drug use practices and habits and any associated problems and consequences that stem from continued drug use.

The CDSLAM study recruited out-of-treatment, club-drug users starting in November, 2002 to January, 2005. Participants were drawn from geographical areas indicated by NIDA's International Epidemiology Work Group (IEWG) surveillance network as "emerging or current high-risk areas" for club drugs (IEWG on Drug

[35]NIDA is one of many centers and institutes forming the National Institutes of Health (NIH).

Abuse, 1999). Three sites were selected: St. Louis [Missouri, US; PI: Dr. Linda B. Cottler, Ph.D. - Washington University (data collection lasted between 2002 and 2004)], Miami [Florida, US; Co-Investigator (Co-I): Dr. Jim A. Inciardi, Ph.D. - University of Delaware (2002-2004)], and Sydney [New South Wales, Australia; Co-I: Dr. Jan Copeland, Ph.D. - University of New South Wales (2003-2005)].

Trained interviewers located at all three sites received the same instructional procedure and followed the same research design and study protocol, including identical subject recruitment procedures and applying the same assessment strategy. Potential study participants were presented with detailed information at each site outlining the purpose of the study and their rights as research subjects. Participants were also told that their information was completely confidential; written consent was obtained from each participant prior to the start of the interview. All human subject and study protocol procedures for data collection received approval from the three respective institutional review boards.

*Research Design* -- The CDSLAM project employed a mixed-design approach (Green et al., 1989), combining elements of both quantitative and qualitative research methods (Creswell & Plano, 2007). Specifically, the study was carried out in two phases. The first phase involved focus group discussions (unstructured "group" interviews) that were used to engage club drug users in discussion about their consumption preferences. Focus groups are part of an exploratory qualitative (ethnographic) phase that provides in-depth information

confirming special idiomatic expressions used to describe drug-related experiences and how individuals "think" about socially or culturally taboo subjects.[36] This ethnographic component of the study was done to acquire a better understanding of the subculture and the contextual factors that promote club drug use. The groups were audio taped and then transcribed, coded, and analyzed to develop an understanding of the thoughts, feelings, and behaviors described by the respondents (Reich et al., 2006). The findings from the focus groups were then later used to guide the development and/or refinement of the survey questionnaires used in the quantitative portion of the study.

The second (or quantitative) phase of the CDSLAM project involved psychometric evaluation, including establishing the reliability and validity of self-reported data pertaining to the potential abuse and dependence liability of each club drug. This phase also involved establishing the psychometric properties of various risk factors that have been suggested in the literature as putative causes of drug use and drug consequences. This phase began with a pilot study conducted in each site to determine the applicability, acceptability, and practicality of the questionnaires that have been developed and further revised based on the focus groups information.

The pilot study focused first on comprehension issues (e.g., clarifying terminology, and gaining insight whether respondents had difficulty answering and/or

[36]Focus groups are a common practice in behavioral science and entail group discussion involving anywhere from 8 to 12 individuals who informally "chat" about some topic of interest. The topics are presented in order by a moderator or trained facilitator and the group discusses the topic from several different angles.

interpreting questions) and the flow of the questions asked (e.g., problems with interview skip patterns). Members of the evaluating team [including the study PI, Co-PIs, Project Director (or Coordinator), and interviewers (or raters) hired in St. Louis] took turns experimenting with the assessments by interviewing each other. Findings from this intense pilot test were subsequently used to revise and improve the computerized interviews.

The computerized version of each assessment was carefully tested locally for contents (e.g., no spelling errors or missing survey items) and programming errors. Next, all the assessments were tested by conducting interviews with a small (5 to 10) number of drug users in each of the three sites for final pilot validation. The information gathered from this step was also used to correct or refine the final version of the computerized instruments. The revised questionnaires were finally implemented first at the home-study site, St. Louis, and then distributed to the other sites for their own data collections.

The instruments for the CDSLAM project were administered to the same individual at two separate (about one week apart) occasions (referred to as "Time-1 & Time-2" interviews or "test-retest"). A different lay interviewer was used at each time to provide estimates of inter-rater reliability (i.e., assessing the concordance of the interview process). A diagnostic validation component included a semi-structured interview that was later administered (Time-3) by a certified clinician. Additionally, the test-retest component included a short debriefing and a Discrepancy Interview

Protocol (DIP) to identify the reasons for inconsistencies between the respondent's answers at Time-1 and Time-2 interviews. Tests of research hypotheses for the psycho-economic model rely on Time-1 interviews only.

*Subject Recruitment* -- The CDSLAM study recruited out-of-treatment, community club-drug users in order to ensure a broad cross-sectional representation of the research sample. Given the difficulty in randomly (probability) sampling such a hard-to-reach, illicit-drug-using population, the CDSLAM sampling plan used a modified "non-probability" approach, combining "targeted" sampling (Carlson et al., 1994; Watters & Biernecki, 1989) with a "chain-referral network" or "respondent-driven" sampling technique that draws on the drug users' social networking familiarity (Heckathorn, 1997).

Both sampling methods have been widely applied to reach hidden or "hard-to-reach" populations including drug users (Heckathorn et al., 1999, 2002; Semaan et al., 1998; Peterson et al., 2008). Also, since the parent study emphasized establishing the psychometric properties of DSM-IV adopted criteria for club drugs use, it did not require validating prevalence information, making the applied sampling techniques appropriate. More importantly, the combined sampling procedures minimize as much as possible their respective sources of biases[37] and create statistically representative

[37]This concern refers to the potential biases associated with a) the volunteerism in target sampling (participation from interested subject only) and b) the selection of initial respondent in chain referral sampling (i.e., referring subjects that are behaviorally similar through peer or friendship "selection" mechanisms: Salganik & Heckathorn, 2004).

samples of hard-to-reach subjects (Heckathorn, 2002; Magnani et al., 2005; Robinson et al. 2006; Salganik & Heckathorn, 2004).

Based on the combination of these two sampling methods, a number of distinct subject recruitment techniques were implemented to ensure diversity in the final sample. Recruitment efforts included posting and/or distributed flyers in public areas and locations frequented by young adults, including dance clubs and bars; running advertisements in local newspapers; postings in high-school and college newspapers; internet postings on bulletin board systems, blogs and social network sites (such as "FaceBook" and MySpace); and referrals from the community.

Additionally, the study also used respondent-driven recruitment techniques (Watters & Biernacki, 1989). Once the Time-2 interview was completed, recruited participants were asked to refer acquaintances and friends from their social networks. An incentive of $5 was offered for each recruited referral.

Potential participants approached directly on the streets or referred to the study were briefly informed about the study aims and given a flyer providing them information on the CDSLAM project. The flyer included the local study-site phone number that participants were asked to call to find out more about the study and/or to confirm their willingness and eligibility to participate. During the call, a trained Research Assistant (RA) verified the caller's eligibility and addressed relevant questions about the study.

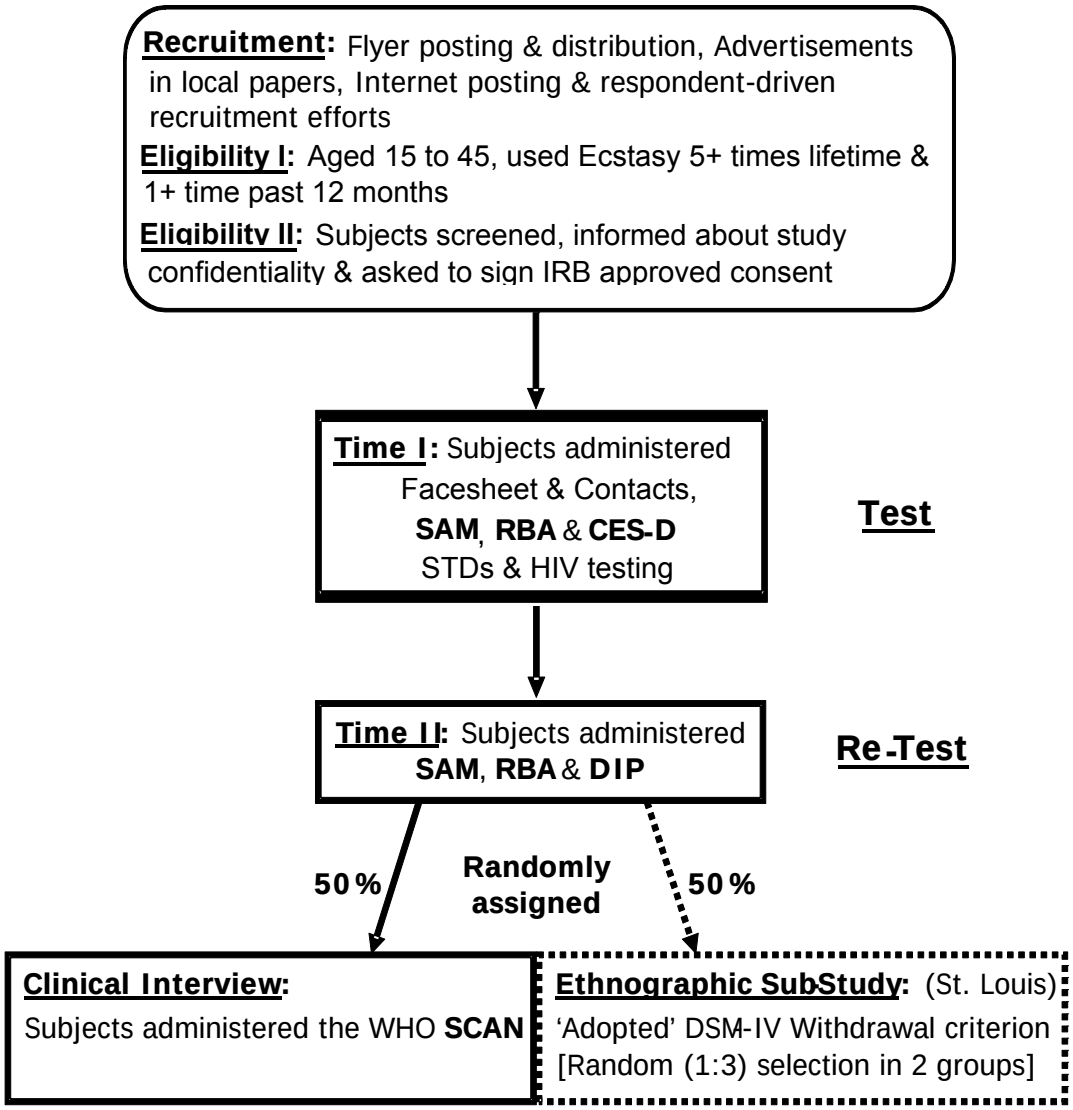
To be eligible for enrollment in the quantitative study phase, participants in all three sites were required to be between 15 and 45 years old, and to have used at least one club drug (i.e., Ecstasy, Ketamine, GHB, and Rohypnol) more than five times lifetime, with the most recent use occurring within the last 12 months.

In addition to these study eligibility criteria, potential participants were also required to a) provide a signed parental permission for legal minors, younger than 18 years; b) have not participated in the study's prior focus group phase; c) be willing to take part in potentially three interview sessions within a 10 days period; and d) speak and understand English, as all interviews were conducted in English. Once eligibility of the prospective calling-participant was determined, a verbal consent was sought while on the phone and Time-1 & 2 interviews were scheduled.

*Study Protocol and Procedures* -- Figure 3.1 below outlines the CDSLAM study protocol and "timeline" (i.e., flow chart) for the procedures and measurements used. The three study sites followed this same protocol for data collection with two non- essential exceptions to the current investigation. Specifically, St. Louis, the home-study site, had an additional ethnographic sub-study aimed to provide an in-depth understanding of Ecstasy withdrawal and tolerance. In addition, Sydney participants were not tested for "Human Immunodeficiency Virus" (HIV) nor were

they tested for other sexual transmitted diseases (STDs), such as Chlamydia, Gonorrhea, hepatitis B and C, Herpes and Syphilis.[38]

**Figure 3.1.** CDSLAM Study Flowchart for the Psychometric Testing Phase




[38]STDs and HIV testing was required by NIDA for all studies among drug users conducted in the US. More details on this requirement can be found on the following NIH web site: http://grants1.nih.gov/grants/guide/notice-files/NOT-DA-07-013.html, last accessed February 17, 2011.

As Figure 2 shows, the qualitative phase included three interviews: the two test-retest (reliability) interviews and an in-depth clinical (validity) or ethnographic interview.[39] For the reliability arm of the study, all confirmed eligible subjects were required to participate in at least two interview (Time-1 & 2) sessions. After the second interview (Time-2), respondents were randomized to have either a clinical or an ethnographic interview.[40] At all three sites all of the interviews were conducted by independent interviewers.

Prior to initiating Time-1 interview, each participant was provided important details about the study, consented in writing, and informed that all information gathered are protected (using a NIDA Certificate of Confidentiality) and treated as confidential.[41] At that point, all participants were reminded that one of the aims of the CDSLAM study was to examine item-specific reliability of DSM-IV criteria as adopted for club drugs, based on their Time-1 & 2 interviews. They were also told that the same questions are asked at both interviews and that the same answers could be given each time. Additionally, study participants were advised that they could

[39]Reliability refers to the extent to which, if repeated, the same questionnaire leads consistently to the same answer. Validity, on the other hand, refers to the extent to which the questionnaire measures what it is supposed to measure (Joppe, 2000).

[40]Randomization to the ethnographic interview applied to St. Louis participants only. Participants in Miami and Sydney where only randomized to have the clinician interview.

[41]Several steps were taken to assure the confidentiality of data, including de-identifying each individual record and storing the final data on a secure and privately managed server. Only research staff with the highest investigator clearance could access personal records (FaceSheet & Contact data). All data were only accessible through password protected files and secure servers.

withdraw from the study at any time and that there would be no penalty or loss of compensation. Following a discussion of these study and other ethical issues, detailed locating information on each participant was solicited to facilitate mailing study reminders and/or tracking each one for follow-up (Time-2) interviews.

After gathering the locating information, urine and hair samples were collected from each participant in all three sites and analyzed for marijuana, cocaine, heroin, PCP, and methamphetamine. The urine samples from St. Louis and Miami participants were also tested for the presence of STDs. Additionally, oral fluid collection device, "OraSure®," was used to test participants in St. Louis and Miami for HIV/AIDS and other STDs. All HIV tested participants received counseling regarding HIV infection and were given up to one hour of individualized pre- and post-test counseling, as required by the funding institute (NIDA). Following the collection of biological specimens, the Time-1 interview proceeded. A week later, each participant was invited back for Time-2 interview.

Once Time-2 interview was completed, all participants were interviewed with the Discrepancy Interview Protocol (DIP) to determine the reasons for any differences in their answers at both times (Cottler et al., 1994). Immediately after completing the DIP interview, each participant was handed a sealed envelop concealing their random assignment to the validity portion of the study, including the clinical interview (referred to as Time-3 interview). In each site, only half of the participants were randomly selected and scheduled for a clinical appraisal. The other

half were either told that the study was completed or invited to participate in a one-on-one ethnographic interview to discuss their experience with tolerance and withdrawal from club drugs.[42] The clinician (or Time-3) interview was conducted using a revised substance use section of the World Health Organization (WHO) Schedules for Clinical Assessment in Neuropsychiatry (SCAN). Either (the clinical or ethnographic) interview was conducted within the next four days following Time-2. The clinician as well as the ethnographic interview took less than one hour each.

*Interviews Setting and Quality Control* -- All interviews were conducted face-to-face by trained interviewers and a certified clinician in private settings (study-site office building, mostly) and behind closed doors to assure privacy. In each site, recruited interviewers underwent a week-long formal training on the protocol and the study assessment tools. The training was conducted by a St. Louis team, including the Principal Investigator (PI) and the Project Director, in all three sites. After the group training, interviewers were required to pass a final quality control check (a "mock interview") prior to interviewing in the field.

Throughout the project, interviews were audio-recorded and their electronic medium was mailed to the St. Louis site for quality and accuracy evaluation. At the start of the data collection, all audiotapes of each interviewer were reviewed in their

[42]Only St. Louis participants had these options. Miami and Sydney participants, who were not selected for clinical interview, were basically told that the study required no further participation after the Time-2 interview. The selection for the ethnographic interview was not randomized. Instead, it was based on whether the participant has endorsed tolerance and/or withdrawal symptoms, and was not eligible for the clinical (Time 3) interview.

entirety by an experienced Quality Control supervisor. Later on during the study, a random sample of 20% and then 10% of each interviewer's tapes were reviewed to ensure quality of the data. Feedback on each reviewed tape was immediately sent to their appropriate site for the local Project Coordinator to discuss with the interviewers. In addition, teleconference meetings involving all three sites were held on a regular basis during which the Project Director, and Coordinators discussed the project progress and site specific issues. Participants were remunerated up to $70 as a compensation for their time and inconvenience completing up to three (Time-1, Time-2, and clinical or ethnographic) interviews.

*Study Instruments* -- The purpose of the CDSLAM quantitative phase was to collect information about various aspects of club drugs consumption and related consequences. Five standard research questionnaires were selected to fit the study areas of interest, revised to focus mainly on club drugs, and evaluated in terms of their content, depth, sensitivity, and responsiveness as described earlier. The originally selected survey questionnaires were: The Substance Abuse Module (SAM), The Risk Behavior Assessment (RBA), The Center for Epidemiological Studies Depression Scale (CES-D), The Discrepancy Interview Protocol (DIP), and The WHO Schedules for Clinical Assessment in Neuropsychiatry (SCAN).

After revisions, the selected assessments were computerized for ease of use and to minimize interviewers' mistakes. The first four (SAM, RBA, CES-D, and DIP) instruments were used for the test-retest interviews [or reliability (Time-1 & 2)] while

the fifth (SCAN) instrument was used by the study clinician during the validity interview session (Time-3). Data gathered for the current investigation were derived directly from Time-1 interview, using the SAM, RBA, and CES-D instruments only. The remainder of this section provides a brief history and a description of each instrument.

*Substance Abuse Module for Club Drugs (SAM-CD)* – The SAM-CD was a revised version of a preexisting instrument known as the Substance Abuse Module (SAM: Cottler et al, 2001). The original SAM (CIDI-SAM: Cottler, 1990) was an expansion of the substance use disorders (SUD) sections of the Composite International Diagnostic Interview (CIDI Version 1.0, WHO 1987; Robins et al, 1988; Robins, Cottler & Babor, 1990), which itself was an amalgamation of two preexisting instruments at the time: The Diagnostic Interview Schedule (DIS) developed at Washington University (Robins et al., 1981) and the Present State Examination developed at the Institute of Psychiatry, London (Wing et al., 1974).[43]

The CIDI was initially the product of a collaborative effort led by the World Health Organization (WHO) and the former Alcohol, Drug Abuse and Mental Health Administration (ADAMHA) [parent agency of the three current NIH institutes, including: National Institute of Mental Health (NIMH), National Institutes of Alcoholism and Alcohol Abuse (NIAAA), and National Institute on Drug Abuse

[43]The CIDI-SAM represents the third-generation of diagnostic schedules for psychiatric disorders. See Robins (2004) for a detailed account of the historical evolution of the current psychiatric instruments.

(NIDA)] to facilitate collaborative psychiatric epidemiologic research throughout the world. Robins and colleagues from Washington University led the Psychiatric Assessment Task Force effort in the development of the original CIDI (Robins et al., 1988).

The WHO-CIDI (CIDI-Core) is a fully-structured diagnostic interview designed for use by well-trained lay interviewers, who are not necessarily clinicians, to assess lifetime as well as current mental disorders according to the definitions and criteria established by the two most widely endorsed diagnostic systems: the WHO International Classification of Diseases (ICD) and the APA Diagnostic and Statistical Manual (DSM) for mental and behavioral disorders (WHO CIDI, 1990). The CIDI-Core questionnaire was intended to "serve cross-cultural epidemiologic and comparative studies of psychopathology" (Robins et al., 1988, p. 1069). In field trail testing across 18 sites in major geographic regions of the world during 1988, the CIDI-Core was reported to be generally reliable and valid (Wittchen et al., 1991). However, certain symptom questions and diagnoses for substance use disorders (SUD) were reported difficult to understand, had less then ideal reliability, and therefore required further revisions for a better acceptability and consistency across cultures (Cottler et al., 1991).

The CIDI-SAM, which started as a revised version of the SUD sections of the WHO-CIDI (Cottler et al., 1989; Cottler, 1990; Cottler & Compton, 1993), was soon expended to thoroughly assess psychoactive substance use, abuse, and dependence

based on criteria for DSM-III, DSM-IIIR and ICD-10 diagnostic systems. Over time, the CIDI-SAM has undergone further refinement and expansion and started being referred to as the SAM (Version 4.1). In 1992, the SAM was updated to include DSM-IV SUD taxonomy; was subsequently computerized in 1998 (C-SAM); and field tested for validity in 2000 by its developer Dr. Cottler and her Washington University team with support from NIDA (DA05585) (Cottler et al., 2000). The C-SAM has also been used in numerous "nosological" (i.e., classification of SUD) studies in the U.S. as well as abroad and was deemed to be acceptable with good to excellent psychometric (reliability and validity) properties (see, for example, Compton et al., 1996; Cottler et al., 1993, 1995, 1997, 2001, 2009; Horton et al., 2000; Howard et al., 2001).

Consistent with its parent interview format (the CIDI), the SAM is a highly structured instrument with closed-ended questions; each question included specific instructions for the interviewers. The SAM instrument contains five sections: Section A covers socio-demographic questions, Section B is reserved for questions relating to tobacco, Section C contains alcohol questions, Section D asks about drug use, and Section E deals with caffeine.

More specifically, Section D assesses lifetime as well as current (in the past 12 months) abuse and dependence on substances and categories of substances used more than five times lifetime such as those defined by the DSM and ICD taxonomies. These substances include: cannabinoids (marijuana and hashish), cocaine and crack,

hallucinogens (DMT, LSD, acid, mescaline, mushrooms, peyote and psilocybin), inhalants (glue, toluene, gasoline, paint and paint thinner), opiates [opioids (codeine, Darvon, Demerol, Dilaudid, methadone, morphine, Percodan, and Talwin), opium, T's & blues and heroin], PCP, stimulants (amphetamines, diet pills, Ritalin, or any other stimulant), sedatives (barbiturates, Librium, Seconal, sleeping pills, tranquilizers, Valium, Xanax, or any other sedative), and other miscellaneous substances (amyl nitrite, poppers, anabolic steroids, and nitrous oxide).

The SAM for Club Drugs (SAM-CD) included additionally a specific category for club drugs with individual questions for Ecstasy (or MDMA), GHB, Ketamine, and Rohypnol. The SAM and its predecessors contain numerous questions about symptoms from the use of each specific drug. The nosological classification of DSM divides these symptoms into those operationalizing abuse and dependence. An example of an abuse symptom includes "getting into physical fights" whereas a dependence symptom includes "continued use despite physical health problems." To gain clarity on these conceptual distinctions consider that abuse (either symptoms or criterion) refer to functional impairment in day-to-day functioning with regard to role responsibilities (obligations of work or social functioning), legal problems, or disruption to home life.

Dependence symptoms, on the other hand, are those reflecting physiological manifestations (withdrawal and tolerance) and continued use despite warning signs of psychological or physical health problems (this is only meant to exemplify the bi-

axial formulation). According to the DSM classification rules, the individual symptoms are then bundled into aggregate clusters or "criterion," which is then used to make clinical diagnoses of abuse or dependence, the latter two categories used to define substance use disorders as a basis for understanding addiction.

A distinguishing feature of the SAM is its ability to provide information regarding age of onset and most recent occurrence of each of the bundled criterion, as well as the individual withdrawal symptoms, and specific physical, social, and psychological consequences of each substance. This information is then used to estimate duration and course of the individual symptoms as well as to formulate the criterion. Coupled with this information, additional data on the quantity and frequency of use are then used to judge the severity and course of each disorder. The SAM also provides an evaluation of each respondent's substance use impairment and treatment history.

*Risk Behavior Assessment for Club Drugs (RBA-CD)* – The RBA-CD was adopted from the Risk Behavior Assessment (RBA) questionnaire, which was originally developed by the National Institute on Drug Abuse (NIDA) in the early-1990s as a standard method for collecting HIV risk-taking data related to drug abuse and sexual behaviors at the community level (NIDA, 1991). The original RBA was first used in a NIDA-funded, multi-site study conducted during the 1990s entitled "Cooperative Agreement on AIDS Community-Based Outreach/Intervention

Program" (CA). The study targeted out-of-treatment crack-cocaine and injection drug users and included 38 cities throughout the U.S.[44]

The RBA was designed to identify risk factors for HIV acquisition and transmission. It was specifically used to collect self-reported data on socio-demographic characteristics (e.g., gender, age, race, education level attained, past 12 month employment and income, as well as general health status), recent drug use behaviors [including drug use patterns, injection drug use (IDU) habits, and drug use treatment history], and sex practices (e.g., type and number of sex activities, number of male and female sex partners, condom use patterns, sex trading behaviors, and perceptions of risk as well as belief in risk reduction behaviors). All questions pertaining to drug use practices and sexual behaviors refer to past 30-days period from the interview date to reduce "response biases" that could be attributed to inaccurate recall. The drug section covers also last 48 hours drug usage, corresponding to the approximate maximum time period during which urinalysis is sensitive for drug detection. The reliability and validity of the original RBA questionnaire has been thoroughly tested with favorable results. In particular, the drug-use questions have been found to have excellent test-retest reliability and good

[44]Dr. Cottler and the EPRG team were one of several NIDA grantees on the CA study tasked with conducting a randomized intervention study (referred to as "Each One Teach One [EOTO], conducted from 1993 to 1999). The study focused on providing educational information on the risk of transmission of HIV and STDs among crack-cocaine users and drug injectors in St. Louis (Cottler et al., 1998). Dr. Cottler was a member of the NIDA consortium of CA-funded researchers who developed the original RBA.

concurrent validity as demonstrated by the urine test (Dowling-Guyer et al., 1994; Edwards et al., 2007; Needle et al., 1995; Weatherby et al., 1994).

Over the past few years and in response to specific study requirements, Dr. Cottler and the EPRG team at Washington University have made several revisions to the original RBA to increase its utility with female drug users, heavy drinkers, and offenders; as well as male and female inhalants users and club drug users. For the CDSLAM study the RBA was significantly modified based on the findings from focus group discussions (qualitative phase of the CDSLAM study) and refined later through several rounds of pilot-testing, as described earlier.

The RBA has always been used to enrich the data provided in the SAM, which serves primarily a diagnostic purpose. The RBA for Club Drugs (RBA-CD) focused not only on HIV risk-taking behaviors, as they relate to drug use and sexual behaviors, but also on situations and events that could shed more light on the abuse and dependence liability of each club drug; such as bingeing, concomitant use of over-the-counter drugs (like 5HTP) to "come down," school or work performance, and parental monitoring history. Additional information on the reasons for drug use, rave party attendance, religion and music preferences, and perception of harms were also added. The original sections on IDU habits (needle sharing) and sex practices were replaced with more relevant questions about sex practices while under club drugs influence as well as sharing drugs at parties.

The RBA-CD assessment also included questions to gather a wide range of economic data; such as drug availability, dealer access and user network, lifetime quantity of each club drug used and other detailed information on past 30 day consumption, actual price paid last time using a particular drug as well as respondent's own expected price, employment, current income and other relevant information detailing sources of income. The RBA-CD has been found to have good test-retest reliability (Shacham & Cottler, 2009).

*The Center for Epidemiological Studies Depression Scale (CES-D)* – The CES-D is a 20-item self-report scale developed by the NIMH based on previously validated scales for depression (Radloff, 1977). The CES-D scale covers several aspects of depression within the past week (last 7 days). The items include depressed mood, lack of concentration, feeling of guilt, sadness and worthlessness, crying spells, loss of appetite, and sleeping disturbance, among others. All 20-symptoms are scored on a 4-point scale, ranging from rarely to almost always and four items are reverse coded for scale consistency. Validation studies with clinical populations have established well defined total scoring ranges: less than 15, indicating no endorsement of major depressive symptoms; 15-21, mild to moderate depression; and over 21, indicating major depression. The CES-D has been extensively used as a screening tool for assessing current depressive symptomatology in clinical as well as research settings using general population samples. Several branches at the NIH have used the CES-D questionnaire in their large, multi-site studies of diverse populations due to its

excellent psychometric properties among general population samples (Beals et al., 1995; Golding & Aneshensel, 1989). The CES-D has been shown to have very high internal consistency and adequate psychometric properties among youth and young adults.

*Interview-Time Requirements* -- Time-1 interview sessions required between two and three hours. The CD-SAM took approximately 60 minutes, the RBA-CD took a minimum of 20 minutes, and the CES-D about 10 minutes. In addition, each participant spent about 20 minutes on average providing locator information to facilitate tracking during follow-up interviews (Time-2 & 3). It was also estimated that respondents traveled 30 minutes on average to get to the interview site. Participants in the CDSLAM quantitative data collection were able to receive up to a maximum of $120 U.S. dollars in monetary compensation for their participation in three different time period interviews. The incentive included compensation for assistance with recruitment.

*Study Sample* -- The use of multiple sampling techniques (described earlier) in combination with the PI's weekly-meeting monitoring-system for recruitment progress proved to be a highly effective recruitment strategy. A total of 1084 individuals from the community responded to the targeted outreach efforts (e.g., flyers, newspaper ads as well as electronic advertisements, to name a few strategies) and respondent's referrals. As was described above, an initial eligibility screening was performed over the phone. Of the 1084 subject contacts, 157 (14%) respondents

were immediately found ineligible through the telephone screen. The remaining 927 callers were invited to enroll in the study upon a final in-house determination of their eligibility. At this point, an additional 9 respondents were eliminated. As a result, 918 individuals consented and were enrolled in the study across all three sites [439 (48%) subjects in St. Louis, 317 (34%) in Miami, and 162 (18%) in Sydney]. Out of the 918 enrolled respondents, 269 (29%) never showed up to their Time-1 interview and 649 were interviewed, yielding slightly more than a 70% overall recruitment response rate.

Additionally, 5 (0.5%) respondents were eliminated for various reasons; including relocation too far for staff to conduct cost-effective interviews, the participant withdrew from the study or was noticeably intoxicated on some substance during the interview. Among the remaining 644 surveyed respondents at Time-1, 4 did not have complete information on all the study variables needed for this investigation and were therefore eliminated, leaving a final analysis sample of 640 participants [296 (46%) subjects from St. Louis, 186 (29%) from Miami, and 158 (25%) from Sydney].

**Measurement Specification**

Data for the present modeling efforts were gathered from 83 questions that appeared in five sections (Socio-demographics, Ecstasy use, Ecstasy abuse and dependence, depression, and HIV-related sexual risk behaviors) of the three assessment batteries described earlier (SAM-CD, RBA-CD, and CES-D). All of the

questionnaire items were used in the construction of measured indices (or multi-item scales). For some measures a single questionnaire item was used. When multiple indicators were used to reflect latent constructs, these indicators were generally constructed with several items averaged, or in some cases a summed unit-weighted index was created. The three different approaches to creating measures are briefly described below.

*Ecstasy Use* -- Four measured indicators reflected a latent construct of Ecstasy "Consumption," one of the two main outcomes or dependent measures used in this study (labeled 'Ecstasy Use'). These included:

- A measure of lifetime number of pills used [The RBA-CD asks (QNTYLT): "If you were to add up all of the Ecstasy pills you have used since you first started using Ecstasy, about how many pills would that be?"], with response values recoded in increments of 10 pills ranging from 'Less than 10 pills' (coded as "1") to 'greater than 100 pills' (coded as "11");

- Number of times using Ecstasy in the past 30-day period [The RBA-CD asks (TMSP30DAY): "How many days have you used Ecstasy or MDMA in the last 30 days?"], with responses coded in terms of total number of days used;

- Frequency of Ecstasy use per day in the past 30-day period [The RBA-CD asks (FRQP30DAY): "During these days {when you used}, how many times a day did you usually use Ecstasy or MDMA?"], with responses coded in terms of number of times Ecstasy was consumed per day;

- A measure of recency of Ecstasy use [The SAM-CD asks (RECENT): "When was the last time you used {Ecstasy}?"], with response categories ranging from 'within past 30 days' (coded as "1"), 'not in the past 30 days but during the last 12 months (coded as "2") to 'more than 12 months ago' (coded as "3").

Descriptive statistics revealed highly skewed distributions for the last two items (recent use and frequency). The data were accordingly transformed. Categories 2 and 3 for recent Ecstasy use were recoded to "0" to avoid sparse numbers in the cells. The frequency of Ecstasy use per day in the past 30-day period showed that responses ranged from 0 through 12, which was then truncated (due to low frequency of response for number of times greater than 4) to range between 0 and 4.

*Ecstasy Dependence* -- Standard DSM-IV abuse and dependence criteria were used to mimic the diagnostic classification techniques used with other illicit drugs. For this investigation, only the items reflecting dependence were modeled as the second outcome measure.[45] A latent construct of "Dependence" was assessed using the seven adopted DSM-IV diagnostic criteria. The criteria included: (1) tolerance,

[45]Actually, diagnostic criteria for both abuse and dependence were included initially in the modeling procedure, as indicators of two separate latent constructs measuring the addictive potential of Ecstasy use. However, we were unable to obtain a satisfactory latent-variable model positing distinct constructs of abuse and dependence. The statistical artifact of an almost perfect correlation between the two constructs necessitated modeling only one construct. We also considered collapsing items from the two latent constructs into a single latent construct; however this procedure might go against the grain of certain diagnostic models. As a result the modeling efforts posited only the dependence construct. This also provides some clarity with respect to the consequences of Ecstasy consumption, and incorporates a construct possessing greater reliability (alpha for the Abuse construct was .91, whereas alpha for the Dependence construct was .96).

(2) withdrawal, (3) increased use of larger amounts over a longer period of time than intended, (4) persistent desire or unsuccessful efforts to cut down or control use, (5) great deal of time spent in activities to obtain substance, use substance, or recover from its effects, (6), giving up or reducing important social, occupational or recreational activities because of substance use; and (7) continued use despite knowledge of persistent or recurrent physical or psychological problems caused or exacerbated by the substance. Each one of these criteria (referred to in the model as DEP-1 through DEP-7) was coded as "1" if endorsed by the subject and as "0" otherwise.

*Economic Predictors* -- Three conceptually distinct measures of economic importance were created through data transformations including: income, unit price, and opportunity cost. An index of income status (labeled 'Income Index') consisted of work status in the past 12 months [The SAM-CD asks (WRKP12M): "In the past 12 months, how many months did you work for pay full time?"], sources of income in the past year [The RBA-CD asks (SRCINCP12M): "In the last 12 months, what were your sources of income?"], reported earnings [The RBA-CD asks (TINCP12M): "Considering all sources of your income, how much money did you make altogether in the last 12 months?"], and current employment status [The RBA-CD asks (CEMPSTS): "Which of these best describes your current work situation?"]. Sample work situation items included "unemployed," "working full or part time," "homemaker," "student," and "disabled." Based on sound judgment, these categories

were reduced to dichotomous categories including: “Employed and having an income” (coded as “0”) versus “Unemployed and not having a visible means of support” (coded as “1”). The measure of sources of income included 12 different response categories, which were further dichotomized into those representing legal means (e.g., paid job, welfare, social security, and alimony) coded as “0” and those representing illegal means (e.g., dealing drugs, prostitution, or sex) coded as “1.” Reported earnings contained response categories in $5,000 increments, ranging from $0-3,999 through $25,000 and thereafter in $10,000 increments through $65,000, and then $65,000-$100,000). The index was reduced to a binary variable approximating the federal income poverty level (less than $15,000 for a family of three: Department of Health and Human Services, 2005) coded as “1” and those earning in excess of this amount coded as “0”. The resultant ‘Income Index’ comprised of the four unit-weighted composites assessed ‘social anomie’ and ranged from 0 through 4 with higher scores indicating participants with lower earning potential and experiencing economic displacement.

Another important measure of economic influence is the cost to acquire an illicit drug. In economics, such a cost is referred to as the "full price" which generally includes a monetary price paid for a unit of the drug purchased, a value of the time and effort spent to get the drug, and an expected cost for future health consequences as well as potential penalties for illegal use of psychoactive substances. In this study, only the first two components (unit price and time spent obtaining Ecstasy) were

considered.[46] The unit price of Ecstasy (labeled 'Monetary Cost') was self-reported [The RBA-CD asks (UPRICE): "How much did you pay for one pill of Ecstasy the last time you bought it?"], with response categories recoded as 'under $10', '$10-$20', '$21-$30', and 'greater than $30'. These categories were then dichotomized to '$20 or less' coded as "1" and 'greater than $20' coded as "0".

Users' time spent procuring Ecstasy (labeled 'Opportunity Cost') was also self-reported [The RBA-CD asks (TIME2GETX): "If you wanted to get Ecstasy right now, how long would it take you to get it?"], with response categories coded in minutes, hours, days, and weeks. This measure assesses the cost of passing up other opportunities, which can serve as a monetary motivation in the drug user's decision process. Based on inspection of the resulting distribution of this cost measure, we converted all responses to a daily metric and then further refined it to a binary form representing 'a day or less' coded as "1" and 'greater than one day' coded as "0."

*Other Explanatory Measures* -- The possibility of spuriousness and confounding relations makes it important to control for psychosocial functioning in a model detailing the unique role of economic measures to account for variation in consumption. A latent construct of "Motivation" for Ecstasy use was reflected by indicators assessing opportunities for obtaining Ecstasy [The RBA-CD asks (WAYS2GTX): "We are interested in all the ways people get ecstasy, have you ever

[46]The last two components of the economic cost (the future cost of health care and potential penalties) were not assessed in the parent study and the use of other sources was considered inappropriate, as explained earlier in this chapter.

gotten ecstasy from …," with response formats including "spouse, family member, roommate, stranger, and dealer" then forming an additive index ranging from 0 to 5]; places to use Ecstasy [The RBA-CD asks (PLACES): "We are also interested in all of the places people take or use Ecstasy. Have you ever taken or used it in …," with responses including a myriad of places including rave clubs, bars, and fraternities, to name a few, which were dichotomously coded ('yes/no') and summed into an additive index); a unit-weighted index of people to share Ecstasy with [The RBA-CD asks (PEOPLE): "Have you ever used Ecstasy with …", listing different people including spouse, friends, roommates, dealer, to name a few]; and a unit-weighted index assessing various affect regulation and positive enhancement motives for using [The RBA-CD asks (MOTIVE): "have you ever taken Ecstasy for …," with response categories including "stress relief, bonding, pressure, spiritual experience, and curiosity," among others, which were all coded 'yes/no' (1/0) and summed].

A latent factor of depression (labeled "Depression") was reflected by four five-item random parcels capturing the behavioral (e.g., "I talked less than usual"), somatic (e.g., "I did not feel like eating, my appetite was poor"), affective (e.g., "I had crying spells"), and cognitive (e.g., "I had trouble keeping my mind on what I was doing") components of depression. Random parcels represent an excellent means of preserving scale integrity, homogeneity, and capturing the underlying multidimensional structure of depression (e.g., Radloff, 1977; Bagozzi & Heatherton, 1994; MacCallum et al., 1992; Little et al., 2002). Items were distributed evenly

across the four parcels (CESD-1 through CESD-4) with consideration of content balance and reliability.

Additionally, we included a unit-weighted index of HIV sexual risk-taking (labeled "Sex-Risk"), including dichotomously scored items ('yes/no' coded 1/0) assessing frequency of vaginal intercourse [The RBA-CD asks (EHADVSEX): "have you ever had vaginal sex?"], repeated identically for oral and anal sex; age of onset [The RBA-CD asks (AOSEX): "How old were you the first time you had sex of any kind?"], coded as 'younger than 15' (coded as "1") and 'older than 15' (coded as "0"); number of sex partners in the last three months [The RBA-CD asks (SEXPARTNRS): "In the last three months, how many different sex partners have you had?"], dichotomized as more than three sex partners versus less ('yes/no'); forced sexual contact with a dating partner [The RBA-CD asks (FRCDSEX): "Have you ever been forced to have sex with a dating partner?"], coded 'yes/no' (1/0); frequency of condom use [The RBA-CD asks (CNDMVP12M): "In the last 12 months, how often have you used a condom or other barrier protection when having vaginal sex?" which was repeated for oral and anal sex] with response categories coded as 'Never' (coded as "0") through 'Always' (coded as "4"), which were further divided into 'Never and Rarely' (coded as "1") and 'More Frequent Use' (coded as "0") (designating lower risk with more frequent condom use), and having sex under the influence [The RBA-CD asks (SEXUNDER): Having ever been under the influence of Ecstasy while having any kind of sex" ('yes/no')]. The sexual behaviors

used to index drug users' risk-taking in this study are consistent with Center for Disease Control and Prevention (1991) guidelines for "high risk" activity related to HIV and other morbid conditions (STD).

*Control Variables* -- The model also contained several exogenous measures to control for potential subject differences. These included demographic characteristics, including gender (male coded as "1"), race [White (coded as "1") and racial minorities and others (coded as "0")], age ['less than 21' (coded as "1") versus 'older' (coded as "0")], and education ['less than high school' (coded as "1") and 'beyond high school including vocation and technical education' (coded as "0")]. These subject characteristics were modeled into a single structural equations model and then further used to examine subgroup differences through more refined tests of moderation.

3. **Statistical Modeling Method**

As previously stated, the present study applied Structural Equations Modeling (SEM) analyses to test the hypotheses regarding a psycho-economic model of Ecstasy consumption and Dependence. For this purpose, all statistical computations including model parameters estimation and fit indices were performed using the EQS 6.1 for Windows statistical program (Bentler, 2004). EQS was specifically chosen for this investigation because it offers distinctive advantages, including its built-in robust statistics function to correct for non-normally distributed data (i.e., reducing Type I error in parameter estimates; Byrne, 1994).

Preliminary descriptive, bivariate correlation, reliability, and other standard statistical data analyses were carried out using the SAS® 9.2 software package for Windows (SAS Institute Inc., 2009). The rest of this section provides the basic underlying principles behind SEM and describes how this statistical modeling procedure was specifically utilized in the analyses.

Basics of SEM --- The SEM technique has been in use since the early 1970s, but its origin can be traced back to 1904, when Charles Spearman first used "factor analysis" to identify common factors underlying the association among manifest indicators. Also, Sewall Wright made a substantial contribution in 1921 as he was credited with testing the first path model (with observed measures). Early historical reviews of the development of SEM have been provided by Bentler (1986), Jöreskog (1982), and Mueller (1996). Economists have also adopted this approach (Duncan, 1975; Goldberger, 1972; Kline, 2005); however, SEM was "greatly misused" and "inadequately formalized" by economists very early on and never became a standard practice in causal economic modeling (Freedman, 1987).

In general, SEM provides a statistical tool for validating the psychometric properties of multi-item scales and also for testing causal multivariate processes. In the economic and social science literatures, SEM has been exclusively applied to analyze consumer behavior with regard to travel choice (see, for example, Golod, 2001; Kim, 2008; and Rangaswamy et al., 2008), decision making as well as participation in organizations and management (Rosa Diaz, 2002; Salo & Karjaluoto,

2007; Shook et al., 2004). It has also been used to estimate the determinants and size of underground (hidden or shadow) sectors in the economy (Brambila-Macias, 2008; Dell'Anno & Schneider, 2009; Schneider, 2007; Vuletin, 2008).

*What is SEM?* -- SEM is a second generation, multivariate technique for analyzing theory-driven and complex interrelations among directly observable and latent variables in a predictive framework (Bollen, 1989; 2002). SEM is widely recognized as a powerful model-building and theory testing methodology because it combines different aspects of various traditional multivariate statistical procedures including factor analysis, regression, and path analysis (Cudeck, du Toit, & Sörbom, 2001). Although these procedures have high utility individually, by integrating them together into a single procedure, SEM provides a superior statistical framework for testing and validating theories (Bentler, 1978; Kline, 2005). Lomax (1989) even suggested that SEM has been "the single most important contribution of statistics to the social and behavioral sciences during the past twenty years" (p. 171).

Typically, when elaborating SEMs, a researcher is required to specify a priori a given theoretical model (Bentler, 1978). The implied model is then tested against the sample data and evaluated with several absolute and inferential measures of fit (Bentler, 1990; Bentler & Bonnet, 1980; Kline, 2005). The idea behind SEM is to minimize the difference between the observed variance/covariance matrix based on the actual sample data and the implied or hypothesized population matrix. No one single fit index adequately determines the overall fit of a SEM model or its

correspondence with theory. Rather several fit indices are used to gauge model fit including the standardized factor loadings (determining how well the latent factors were hypothesized), the large sample chi-square test (minimizing the discrepancy function between the sample and implied population variance-covariances), and the magnitude of the off-diagonal residual covariances (indexing poorness of fit) (Hu & Bentler, 1999; Kline, 2005).

One other indication of model "fit" relies on an assessment of model "parsimony" or the ability of the specified model to account for structural relations with the fewest parameters (Bentler & Mooijaart, 1989). The Law of Parsimony is achieved through an iterative process of model specification, estimation, and validation.

*What is the Structure of a Typical SEM Model?* -- A typical SEM contains two components: a measurement model detailing the psychometric properties of the various latent constructs, and a second component detailing the structural relations (regressions) between measures and latent constructs. The measurement component specifies relations between latent (unobservable or hypothetical) variables and their respective manifest (observed) indicators. Typically, this component corresponds to a confirmatory factor analysis (CFA) in which each latent construct is operationally defined by a set of measures and then the fit of this configuration tested. A measurement model can be specified in several ways, but usually the latent factors are allowed to freely covary (restrictions can be imposed and tested against the more

"relaxed" model). An observed measure can be posited to load on only one "factor" as with simple structure or allowed to load on more than one factor as with a complex factor loading. Errors that reflect variance net of prediction (a factor is hypothesized to predict the manifest variable) can also be correlated to represent "measurement or time-specific variance." These model modifications are made using empirical specification searches that can improve the overall fit of a model (Chou & Bentler, 1990). Usually a researcher desires a more pure (and replicable) model so the simple structure approach without correlated errors is most commonly used.

In order to deal with problem of "identification," the latent variables are assigned a unit of measurement either by fixing the loading of a reference indicator to one or standardizing the factor variance. This provides a "metric" and helps identify the model and yields its measurement properties. From the CFA portion of the model a researcher can learn about the reliabilities of various measures and from the pattern of their inter-correlation with other factors or measures learn about their construct, divergent, and convergent validity.

The structural component of a SEM expresses the hypothesized inter-dependence and causal relations between latent factors and in certain cases with other observed variables. This part of the model represents the simultaneous estimation of several regressions at once, including direct effects, indirect effects (mediated by intervening variables), and associations (or correlations) among both exogenous and endogenous variables (indicators or latent constructs). Depending on the desired

specification, a structural regression model can be regarded as: a) saturated (where all possible relations are included), b) independent [no relations among measured variables or latent variables ([i.e., null model)], or c) constrained. A "constrained" model can be tested or contrasted with a more "relaxed" model that has fewer parameter constraints and the difference in model Chi-square ($\chi^2$) compared with the nested likelihood test (yielding the $\chi^2$ difference per degrees of freedom). A final structural equation model may include parameters that are fixed (set at some designated value usually zero) and/or freely estimated. When the number of freely estimated parameters equals (or exceeds) the number of variables in the data, the SEM model is said to be "just identified" (or "over justified") [i.e., the model has a unique estimate (or more than one potential value) for each parameter].

*What are the Strengths and Weaknesses of SEM?* -- There are a number of strengths and weaknesses associated with SEM techniques. Perhaps the most important and appealing feature of SEM, making it a perfect tool for these analyses, is its ability to model hypothesized latent constructs in a regression framework. The psycho-economic model includes four hypothesized latent constructs; including Ecstasy Consumption, Dependence, Motives, and Depression. Each construct is reflected by multiple indicators (and indicators are constructed from multiple items), thus creating a more parsimonious representation of the data and increasing power.

Another significant feature of SEM is its ability to account for measurement error (or "noise") that occurs at the level of manifest or measured variables. This

specific feature alone gives SEM an advantage over other simpler, relational modeling techniques (such as path or ordinary least-squares regression analysis), which assume that all variables are measured without error.

There is one other noteworthy feature of SEM that distinguishes it from other traditional modeling procedures (such as simultaneous [or system] equations [SE]). Indeed, like SE techniques, SEM provides estimates for all direct and indirect effects based on theoretical specification of causal effects. Unlike SE however, SEM also estimates associations (non-directional relations) between dependent variables net of prediction and allows models to have correlated errors of measurement (Bollen, 2002). In other words, if there are several predictors and two dependent or outcome measures in an equation, SEM will estimate the effects of the predictors on both of the dependent measures and then estimate the association between the dependent measures net of prediction. This extra step provides a more accurate estimation of the model, drains meaningful variation from the covariance matrix, and provides a more optimal fit between the sample data and the implied population model. Related to this last point, SEM estimates the entire set of regression equations simultaneously. It can test whether one regression parameter is different (null model) from another as a whole system. In other words, SEM examines the entire architecture of the underlying relations in the model of interest rather than invoking a "straw-man" alternative (Jöreskog et al., 1999; Tomarken & Walker, 2005).

There are also several weaknesses associated with SEM procedures. SEM is mainly a confirmatory technique, which requires a priori theoretical specification of a model. Thus, a researcher must have a fairly good indication of the theoretical linkages (i.e., postulates, syntax, and axioms) before the model is tested. SEM does not compensate a researcher for a poorly generated model or unreliable constructs. In other words, SEM is highly recommended for theory testing in a confirmatory framework and not considered the optimal approach for testing preliminary models in their developmental stages. Overall, these limitations should not however decrease the importance of using SEM for this study. Their mention merely emphasizes the need for thorough knowledge of theory, a complete specification of the model, and a systematic process for analyzing and assessing the model results using the best psychometric tools available (Bentler & Mooijaart, 1989).

Model Estimation and Testing Strategy --- Estimation of SEM proceeds in a systematic fashion. This process includes model identification, estimation, evaluation of fit, and then possible re-specification (i.e., fine-tuning) followed by estimation again (Bollen & Long, 1993; Kline, 2005). Furthermore, SEM is a two-step procedure with the psychometric [confirmatory factor analysis (CFA)] part of the model tested prior to its structural component (Anderson & Gerbing, 1988). Any changes in the CFA that provide insight to the psychometric properties of measures and latent constructs are considered prior to estimation of structural regression

effects. This iterative process was thoroughly followed in this investigation. A description of the adopted estimation and evaluation strategies are presented next.

*Model Estimation Procedure* -- The EQS approach to SEM analysis works by providing parameter estimates that minimize the discrepancy between the model-implied population covariance matrix and the actual (observed) covariance matrix based on the sample data. In particular, the observed covariance matrix is assumed to be based on a random sample drawn from the entire population. EQS offers a number of estimation methods based on different fitting functions. These include full-information maximum likelihood (ML), weighted least squares (similar to ML under full data normality), and asymptotic distribution-free estimators (no distribution required) among others (Bentler & Wu, 1995).

The ML estimation technique is the most commonly applied method for estimating SEM models. It proceeds iteratively and estimates all model parameters simultaneously. The ML technique has been shown to provide consistent, efficient (having minimum standard error variance) estimates, assuming multivariate normally distributed continuous variables (Kline, 1998). The EQS program provides several remedies for dealing with violations of normality (i.e., when data violate requirements for multivariate normality or when the underlying distributions of the data represent a mixture of categorical and continuous scales). The EQS program provides adjustments for non-normality, offering distribution-free estimation methods and statistical means to test for these violations (Satorra & Bentler, 2001).

Additionally, EQS provides "robust" standard errors of the estimates to account for the extent of non-normality (Bentler, 2004). For all these reasons, the EQS ML method option was adopted for estimation of the models tested in this study.

*Sample Size Requirement* – Because the covariance structure (SEM) method of analysis is based on large sample theory, the correct sample size becomes an important issue for the estimation of stable parameter values (Kline, 2005). In particular, parameter estimates and overall $\chi^2$-test of model fit are sensitive to sample size. Therefore, the greater the number of free parameters specified in a model, the larger the sample size that is required to achieve a desired level of statistical power. There is, however, a lack of general agreement about how large is large enough to obtain reliable model estimates. Some researchers have suggested a range of sample sizes for the use with ML estimation methods; including less than 100 observations defined as a small sample, between 100 and 200 as a medium size sample, and more than 200 as a large sample (Kline, 2005). Parameter estimates should be reliable and stable with small standard errors given the relatively large sample size of this study.

Other researchers have recommended a "rule of thumb" to determine the minimum sample size for SEM model. The rule stipulates that an adequate sample should include at least 10 to 20 cases (or observations) for each independent variable included in a model (Hair et al., 1998). Applying this rule, and given the number of independent measures, the psycho-economic model would require a minimum of 220

to 440 case; thus, the dataset we are using is more than adequate and sufficiently powered to detect effects.

Bentler (1995) has suggested using the number of estimated parameters rather than the independent variables for power computation. Following this suggestion, reliable estimates for the present model would require a sample size varying between 550 and 1100 observations. Since a saturated model will not be the goal of this analysis, the actual sample of N = 640 is determined to be adequate. Moreover, EQS offers test statistics to evaluate whether the size of the sample applied is appropriate (Bentler & Yuan, 1999).

*Model Testing Strategy* -- An initial CFA model tested the overall statistical reliability of the hypothesized latent factors (Consumption, Dependence, Depression, Motives). The psychometric model indicates whether the latent constructs were conceptualized correctly. In addition, the CFA model provided a means to inspect the error-free correlations among the latent constructs and between latent constructs and any measured variables. Following the CFA model we conducted a series of structural models that incrementally tested the effects of economic indicators first on Ecstasy Consumption and then on Dependence. Additionally, given the cross-sectional nature of the data the relation between Dependence and Ecstasy Consumption was estimated freely as a correlation rather than estimating a causal effect. Subsequent models estimated relations between latent constructs of Depression and Motives and their prediction of Ecstasy Consumption and

Dependence controlling for the economic predictors. This model is one of several in a series that tests the unique influence of economic indicators on the two endogenous constructs controlling for psychosocial risk. A "fully conditioned model" specified the contents of the previous model containing the two endogenous constructs (Ecstasy Use and Dependence) along with the predictor constructs (Depression and Motives), and added the observed measure of sexual risk and the economic measures. The latter fully conditioned model was then re-estimated using empirical specification searches to capture any nonstandard effects (details on these methods are explained below) that were not hypothesized a priori. In light of the obtained mean differences based on race, age, education, and site we added these measures to the final model to examine whether obtained parameter estimates dramatically changed following their inclusion.

*Goodness-of-fit criteria* – Evaluation of the fit of SEMs involves several model fit indices. One measure of goodness-of-fit, the discrepancy function or large sample $\chi^2$ examines the difference between the observed and implied population covariance matrices. A non-significant $\chi^2$ value ($p > .05$) indicates the model fits well and there is very little residual covariation in the matrix after imposing the model on the sample data. As a measure of fit, the $\chi^2$ is sensitive to large sample sizes and the complexity (degrees of freedom) built into the model. Under such considerations, the $\chi^2$ measure has been shown to increase the risk of Type II error, or the probability of rejecting a true model (Kline, 2005). As a result, additional goodness-of-fit indices

have been proposed that provide additional model fit information (Hu & Bentler, 1998). These indices can be grouped into: 1) Measures of absolute fit [such as the chi-square divided by its degree of freedom ($\chi^2$/df, also called normed $\chi^2$), Goodness-of-fit index (measuring the overall degree of fit), and Root Mean Square Error Approximation (RMSEA: measuring an error in approximation; Browne & Cudeck, 1993)], 2) Incremental fit measures [such as Normed Fit Index (NFI: comparing the proposed model with a null model; Bentler & Bonnet, 1980) and Comparative Fit Index (CFI: similar to NFI but incorporating degrees of freedom and non-centrality parameter evaluation for the both models; Bentler, 1990; Benter & Yuan, 1999)], and 3) Measure of parsimony [Akaike information criterion (AIC: a composite measure of badness of fit and complexity of the model; Akaike, 1987)]. For model evaluation the $\chi^2$/df, NFI, CFI, RMSR and RMSEA were applied in this investigation. Standard benchmarks for these model fit indices include: $\chi^2$/df less than 4[47], NFI, CFI and AGFI with values between .90 and 1.0, and an RMSEA and RMSR less than .08 (Hu & Bentler, 1998).

In sum, this chapter presented the study methodology, including the methods for data acquisition and measurements formulation, as well as the statistical modeling approaches used. The chapter also introduced the basic tenets of SEM and outlined the principles of model estimation and the validation strategy adopted. These tools were fully implemented and the results are presented next.

[47]Acceptance criterion for $\chi^2$/df varied in the literature, ranging from less than 2 (Ullman, 2001) to less than 5 (Schumacker & Lomax, 2004).

# CHAPTER IV: RESULTS

This chapter presents the results of the statistical analyses conducted. In order to integrate the voluminous material, the chapter is organized into three sections. The first section describes the demographic characteristics of the participants as well as their history of illicit-substance use and problems associated with drug use. This descriptive material includes their lifetime use and current (past 30-days) patterns (quantity and frequency) of Ecstasy consumption. Differences in the sample characteristics, patterns of substance use and complications are also described by site and gender.

Section two presents summary statistics for all of the variables used in the model, including measures of central tendency (i.e., mean standard deviation, skewness, and kurtosis). These descriptive statistics provide a means to check violations of normality assumptions required for conducting the covariance structure analyses. Additional information includes the results of variance decomposition of the key measures presented by gender and site. Additionally, Pearson product moment correlations between all the latent constructs and measured variables/indices used in the model were examined to check for multicollinearity, possible suppression, and confounding. Information from the correlation matrix was used to examine interrelationships among the latent constructs and also associations between constructs and measured variables (Hair et al., 1998). All of these preliminary

descriptive analyses were carried out using the SAS® 9.2 software package for Windows (SAS Institute Inc., 2009).

Section three presents results of a series of measurement and structural equation models implemented to test the specific research hypotheses. Briefly, the psycho-economic model was assessed using a two-step procedure (Anderson & Gerbing, 1988): First a "measurement model" was tested using confirmatory factor analysis (CFA) procedure. This portion of the model assesses the psychometric properties of the hypothesized latent constructs and provides a means to examine "error-free" associations among the four hypothesized latent constructs. The four latent constructs included Depression, Motivation, Consumption, and Dependence. Each construct was reflected by multiple indicators (observed measures), as described in the previous chapter.

The CFA model provides two distinct pieces of information: the reliabilities (i.e., accuracy of measurement) of the indicators used to reflect the latent constructs and also information detailing the statistical associations among the latent constructs and between measured variables and composite measures posited in the model. The reliabilities are computed based on methods for structural composites (Werts, Linn, & Jöreskog, 1974). The relations between the four latent constructs as well as the free-standing measured variables (e.g., income, unit price, and opportunity cost) and composites are indicated by Pearson product moment correlations. In the case of the

factor-to-factor relations, these associations are disattenuated for error of measurement.

A second step included testing and refining the "structural model" (referred to here as the SEM). The SEM procedure assesses the fit of the hypothesized psycho-economic model in the sample data against the implied population model. The SEM was tested in a stepwise manner, starting with the economic measures to derive their unbiased parameter estimates and then adding the psychological measures (i.e., Motivation) and other selected risk factors (i.e., Depression and sexual risk) in an incremental fashion until all the measures and constructs were incorporated. The final model-parameter estimates (standardized regression coefficients) are adjusted for all the variables included in the model. This forward "inclusion" procedure was chosen to arrive at an acceptable model and eliminate any potential confounder bias, spuriousness, and inconsistent effects (Nachtigall et al., 2003). The final and most parsimonious model was then used to examine possible gender as well as site differences. The suitability of a particular model was determined using several overall fit indices, including Chi-square ($\chi^2$(df)), Normed Fit Index (NFI), Comparative Fit Index (CFI), Standardized Root Mean Square Residual (SRMR), Root Mean Square Error of Approximation (RMSEA), and the Adjusted Goodness of Fit Index (AGFI). All of the CFA and SEM models were tested using the EQS software program for Windows Version 6.1 (Bentler & Wu, 1995). The chapter concludes with a brief summary of the findings.

1. **Descriptive Data Analysis**

As previously described in the methodology chapter, this investigation used data from a NIDA funded "Tri-City Study of Club Drug use, Abuse and Dependence," referred to as the "CDSLAM." The CDSLAM study was designed to examine club drug (including Ecstasy, Ketamine, GHB, and Rohypnol) use behaviors between 2002 and 2005 at three sites [St. Louis (Missouri, US), Miami (Florida, US), and Sydney (New South Wales, Australia)]. These particular sites were selected based on epidemiological evidence suggesting an increased incidence of Ecstasy use. The study's main eligibility criteria required that participants must have used Ecstasy more than five times in their lifetime, with the most recent use being within the 12 month period prior to the CDSLAM survey. The parent study included test-retest reliability (Time-1 & 2) and validity (Time-3) components. For the present analyses, only Time-1 interview data was used. The selected sample was further limited to current Ecstasy users who had complete data for all the variables of interest to this investigation. The final analysis sample consisted of N=640 participants. This first section provides brief background information describing the study participants and their pattern of drug use, including their consumption of Ecstasy and other substances.

Participants' Demographic Profile --- Table 4.1 shows descriptive statistics for the total sample (N=640) and by site. A total of 46% of the participants were from St. Louis (N=296), 29% were from Miami (N=186), and 25% were from Sydney,

Australia (N=158). Table 4.1 also contains numerical frequencies and percentages for categorical variables and means and standard deviations (SD) for continuous measures. Comparisons across sites for categorical measures were conducted using the chi-square test of independence and for continuous measures using variance decomposition techniques (single-factor analysis of variance, also known as one-way ANOVA).

For all three sites combined (N=640), 58% of the participants were male (N=369), and 42% were female. All three sites had more male than female participants (54% at St. Louis, 61% at Miami, and 59% at Sydney). However, there were no statistically significant differences in the proportion of male or female participants across sites.

A variable coding participant's age at study time was categorized into three age groups: "Minors," defined as being 20 years or younger, "Young Adults," included 21 to 24 years old, and "Adults," defined as being 25 years old or older. The overall mean age of the participants in the sample was 23.3 years [Range=16 – 45 years (not shown) and Standard Deviation (SD) = 5.01]. A total of 214 participants (33%) were "Minors," 246 participants (38%) were "Young Adults," and 180 participants (28%) were "Adults." Although there were more individuals classified as "Young Adults" among St. Louis participants than in either Miami or Sydney, there were no significant differences in mean age or distribution of the three levels across the three sites.

**Table 4.1 Socio-Demographic Characteristics of the Study Sample**

| *Characteristic* | *Total Sample* (N =640) n(%) | *Site* *St. Louis* (N =296) % | *Miami* (N =186) % | *Sydney* (N =158) % |
|---|---|---|---|---|
| **Gender** | | | | |
| Female | 271(42%) | 46% | 39% | 41% |
| Male | 369(58%) | 54% | 61% | 59% |
| **Age** | | | | |
| Minors(20 years or younger) | 214(33%) | 32% | 33% | 35% |
| Young Adults(21 - 24 yrs) | 246(38%) | 42% | 35% | 35% |
| Adults(25 years or older) | 180(28%) | 25% | 32% | 29% |
| Mean Age(SD) | 23.3(5.01) | 23.2(5.08) | 23.6(4.98) | 23.2(4.94) |
| **Race/Ethnicity** | | | | |
| White/Caucasian | 400(62%) | 73% | 31% | 80%*** |
| Black | 55(9%) | 16% | 4% | 0% |
| Hispanic | 113(18%) | 3% | 55% | 1% |
| Others | 72(11%) | 8% | 10% | 19% |
| **Marital Status** | | | | |
| Currently married | 19(3%) | 4% | 4% | 0% |
| Separated/Divorced/Widowed | 23(4%) | 4% | 4% | 1% |
| Never married | 598(93%) | 92% | 91% | 99% |
| **Education Level** | | | | |
| Elementary | 42(7%) | 6% | 4% | 9%** |
| Secondary(High School) | 402(63%) | 69% | 57% | 58% |
| Post-Secondary | 196(31%) | 24% | 39% | 33% |
| **Current Work Status** | | | | |
| Working Full/Part-time | 187(29%) | 27% | 25% | 37% |
| Student Working Full/Part-time | 280(44%) | 44% | 45% | 41% |
| Unemployed and Looking for work | 100(16%) | 17% | 17% | 12% |
| Unemployed, not Able/Looking for work | 73(11%) | 12% | 13% | 10% |
| **Total Income in the Last 12 Months** | | | | |
| $3,999 or less | 120(19%) | 23% | 19% | 10%** |
| $4,000 - $6,999 | 78(12%) | 11% | 16% | 10% |
| $7,000 - $10,999 | 100(16%) | 17% | 16% | 13% |
| $11,000 - $14,999 | 67(11%) | 10% | 8% | 15% |
| $15,000 - $18,999 | 88(14%) | 16% | 11% | 14% |
| $19,000 - $24,999 | 62(10% | 8% | 14% | 8% |
| $25,000 - $34,999 | 58(9%) | 8% | 8% | 12% |
| $55,000 - $44,999 | 29(5%) | 3% | 4% | 8% |
| $45,000 or more | 38(6%) | 5% | 5% | 9% |

Notes: 1. Percents might not add up to 100% in some cases due to truncation

2. Sites comparisons were assessed with t-test for categorical variables and ANOVA for continuous variables. Statistically significant levels are indicated by * for $p \leq .05$, ** for $p \leq .01$, and *** for $p \leq .001$

When participants were asked to indicate their race (or ethnicity), 62% (N=400) identified themselves as "White" (or "Caucasian"), 18% (N=113) self-identified as "Hispanic," and 9% (N=55) classified themselves as "Black" (or "African American," all of these individuals were from the US). The remaining 11% of the sample (N=72) opted to choose "Other" as their racial designation. Included in the "Other" group, 30 participants (about 5%) were Asian and 42 (about 7%) participants were from various ethnic groups, including 1 Alaskan Native, 2 American Indians, 6 Middle Easterners, 3 Pacific Islanders, 18 Biracial, and 12 Multiracial. The Pearson chi-square test indicated statistically different racial composition across the three sites, $\chi^2(6)=296.4$, $p<.0001$. Indeed, while most Whites [N=343 out of 400 (86%)] were from St. Louis [N=217 (54%)] and Sydney [N=126 (31%)], nearly all of the Hispanics [N=102 out of 113 (90%)] were from Miami.

Table 4.1 also shows that 93% (N=598) of the participants reported they were "Never Married;" only 3% (N=19) were "Currently Married," and 4% (N=23) indicated they were "Separated," "Divorced" or "Widowed." Proportional tests of independence indicate no statistically significant differences for marital status across the three sites. This most likely resulted from the high proportion of "single" participants at each site (92%, 91%, and 99%, respectively at St. Louis, Miami, and Sydney).

When asked about their educational status 63% (N=402) of the participants reported that they received a "High School Diploma" or a "G.E.D." certificate, and

approximately 31% (N=196) indicated that they held a college degree ("Bachelor" or "Master" degree). On the other hand, only 42 participants (about 7%) had an "Elementary or Junior High" level of education. Participants' education was significantly different across the three sites, $\chi^2(4) = 15.25$, $p = .0042$. There were relatively more college level participants in both Miami (39%) and Sydney (33%) than in St. Louis (24%). On the other hand, St. Louis had more participants that were high school graduates (69%) than Miami (57%) or Sydney (58%).

Participants were also asked to describe their "current work situation." For all three sites combined, 29% (N=187) of the participants reported they were currently working [Either "Working full-time (35 hours a week)" 17% (N=112) or "Working part-time (less than 35 hours a week)" 12% (N=75), not shown in Table 4.1] and 44% of the total sample (N=280) reported they were students, including 143 participants who were "Full-time students and working part-time," 51% (N=29) were "Full-time students and working full-time" (10%), and the remainder, 39% (N=108), were full-time students and not currently employed. The remaining participants consisted of 16% (N=100) that indicated they were "Unemployed or laid off and looking for work" and 11% (N=73) who were "Unemployed or laid off and not looking for work." Overall, the participants' current working situation was not statistically different across the three study sites.

Participants were also asked to add up all money they collected from all sources of income in the past 12 months and to report their total by income ranges or

brackets. Not surprising, given the participants' somewhat youthful age and the high proportion that were students at all three sites (see Table 4.1), the distribution of a measure of their purchasing power (total income) was positively skewed. More than half of the sample (57% or N=365) earned less than $15,000 during the past 12 months period prior to their interviews.[48] The remaining 43% (N=279) earned substantially more money, including 38 participants (6%) reporting a total income of $45,000 or more. Specifically, the positive tail of the distribution included 16 participants (about 3%) (Not shown in Table 4.1) that reported total income between $65,000 and $100,000 or more. By contrast, the low income side of the distribution included 120 participants (19%) who reported total income less than $4,000 in the 12 month time frame. Moreover, there was a significant difference in the distribution of the participants' total income across the three sites, $\chi^2(18)=38.75$, p=.0031. While a majority (51%) of participants from St. Louis and Miami earned less than $11,000 a year and the rest of the participants had higher income stretching out to more than $100,000, participants from Sydney were more evenly spread out from the lowest income bracket "$3,999 or less" to the highest bracket "$45,000 or more."

Although not shown in Table 4.1, participants were also requested to indicate their sources of income over the past 12-month time frame from a list of 16 categories. The income question provided a response format indicating "Anything

[48]Fifteen thousand dollars was defined as the threshold for the US federal income poverty level (less than $15,000 for a family of three). Source: Department of Health and Human Services, 2005.

else?" and if the respondent selected "YES," they were asked to further "SPECIFY: …" the source. The list included legal sources of income (such as "Paid job, salary, or business," "Welfare, public assistance, or AFDC," "Social Security, disability, or Workman's Compensation," "Student Loan," and "Selling or trading goods, or bartering") as well as illegal sources of income (such as "Dealing drugs," "Winnings from gambling or betting," and "Prostitution or trading sex"). Approximately one third (33%, N=209) of the participants reported using one or more illegal activities as additional sources of income. Cross-tabulation of the measure of income distribution and sources of income (legal vs. illegal) indicated that individuals from lower income brackets ($15,000 and under) resorted more to illegal sources of income than participants with higher income brackets, $\chi^2(2)=10.04$, p=.007.

Consumption Patterns of Ecstasy --- Table 4.2 includes descriptive information indicating levels of involvement with Ecstasy and other illicit drugs. The Table also provides psychiatric diagnostic information used to designate whether a participant met criteria for abuse or dependence; i.e., addicted on a particular drug. The first column in Table 4.2 shows descriptive statistics for the overall sample (N=640), while the remaining columns describe the sample by gender (second and third columns) and site (fourth, fifth and sixth columns). The statistical information includes numerical frequencies and percentages for categorical variables, and means with their standard deviations (SD) for continuous variables. Statistical analysis of

categorical measures relied on the chi-square ($\chi^2$(df)) statistic, while t-tests or one-way analysis of variance (ANOVA) was used for continuous measures.

*Age of Onset of Ecstasy Use* -- Participants were asked to indicate the earliest age when they began using Ecstasy. The average reported age of first use (see Table 4.2) for the entire sample (N=640) was 19 years (SD=4.11), and ranged from 13 to 44 years (not shown in the table). Males were slightly older than females when they began to use Ecstasy, t=-3.21, p=.0014 [$M_M$=19.42 (SD=4.42) with a range of 13 to 44 years; $M_F$=18.39 (SD=3.57) with a range of 13 to 40 years, for males and females, respectively]. Age of onset differed significantly across the three sites, F(2)=3.43, p=.0329. In particular, participants in St. Louis were on average significantly older than those from Sydney when they first tried Ecstasy [St. Louis $M_{age}$=19.43 (SD=4.47) vs. Sydney $M_{age}$=18.42 (SD=3.22)].

To assess whether these differences were consistent across the age ranges of participants' first use of Ecstasy, the age of onset variable was categorized, using 5-years date bands. Overall, nearly 80% of participants reported initiating their use of Ecstasy before the age of 21, corresponding to the minimum legal drinking age in the United States. In particular, 16 participants (2% of total sample) started using Ecstasy while they were 14 years old or younger and 491 participants (77%) used Ecstasy when they were between the ages of 15 and 20 years. In contrast, 87 participants (14% of the total sample) reported initiating their use of Ecstasy when they were

**Table 4.2 Ecstasy Use Pattern among Study Participants by Gender and Site (N=640)**

| Characteristic | Total Sample (N =640) n(%) | Gender | | Site | | |
|---|---|---|---|---|---|---|
| | | Female (N =271) % | Male (N =369) % | St. Louis (N =296) % | Miami (N =186) % | Sydney (N =158) % |
| **Age of Onset of Ecstasy Use** | | | | | | |
| 15 years or younger | 66(11%) | 14% | 8%* | 9% | 15% | 10%* |
| 16 - 20 years | 438(68%) | 70% | 67% | 66% | 67% | 76% |
| 21 - 24 25 years | 87(14%) | 11% | 15% | 17% | 12% | 9% |
| 25 years or older | 46(7%) | 5% | 9% | 9% | 7% | 4% |
| Mean Age of Onset(SD) | 19.0(4.11) | 18.4(3.57) | 19.4(4.42)*** | 19.4(4.47) | 18.8(4.13) | 18.4(3.22)* |
| **Years Since 1st Ecstasy Use** | | | | | | |
| 2 years or less | 103(16%) | 18% | 15% | 17% | 14% | 17%*** |
| 3 - 4 years | 207(32%) | 32% | 33% | 42% | 22% | 28% |
| 5 - 6 years | 171(27%) | 27% | 26% | 23% | 34% | 25% |
| 7 years or more | 159(25%) | 23% | 26% | 18% | 31% | 30% |
| Mean years(SD) | 5.3(3.21) | 5.1(2.91) | 5.4(3.41) | 4.7(2.83) | 5.7(3.25) | 5.8(3.67)*** |
| **Lifetime Use of Ecstasy** | | | | | | |
| Mean number of pills(SD) | 227.7(543.7) | 208.4(489) | 241.8(580.8) | 184.7(526.1) | 255.3(608.5) | 275.6(489.9) |
| **Current Use of Ecstasy** | | | | | | |
| Within past 30 days | 270(42%) | 44% | 41% | 30% | 31% | 79%*** |
| More than 30 days ago, but in past 12 months | 370(58%) | 56% | 59% | 70% | 69% | 21% |
| **Past 30 Days Use of Ecstasy (N =270)** | | | | | | |
| **Number of Days** | | | | | | |
| 1 - 3 days | 200(74%) | 72% | 76% | 82% | 86% | 63%*** |
| 4 or more days | 70(26%) | 28% | 24% | 18% | 14% | 37% |
| Mean number of days(SD) | 2.8(2.69) | 2.8(2.69) | 2.8(2.69) | 2.6(3.01) | 2.0(1.95) | 3.3(2.64)* |
| **Number of Times per Day of Ecstasy Use** | | | | | | |
| 1 time | 157(58%) | 58% | 58% | 70% | 65% | 46%*** |
| 2 or more times | 113(42%) | 42% | 42% | 30% | 35% | 54% |
| Mean number of times a day(SD) | 1.8(1.46) | 1.8(1.57) | 1.8(1.38) | 1.5(1.24) | 2.1(2.19) | 1.9(1.14) |

Notes: 1. Percents might not add up to 100% in some cases due to truncation

2. Sites comparisons were assessed with Chi-Square for categorical variables and t-Test for continuous variables. Statistically significant levels are indicated by
* for $p \leq .05$, ** for $p \leq .01$, and *** for $p \leq .001$

between 21 and 25 years old, and only 46 participants (7%) were 26 years old or older when they first experimented with Ecstasy.

Table 4.2 also depicts essentially the same distributional patterns regarding the age of onset by gender (columns 2 and 3) and site (columns 4, 5 and 6). Indeed, a vast majority of both female (84%) and male (75%) were younger than 21 years old when they first used Ecstasy. There was, however, a statistically significant difference between the ranges of age of onset for each gender, $\chi^2(3)=8.92$, p=.0304. In particular, the distributions for age of onset indicate that females initiated their use of Ecstasy at a younger age than males. Participants also differed with respect to their age of onset across the three sites, $\chi^2(6)=12.80$, p=.0464. While the reported age of onset patterns for Miami and Sydney are quite comparable, individuals in the St. Louis site began their use of Ecstasy at an older age than their counterparts in the other sites.

*Years since First Ecstasy Use* -- The number of years since participants used Ecstasy for the first time was computed as the arithmetic difference between current age and age of onset of Ecstasy use for each participant. Table 4.2 summarizes these results. The overall mean number of years since study participants first used Ecstasy was 5.3 years [Range = 1–25 years (not shown) and SD=3.21]. A total of 16% of the sample (N=103) reported using Ecstasy for 2 or less years, 32% (N=207) used it for 3 to 4 years, 27% (N=171) used it for 5 to 6 years, and 25% (N=159) used Ecstasy for 7

or more years. No significant gender difference was found for the mean number of years since participants first tried Ecstasy.

One-way analysis of variance indicated significant differences in the mean number of years since Ecstasy was first used by study participants across the three sites, $F(2)=7.99$, $p \leq .001$. On average, participants in St. Louis reported fewer years since their first Ecstasy use [$M_{years}=4.7$ (SD=2.83)] than participants in Miami [$M_{years}=5.7$ (SD=3.25)] or Sydney [$M_{years}=5.8$ (SD=3.67)]. Additionally, variability in the number of years since first use differed between St. Louis participants compared to those in Miami or Sydney, $\chi^2(6)=30.99$, $p<.0001$. In particular, Ecstasy users in St. Louis were relatively new to this drug. As shown in Table 4.2, more than half of the participants (59%) in St. Louis were observed to have not more than four years since they first tried Ecstasy, while more than half of the participants in Miami (65%) and Sydney (55%) reported five or more years of Ecstasy use since they first experimented. The source of difference is most likely due to the fact that participants in St. Louis were on average older and started using Ecstasy at a much later age than participants from the other two sites.

*Lifetime Use of Ecstasy* -- Participants were asked "if you were to add up all of the Ecstasy pills you have used since you first started using Ecstasy, about how many pills would that be?" The overall mean number of pills consumed was 227.7 (SD=543.7). Males and females did not differ significantly in their reported lifetime use [$M_M=241.8$ (SD=580.8) with a range of 6 to 5200 pills and $M_F=208.4$

(SD=489.0) with a range of 6 to 4000 pills]. There was a trend for site differences in the mean number of pills used, $F(2)=2.67$, $p \leq .071$, with mean levels of Ecstasy use relatively higher for Sydney and Miami compared to St. Louis [$M_{SYD}$=275.58 pills (SD=489.88)] and $M_{MI}$=255.34 pills (SD=608.49), and $M_{SL}$=184.72 pills (SD=526.08)].

*Current Use of Ecstasy* -- In addition to their lifetime and past year Ecstasy use, participants were also asked "How many days have you used Ecstasy in the past 30 days?" The combination of past year and past 30 day pattern of use indicated that 42% (N=270) of the total sample used Ecstasy within the past 30 days, while 58% (N=370) used it more than 30 days ago, but within the past 12 months. The distribution of current users was not statistically different for male (41% used Ecstasy within the past 30 days and 59% used it more than 30 days ago) and female (44% and 56%, respectively) participants. However, there were significant site differences in current use of Ecstasy, $\chi^2(2)=117.33$, $p \leq .0001$. Specifically, participants in Sydney reported more recent use than those in St. Louis and Miami (79% vs. 30% and 31% for the three sites, respectively).

Participants were also asked about the intensity of their Ecstasy use (number of times a day they used the drug) and the number of days they used Ecstasy in the past 30 days (frequency of use). Gathering information on quantity and frequency is consistent with previous studies seeking to clarify 'regular' and more moderate patterns of use (Cottler et al., 2000, Degenhardt, Barker, & Topp, 2003; Forsyth,

1996; Topp et al., 1999; Sherlock & Conner, 1999; Riley et al., 2001). The category of 'Regular' users was defined as those who take Ecstasy at least once a week on a regular basis (partying on weekends) and 'moderate patterns of Ecstasy use' was defined as taking one or two Ecstasy pills per occasion/episode. Based on these definitions, Table 4.2 shows the responses to the two quantity-frequency questions assessed among the 42% (N=270) of the participants who consumed Ecstasy within the past 30 days prior to their interview (hereinafter, referred to as "recent users").

Overall, recent Ecstasy users reported using the drug for an average of 2.81 days (SD=2.69), ranging from 1 to 15 days a month. There were no observed gender differences in the patterns of recent (30-day) Ecstasy use, as both males and females reported using the drug on average 2.80 days (SD=2.69). In contrast, there were significant site differences for the average number of days participants used Ecstasy, $F(2)=5.45$, $p=.0048$. In particular, Ecstasy users in Miami reported less drug-use days on average per month [$M_{MI}=1.96$ (SD=1.95)] than participants from the other two sites [$M_{SL}=2.63$ days (SD=3.01) in St. Louis and $M_{SDY}=3.32$ days (SD=2.64) in Sydney].

Table 4.2 also depicts additional information on the pattern of Ecstasy use days. Of the 270 participants who used Ecstasy within the past 30 days, 74% (N=200) reported taking it 1 to 3 days, whereas 26% (N=70) used the drug on four or more days (about once a week, on average) during the same 30-day period. This suggests that only one quarter of the current sample of users can be qualified as "regular

users." Furthermore, there was no statistically significant gender difference in the days of Ecstasy consumption over the past 30 days (76% of male used Ecstasy between one and three days and 24% used it four or more days vs. 72% of female used Ecstasy between one and three days and 28% used it on four or more days).

There were, however, significant site differences in the number of Ecstasy use days in the past 30 days, $\chi^2(2)=14.64$, p=.0007. Although about the same pattern of Ecstasy use days was observed in St. Louis and Miami, Sydney had relatively fewer participants (63% vs. 82% in St. Louis and 86% in Miami) who used Ecstasy one to three days and more participants (37% vs. 18% in St. Louis and 14% in Miami) who used it for four or more days. This observed difference suggests that there are relatively more "regular users" in the sample recruited from Sydney than from either one of the two U.S. sites.

Participants were also asked about the "number of times per day" they used Ecstasy. Table 4.2 shows that on average, the 270 participants who used Ecstasy within the past 30 days reported taking it about two (1.82) times a day (SD=1.46). Mean comparisons by gender and across sites showed no statistically significant differences for the average number of times per day study participants used Ecstasy over the designated study period.

As a point of further clarification, 157 or 58% of the 270 "recent" users used Ecstasy one time a day, while 113 (42%) used it two or more times a day. These proportions did not differ by gender, which suggests that the study sample included

users with moderate consumption habits. However, site comparisons indicated significant differences in the daily intake-frequency of use (a proxy measure of quantity) among recent users, $\chi^2(2)=13.64$, $p<.0011$. Whereas about a third of the participants in St. Louis (30%) and Miami (35%) used Ecstasy two or more times per occasion, more than half (54%) of Sydney participants did the same.

Taken together, these findings suggest that study participants in Sydney report strikingly different Ecstasy consumption habits than their counterparts in St. Louis and Miami. Specifically, there are more "regular" Ecstasy users with more frequent pattern of use in Sydney than in the other two sites. This may explain why Sydney users reported taking more Ecstasy pills lifetime than those in St. Louis or Miami.

Consumption Patterns of Other Substances --- Recent evidence suggests that Ecstasy is used alone or in combination with other licit and/or illicit drugs (Cottler et al., 2001; Wu el al., 2009). To examine further the patterns of drug use habits in the current sample, CDSLAM participants were asked about their consumption of alcohol and a variety of other drugs. Self-reported prevalence rates of lifetime (more than 5 times) use of some of these substances among the study sample are reported in Table 4.3. The results show that most participants have used a number of other substances over time. Alcohol, in particular, was very common, as almost 100% of the sample reported having consumed alcohol beverages in the past and that they started drinking at the age of 14. This was a consistent finding regardless of the participant's gender or site.

**Table 4.3 Other Substances Used among Study Participants by Gender and Site (N=640)**

| Characteristic | Total Sample (N =640) n(%) | Gender Female (N =271) % | Gender Male (N =369) % | Site St. Louis (N =296) % | Site Miami (N =186) % | Site Sydney (N =158) % |
|---|---|---|---|---|---|---|
| **Use of Other Substances** (*Lifetime*) | | | | | | |
| **Alcohol** | | | | | | |
| Drank alcohol beverages | 638(100%) | 100% | 100% | 99% | 100% | 100% |
| Mean age of onset (SD) | 14.3(2.76) | 14.3(2.62) | 14.3(2.87) | 14.3(3.02) | 14.4(2.86) | 14.3(2.07) |
| **Other Club Drugs** (Other than Ecstasy) | | | | | | |
| Ketamine | 219(34%) | 69(25%) | 150(41%)*** | 95(32%) | 69(37%) | 55(35%) |
| GHB | 112(18%) | 32(12%) | 80(22%)*** | 40(14%) | 49(26%) | 23(15%)*** |
| Rohypnol | 76(12%) | 21(8%) | 55(15%)** | 14(5%) | 54(29%) | 8(5%)*** |
| Used one or more club drugs | 275(43%) | 93(34%) | 182(49%)*** | 111(37%) | 97(52%) | 67(42%)** |
| Mean age of onset of 1st club drug (SD) | 19.6(4.40) | 19.6(4.81) | 19.6(4.19) | 19.6(4.25) | 19.2(4.83) | 20.3(3.95) |
| **Other Illicit Drugs** | | | | | | |
| Marijuana | 624(98%) | 264(97%) | 361(98%) | 292(99%) | 182(98%) | 151(96%) |
| Hallucinogens | 410(64%) | 153(56%) | 257(70%)*** | 196(66%) | 142(76%) | 72(46%)*** |
| Stimulants | 402(63%) | 154(57%) | 248(67%)** | 172(58%) | 87(47%) | 143(91%)*** |
| Cocaine | 390(61%) | 149(55%) | 241(65%)** | 194(66%) | 133(72%) | 63(40%)*** |
| Mean age of onset of 1st illicit drug (SD) | 14.8(2.97) | 15.0(2.62) | 14.7(3.21) | 14.5(2.82) | 15.0(3.53) | 15.3(2.43)* |
| **Order of 1st Use** | | | | | | |
| Ecstasy used before other illicit drugs | 14(2%) | 3% | 2% | 0% | 5% | 3%*** |
| Ecstasy & other illicit drugs used at the sam time | 497(78%) | 77% | 78% | 73% | 82% | 82% |
| Other illicit drugs used before Ecstasy | 129(20%) | 20% | 20% | 27% | 13% | 16% |

Notes: 1. Percents might not add up to 100% in some cases due to truncation

2. Sites comparisons were assessed with Chi-Square for categorical variables and t-Test for continuous variables. Statistically significant levels are indicated by * for $p \leq .05$, ** for $p \leq .01$, and *** for $p \leq .001$

Table 4.3 also shows that consumption of other drugs is quite prevalent in this sample. When asked about their use of other "club (or party) drugs," 34% (N=219) of the participants reported using Ketamine, 18% (N=112) used GHB, and 12% (N=76) used Rohypnol, all three examples of other popular "club drugs." There were, however, statistically significant differences by gender and site with regards to the use of each one of these drugs. Males were significantly more likely to report using one or more of these drugs than female participants, $\chi^2(1)=14.36$, p=.0002 (49% for males and 39% for females, respectively). On the other hand, with the exception of Ketamine, which was used by about a third of the participants in each site, more Ecstasy users in Miami reported having used GHB and Rohypnol than those in St. Louis and Sydney. Also, the participants' earliest exposure to any of these party-drugs was between the age of 19 and 20 years regardless of their gender or site, suggesting that Ecstasy was the first substance to be used among all four common club-drugs.

Measures of drug consumption also included questions about lifetime use of other illicit drugs from a list of nine commonly known drug categories (Cottler, 2000). Table 4.3 shows the top four most prevalently used drugs. Marijuana was the primary drug reported by most (98%) participants, followed by (64%) hallucinogens, (63%) stimulants, and (61%) cocaine. Both males and females were equally likely to use marijuana (97% vs. 98% for females and males, respectively). The prevalence of use of the other listed drugs differed, however, significantly by gender. More males

than females reported having used hallucinogens, $\chi^2(1)=11.81$, p=.0006 (70% vs. 56%), stimulants, $\chi^2(1)=7.21$, p=.0072 (67% vs. 57%), and cocaine, $\chi^2(1)=7.01$, p=.0081 (65% vs. 55%).

Although study participants did not differ significantly in their use of marijuana, the reported prevalence rates of hallucinogen use were highest among Miami participants (76%) compared to St. Louis (66%) and Sydney (46%), $\chi^2(2)=36.25$, p<.0001. Likewise, the prevalence of cocaine use was significantly higher among participants in Miami (72%) and St. Louis (66%) than Sydney (40%), $\chi^2(2)=40.81$, p<.0001. Also, while most of the participants in Sydney (91%) reported having used stimulants, significantly lower proportions reported doing the same in St. Louis (58%) and Miami (47%), $\chi^2(2)=75.16$, p<.0001.

Additionally, while the overall mean age-of-onset of the first illicit drug used was 14.8 years (SD=2.97) and did not differ by gender, the mean age for participants first trying any illicit drug differed significantly across sites, F(2)=37.48, p=.0143, with the age of onset slightly older in Sydney (15.3 years, SD=2.43) than in St. Louis (14.5 years, SD=2.82) and Miami (15.0 years, SD=3.35).

Examination of the age-of-onset when any illicit drug was used in comparison to the age of first time use of Ecstasy revealed that only 14 (2%) participants started using Ecstasy before using other drugs. On the other hand, a vast majority (N=497, 78%) of the participants started using Ecstasy and other drugs at the same age. The remaining (N=129, 20%) participants started using Ecstasy after using a variety of

other drugs. There was no significant difference by gender in the order of first use of drugs, as a large majority of both female and male were found to have used Ecstasy for the first time either at the same age (77% & 78%, respectively) or a few years after using other drugs (20% of each gender). There were however significant site differences, $\chi^2(2)=24.15$, $p<.0001$. Specifically, while about 85% of the participants in Sydney and Miami initiated their Ecstasy use before or at the same age they experimented with other illicit drugs, almost 100% of St. Louis study participants started using Ecstasy either at the same age or years after using various drugs.

DSM-IV Diagnostic Information --- Table 4.4 contains the lifetime substance use diagnoses for Ecstasy, alcohol, other club-drugs, and other licit and illicit drugs. This information is based on diagnostic algorithms from the DSM-IV (Diagnostic and Statistical Manual of Mental Disorders, 4th Edition). Participants are asked a variety of questions about symptoms or problems that may result from their drug use. These symptoms are then clustered into "criteria" based on defined algorithms. The diagnostic results for Ecstasy use indicated that 25% (N=163) of the participants received no diagnosis, 15% (N=97) met criteria for DSM-IV "abuse," and 59% (N=380) of the sample met DSM-IV threshold (3 or more criteria experienced simultaneously within a 12 month period) for "dependence." Similar proportions were observed for female (23% no diagnosis, 13% abuse, and 64% dependence) and male (27%, 17%, and 56%, respectively) participants. There were also no significant site differences for diagnosis of abuse (17%, 16%, and 12%, respectively for St.

**Table 4.4 Lifetime Addiction among Study Participants by Gender and Site (N=640)**

| | *Total* | *Gender* | | *Site* | | |
|---|---|---|---|---|---|---|
| | *Sample* | *Female* | *Male* | *St. Louis* | *Miami* | *Sydney* |
| | (N =640) | (N =271) | (N =369) | (N =296) | (N =186) | (N =158) |
| *Characteristic* | n(%) | % | % | % | % | % |
| **DSM IV Substance Use Disorders** (Lifetime) | | | | | | |
| Ecstasy | | | | | | |
| No diagnosis | 163(25%) | 23% | 27% | 30% | 21% | 21%* |
| Abuse | 97(15%) | 13% | 17% | 17% | 16% | 12% |
| Dependence | 380(59%) | 64% | 56% | 53% | 63% | 66% |
| Alcohol dependence | 520(81%) | 79% | 83% | 82% | 85% | 73%** |
| Any other club-drug dependence | 132(21%) | 16% | 24%** | 16% | 31% | 17%** |
| Any other licit or illicit drug dependence | 573(90%) | 86% | 92%** | 90% | 92% | 85%* |

Notes: 1. Percents might not add up to 100% in some cases due to truncation

2. Sites comparisons were assessed with Chi-Square for categorical variables and t-Test for continuous variables. Statistically significant levels are indicated by
* for $p \leq .05$, ** for $p \leq .01$, and *** for $p \leq .001$

Louis, Miami and Sydney), but there was a significant difference for diagnosis of dependence, $\chi^2(2)=10.56$, p=.0320 (66%, 63%, and 53%, respectively for Sydney, Miami, and St. Louis).

A diagnosis of "dependence" represents the most severe level of substance use disorder. In this respect, Table 4.4 shows that an overwhelming majority (N=520 or 81%) of the participants were diagnosed with alcohol dependence. There was no significant gender difference in diagnosis of alcohol dependence. There were, however, statistically significant differences by site, $\chi^2(2)=9.00$, p=.0111. Ecstasy users in Miami and St. Louis were found to be more alcohol dependent that those in Sydney, as 85% and 82% vs. 73% of the participants in those three sites were diagnosed with alcohol dependence, respectively.

Similar patterns where observed for dependence with other club-drugs as well as other illicit drugs. Although the prevalence of DSM-IV dependence was lower for "any other club drug" (i.e., Ketamine, GHB, and Rohypnol) (N=132 or 21% of the sample) than for "Any other licit or illicit drug" (i.e., marijuana, stimulants, sedatives, cocaine, heroin/opioids, PCP, hallucinogens, and inhalants) (N=573 or 90%), there were statistically differences by gender and site. More males were found dependent on "Any other licit or illicit drug" (24%) and "Any other licit or illicit drug" (92%) than females (16% and 86% for each group of drugs respectively). Additionally, more individuals from Miami were diagnosed as "other club drug" dependent (31%) than among participants in Sydney (17%) or St. Louis (16%). On the other hand, while the

prevalence rates of dependence among Ecstasy users in Miami (92%) and St. Louis (90%) were very comparable, more participants were dependent on "other licit or illicit drug" in Sydney than their Miami and St. Louis counterparts (85%).

To summarize the descriptive information, the analyses indicated that although Ecstasy users in this sample were a homogenous group with respect to several key demographic measures, they differed across sites on numerous facets of their lifetime and current drug consumption patterns, including patterns of Ecstasy use and dependence.

2. **Exploratory Data Analysis**

Prior to empirically testing the proposed psycho-economic model, the raw data was further scrutinized for potential violations of the basic assumptions of multinormality and non-multicollinearity (or singularity) required for the maximum likelihood estimation procedure used for the SEM parameters estimation (Bagozzi & Yi, 1998). Failure to address these two conditions may bias SEM parameter estimates, produce unreliable standard errors, and more importantly violate basic assumptions underlying the $\chi^2$ statistic as a measure of overall fit the SEM (Hair et al., 1998). The results from this preliminary exploratory analysis are discussed in the present section.

Tests of Normality --- As a necessary, but not sufficient, condition for multivariate normality of data, the univariate normal distribution should be checked for each individual variable in the model. This was accomplished by examining the

skewness and kurtosis as measures of central tendency for each observed variable. Both statistics provide univariate point-estimates of deviation from normality. A common rule-of-thumb dictates that the skew should be within the range of -2 to +2 and the kurtosis should be within the range of -3 to +3 for a variable to be described as normally distributed (Hair et al., 1998). Kline (2005) advocates that skewness greater than 3 in absolute value and kurtosis values greater than 10 in absolute value should be described as extreme non-normality conditions. In this study, the most commonly used rule-of-thumb required cutoff values within ±2 range for skewness and ±3 range for kurtosis.

Accordingly, the 85 separate questionnaire items were regrouped into five major conceptual domains: Demographics (gender, age, race, education, and site), outcome measures (measures used to reflect Ecstasy Consumption and Dependence), economic factors [income index (as a measure of social anomie), unit price of Ecstasy pill, and opportunity cost of acquiring Ecstasy], psychological factors (indicators of Motivation), and other risk factors [indicators of Depression and a composite of sex risk (measuring risk-taking)]. Within each domain, and when possible, the observed items were parceled into groups of theoretically related-items to form reliable scales (unit weighted "index" measures or composites), as already discussed in the methodology chapter.

A summary of descriptive statistics (e.g. mean, standard deviation (SD), skew, and kurtosis) provided by SAS® UNIVARIATE procedure for all of the individual

items and index scales used in the model (except for the demographic variables) are shown sequentially in Tables 4.5. Overall, the skewness and kurtosis values for a vast majority of the observed variables (80% or 64 out of the 80 items reported) fell within the commonly acceptable ranges, fairly suggesting univariate normality of the data. The exceptions included sixteen (20%) variables identified as having values (highlighted in the tables, using italic font and underlined) outside the desired first-order moment ranges indicating low to moderate non-normality. Transformation (both logarithm and square root) of these items alone and in combination with the removal of outlier values did not substantially lower the magnitude of skewness and kurtosis for most of these variables. Thus, violation of the normality assumption may be caused by the true skewness reflected in the consistent response of the participants rather than from the contribution of distinct outliers.

Furthermore, it should be noted that, with the exception of three items (e.g. 'number of days used Ecstasy in past 30 days,' 'continued to use despite knowledge of potential problems,' and 'average time it would take to get Ecstasy'), the highly skewed or kurtotic variables were transformed and parceled into aggregate composites, as described earlier. Such practice of item parceling is often recommended to summarize a large number of homogeneous or conceptually similar variables and reduce the influence of their restricted variances (Bandalos, 2002; Hau & Marsh, 2004; Little et al., 2002). In this study, parceling not only reduced the number of observed variables from 80 to 23 (making the model more parsimonious),

but also resulted in more normally distributed measures than the original items. Indeed, as shown in Table 4.5, the univariate skewness of each of the 12 created item-parcels varied between -0.68 and 1.59, while their respective kurtosis varied between -1.86 and 2.18, both of which are well within their acceptable (±2 & ±3) ranges. The improvements in central tendency and close approximation of normality argued convincingly for using parcels and composite indicators without data transformations (e.g., logarithm, spline, square root, or inverse weighting) or deleting specious outliers (Liang et al., 1990). Furthermore, the EQS Maximum likelihood estimation procedure provides the Satorra-Bentler scaling corrections for the $\chi^2$-statistic (SB $\chi^2$) to adjust for any overall bias in estimation from multivariate non-normality (Chou & Bentler, 1995; Satorra & Bentler, 1988).

In addition to the descriptive statistics, Table 4.5 also includes gender (fifth column) and site (sixth, seventh, and eighth columns) mean differences for all the observed items and scales used in the model estimation. Overall, the results indicate there were several gender differences. For example, female Ecstasy users were more likely to endorse the "adopted" DSM-IV Dependence Criteria for Ecstasy than males. However, although females were more likely than males to endorse six out of the seven dependence criteria, only three out of the six mean differences were at an acceptable statistically significant level ($p \leq .05$). The remaining three criteria indicated a trend ($.05 < p \leq .10$, not shown in Table 4.5) for females to indicate they experienced problems from their Ecstasy use.

**Table 4.5 Summary Statistics for the Selected Items & Scales used in the Psycho-Economic Model (N=640)**

| *Latent Construct and Measured Variable* | *Mean* | *SD* | *Skew* | *Kurtosis* | *Mean Gender (Female-Male) Difference* | *Mean Site Difference St. Louis-Miami* | *St. Louis-Sydney* | *Miami-Sydney* |
|---|---|---|---|---|---|---|---|---|
| ***Outcome Measures*** | | | | | | | | |
| **Ecstasy Use: *Consumption*** | | | | | | | | |
| Lifetime assessment of number of pills used | 6.28 | 4.08 | 0.05 | -1.75 | -0.51 | -1.00* | -1.98*** | -0.97* |
| Number of days used Ecstasy in past 30 days | 1.18 | 2.23 | *3.15* | *12.39* | 0.06 | 0.18 | -1.85*** | -2.02*** |
| Frequency of use per day in past 30 days | 0.71 | 1.03 | 1.60 | 2.03 | 0.01 | -0.10 | -1.02*** | -0.92*** |
| Recency of Ecstasy use | 0.33 | 0.47 | 0.70 | -1.51 | -0.01 | -0.02 | -0.47*** | -0.45*** |
| **DSM-IV Dependence Criterion: *Addiction*** | | | | | | | | |
| Tolerance | 0.50 | 0.50 | -0.01 | -2.01 | -0.03 | -0.13** | -0.12** | 0.01 |
| Withdrawal | 0.69 | 0.46 | -0.83 | -1.31 | 0.04 | -0.03 | -0.13** | -0.10* |
| Increased use over longer period of time than intended | 0.43 | 0.50 | 0.28 | -1.93 | 0.09* | -0.10* | -0.11* | -0.003 |
| Desire or inability to cut down or control use | 0.17 | 0.38 | 1.76 | 1.09 | 0.06* | -0.04 | -0.07 | -0.03 |
| Great deal of time spent to acquire, use, or recover | 0.56 | 0.50 | -0.23 | -1.95 | 0.01 | -0.14** | -0.14** | 0.01 |
| Reduce or avoid important activities because of use | 0.25 | 0.44 | 1.13 | -0.73 | 0.07* | -0.04 | -0.14** | -0.10* |
| Continue to use despite knowledge of potential problems | 0.87 | 0.33 | *-2.3* | *3.08* | 0.03 | -0.05 | -0.04 | 0.01 |
| ***Economic Factors*** | | | | | | | | |
| **Income index** | **1.61** | **1.12** | **0.09** | **-0.89** | **0.01** | **0.06** | **0.22*** | **0.18*** |
| Unemployed, last 12 months | 0.37 | 0.48 | 0.52 | -1.73 | 0.12** | -0.10* | -0.09 | 0.01 |
| Total Income below poverty level, last 12 months | 0.57 | 0.5 | -0.29 | -1.92 | 0.12** | 0.02 | 0.12** | 0.10* |
| Had an illegal source of income, last 12 months | 0.33 | 0.47 | 0.74 | -1.45 | -0.21*** | 0.13** | 0.10* | -0.03 |
| Current job situation | 0.34 | 0.47 | 0.67 | -1.56 | -0.02 | -0.001 | 0.09* | 0.09* |
| **Monetary cost** ($20 or less vs. higher) | **0.59** | **0.49** | **-0.38** | **-1.86** | **0.94** | **-0.36***** | **0.49***** | **0.85***** |
| Price of a pill paid last time purchased | 20.28 | 9.08 | 0.25 | 0.26 | -0.05 | 6.73*** | -10.03*** | -16.76*** |
| **Opportunity cost** | **0.66** | **0.47** | **-0.68** | **-1.54** | **-0.01** | **-0.06** | **-0.18***** | **-0.12*** |
| Average Time it would take to get Ecstasy (in days) | 0.41 | 0.93 | *2.95* | *10.45* | 0.05 | 0.16 | 0.23*** | 0.07 |

Note: Statistically significant differences indicated by * for $p \leq .05$, ** for $p \leq .01$, and *** for $p \leq .001$

(Continued)

**Table 4.5 Summary Statistics for the Selected Items & Scales used in the Psycho-Economic Model (N=640)** (Cont.)

| *Latent Construct and Measured Variable* | *Mean* | *SD* | *Skew* | *Kurtosis* | *Mean Gender (Female-Male) Difference* | *Mean Site Difference St. Louis-Miami* | *St. Louis-Sydney* | *Miami-Sydney* |
|---|---|---|---|---|---|---|---|---|
| ***Psychological Factors*** | | | | | | | | |
| **Motivation** | | | | | | | | |
| **Opportunities to get Ecstasy** | **1.53** | **0.98** | **0.52** | **-0.40** | **-0.30*****| **-0.19*** | **-0.12*** | **0.07** |
| For free | 0.87 | 0.34 | *-2.2* | 2.80 | 0.04 | -0.09** | -0.05 | 0.04 |
| By stealing it | 0.05 | 0.21 | *4.38* | *17.26* | -0.03* | -0.04* | 0.002 | 0.04 |
| As payment for service | 0.32 | 0.47 | 0.77 | -1.41 | -0.14*** | -0.06 | -0.08* | -0.02 |
| From dealing | 0.30 | 0.46 | 0.88 | -1.22 | -0.16*** | -0.004 | -0.0002 | 0.004 |
| **Places/People to get Ecstasy from** | **7.17** | **2.21** | **-0.09** | **-0.50** | **-0.06** | **-1.05***** | **-1.07***** | **-0.01** |
| From spouse or partner | 0.52 | 0.50 | -0.09 | -2.00 | 0.27*** | -0.14** | -0.11* | 0.03 |
| From a family member | 0.13 | 0.34 | *2.15* | 2.63 | 0.02 | -0.08** | -0.10** | -0.02 |
| From a roommate, co-worker or friend | 0.94 | 0.23 | *-3.8* | *12.47* | -0.03 | -0.05* | -0.03 | 0.02 |
| From a stranger | 0.62 | 0.48 | -0.51 | -1.74 | -0.08* | 0.005 | -0.09* | -0.10* |
| From a dealer | 0.66 | 0.47 | -0.68 | -1.54 | -0.01 | -0.11** | -0.21*** | -0.10* |
| At home, apartment or dorm | 0.93 | 0.25 | *-3.4* | *9.70* | 0.01 | -0.04 | 0.04 | 0.08** |
| At a rave | 0.78 | 0.42 | -1.33 | -0.23 | -0.03 | -0.10** | -0.17*** | -0.07 |
| At a bar or club | 0.83 | 0.37 | -1.79 | 1.20 | -0.03 | -0.16*** | -0.25*** | -0.09** |
| At a fraternity or sorority party | 0.13 | 0.33 | *2.25* | *3.08* | -0.06* | 0.03 | -0.12*** | -0.15*** |
| At work or school | 0.15 | 0.35 | 2.00 | 2.01 | -0.07** | -0.04 | -0.02 | 0.02 |
| At a beach, park, or other public place | 0.63 | 0.48 | -0.55 | -1.71 | -0.01 | -0.20*** | -0.05 | 0.14** |
| In a car | 0.62 | 0.49 | -0.50 | -1.76 | -0.05 | -0.09* | 0.07 | 0.17** |
| Some other place | 0.22 | 0.42 | 1.32 | -0.26 | 0.0002 | -0.08* | -0.03 | 0.05 |

Note: Statistically significant differences indicated by * for $p \leq .05$, ** for $p \leq .01$, and *** for $p \leq .001$

(Continued)

**Table 4.5 Summary Statistics for the Selected Items & Scales used in the Psycho-Economic Model (N=640)** (Cont.)

| *Latent Construct and Measured Variable* | *Mean* | *SD* | *Skew* | *Kurtosis* | *Mean Gender (Female-Male) Difference* | *Mean Site Difference St. Louis-Miami* | *St. Louis-Sydney* | *Miami-Sydney* |
|---|---|---|---|---|---|---|---|---|
| ***Psychological Factors*** (Cont.) | | | | | | | | |
| **Motivation** (Cont.) | | | | | | | | |
| **People to share Ecstasy with** | **3.07** | **1.20** | **0.17** | **-0.62** | **-0.18** | **-0.14** | **-0.41*** ** | **-0.27*** |
| With spouse or partner | 0.79 | 0.40 | -1.46 | 0.12 | 0.10** | -0.05 | -0.03 | 0.02 |
| With a family member | 0.26 | 0.44 | 1.10 | -0.79 | -0.01 | -0.09* | -0.18*** | -0.09 |
| With a roommate, co-worker or friend | 0.98 | 0.15 | *-6.6* | *41.07* | -0.01 | -0.03* | -0.02 | 0.007 |
| With a stranger | 0.49 | 0.50 | 0.05 | -2.00 | -0.10* | 0.06 | -0.04 | -0.10 |
| With a dealer | 0.28 | 0.45 | 0.97 | -1.07 | -0.04 | 0.04 | -0.11* | -0.14** |
| Alone | 0.28 | 0.45 | 1.00 | -1.02 | -0.11** | -0.06 | -0.02 | 0.03 |
| **Specific motives to use Ecstasy** | **4.24** | **1.82** | **0.25** | **-0.49** | **0.03** | **-0.29** | **0.02** | **0.31** |
| To relieve stress | 0.32 | 0.47 | 0.76 | -1.43 | 0.03 | -0.05 | -0.03 | -0.01 |
| To bond with friends | 0.68 | 0.47 | -0.76 | -1.42 | -0.05 | -0.02 | -0.01 | 0.005 |
| Pressured by others | 0.15 | 0.36 | 1.95 | 1.80 | -0.02 | -0.02 | -0.03 | -0.003 |
| To get in touch with yourself | 0.37 | 0.48 | 0.55 | -1.71 | -0.01 | -0.06 | 0.03 | 0.09 |
| To have a spiritual experience | 0.31 | 0.46 | 0.84 | -1.29 | -0.07 | -0.05 | 0.07 | 0.12* |
| To numb your mind or forget problems | 0.41 | 0.49 | 0.38 | -1.86 | 0.07 | -0.12** | -0.09 | 0.03 |
| For no reason | 0.68 | 0.47 | -0.76 | -1.42 | 0.07 | -0.02 | 0.07 | 0.09* |
| Out of curiosity | 0.90 | 0.30 | *-2.7* | *5.48* | 0.01 | 0.01 | 0.08** | 0.07* |
| For some other reason | 0.42 | 0.49 | 0.32 | -1.90 | 0.01 | 0.04 | -0.07 | -0.10* |

Note: Statistically significant differences indicated by * for $p \leq .05$, ** for $p \leq .01$, and *** for $p \leq .001$

(Continued)

**Table 4.5 Summary Statistics for the Selected Items & Scales used in the Psycho-Economic Model (N=640)** (Cont.)

| Latent Construct and Measured Variable | Mean | SD | Skew | Kurtosis | Mean Gender (Female-Male) Difference | Mean Site Difference St. Louis-Miami | St. Louis-Sydney | Miami-Sydney |
|---|---|---|---|---|---|---|---|---|
| ***Other Risk Factors*** | | | | | | | | |
| **Depression** | | | | | | | | |
| **Behavioral** | **0.91** | **0.95** | **0.82** | **-0.11** | **0.05** | **-0.08** | **0.28**** | **0.36***** |
| Unfriendly: *People were unfriendly* | 0.53 | 0.74 | 1.34 | 1.27 | -0.06 | 0.03 | 0.26*** | 0.23** |
| Restless: *Sleep was restless* | 1.08 | 1.01 | 0.59 | -0.75 | 0.03 | 0.003 | 0.10 | 0.10 |
| Effort: *Everything was an effort* | 1.18 | 1.02 | 0.46 | -0.88 | 0.15 | -0.01 | 0.44*** | 0.45*** |
| Appetite: *Did not feel like eating* | 0.67 | 0.89 | 1.20 | 0.47 | 0.11 | -0.09 | -0.08 | 0.01 |
| **Somatic** | **0.55** | **0.84** | **1.59** | **2.18** | **0.06** | **0.07** | **0.15** | **0.08** |
| Lethargic: *Could not get 'going'* | 0.83 | 0.89 | 0.81 | -0.25 | 0.05 | 0.27*** | 0.03 | -0.25** |
| Quiet: *Talked less than usual* | 0.70 | 0.88 | 1.08 | 0.23 | -0.15* | -0.04 | 0.06 | 0.11 |
| Crying: *Had crying spells* | 0.33 | 0.66 | *2.19* | *4.66* | 0.41*** | 0.001 | 0.02 | 0.02 |
| Disliked: *Felt disliked by people* | 0.41 | 0.71 | 1.80 | 2.87 | -0.001 | 0.05 | 0.02 | -0.03 |
| **Affective** | **0.245** | **0.94** | **0.36** | **0.96** | **0.01** | **0.05** | **0.28**** | **0.23*** |
| Failure: *Thought life had been a failure* | 0.38 | 0.72 | *2.05* | *3.71* | -0.04 | 0.03 | 0.05 | 0.02 |
| Enjoy life: *Enjoyed life* | 0.61 | 0.83 | 1.19 | 0.45 | 0.11 | 0.03 | -0.19** | -0.22** |
| Happy: *Was happy* | 0.72 | 0.85 | 0.98 | 0.09 | 0.12 | -0.07 | -0.19** | -0.13 |
| Depressed: *Felt depressed* | 0.79 | 0.9 | 0.96 | 0.05 | 0.15* | 0.07 | 0.18* | 0.11 |
| Fearful: *Felt fearful* | 0.56 | 0.81 | 1.35 | 1.02 | 0.04 | 0.03 | 0.18* | 0.14 |
| Mind: *Trouble keeping focused on tasks* | 1.21 | 0.94 | 0.28 | -0.84 | 0.15* | 0.03 | 0.10 | 0.07 |
| **Cognitive** | **2.33** | **1.04** | **0.92** | **1.62** | **0.06** | **-0.06** | **0.34***** | **0.39***** |
| Hopeful: *Felt hopeful about the future* | 0.74 | 0.90 | 1.01 | 0.03 | 0.22** | -0.02 | -0.25** | -0.23** |
| Blues: *Could not shake off the blues* | 0.69 | 0.91 | 1.10 | 0.15 | 0.13 | 0.13 | 0.28** | 0.15* |
| Lonely: *Felt lonely* | 0.79 | 0.94 | 0.96 | -0.14 | 0.04 | 0.01 | 0.13 | 0.12 |
| Bothered: Was bothered by things | 0.66 | 0.83 | 1.12 | 0.52 | 0.20** | -0.04 | 0.08 | 0.12 |
| As good as others: *Felt just as good as other people* | 0.64 | 0.92 | 1.26 | 0.47 | 0.09 | -0.12 | -0.22** | -0.10 |
| Sad: *Felt sad* | 0.77 | 0.82 | 0.97 | 0.51 | 0.22*** | 0.07 | 0.13 | 0.06 |

Note: Statistically significant differences indicated by * for $p \leq .05$, ** for $p \leq .01$, and *** for $p \leq .001$

(Continued)

**Table 4.5 Summary Statistics for the Selected Items & Scales used in the Psycho-Economic Model (N=640)** (Cont.)

| *Latent Construct and Measured Variable* | *Mean* | *SD* | *Skew* | *Kurtosis* | *Mean Gender (Female-Male) Difference* | *Mean Site Difference St. Louis-Miami* | *St. Louis-Sydney* | *Miami-Sydney* |
|---|---|---|---|---|---|---|---|---|
| ***Other Risk Factors*** (Cont.) | | | | | | | | |
| **Sex Risks** | **5.23** | **1.59** | **0.12** | **-0.20** | **0.10** | **0.01** | **0.32**** | **0.31*** |
| Ever had vaginal sex | 0.97 | 0.18 | *-5.1* | *24.33* | 0.04* | 0.004 | -0.002 | -0.006 |
| Ever had oral sex | 0.98 | 0.14 | *-7.1* | *48.74* | 0.01 | -0.004 | -0.001 | 0.003 |
| Ever had anal sex | 0.46 | 0.50 | 0.16 | -1.98 | -0.08 | -0.08 | 0.03 | 0.12* |
| Age first time had sex | 0.29 | 0.46 | 0.91 | -1.18 | -0.06 | 0.03 | 0.14*** | 0.11** |
| Had 3 or more sex partners, in last 3 months | 0.18 | 0.38 | 1.69 | 0.85 | -0.10*** | 0.02 | -0.001 | -0.02 |
| Ever experienced forced sexual contact | 0.16 | 0.37 | 1.82 | 1.31 | 0.14*** | 0.01 | 0.004 | -0.01 |
| Use of condom with vaginal sex, in past 12 months | 0.31 | 0.46 | 0.80 | -1.40 | 0.09* | -0.002 | 0.03 | 0.03 |
| Use of condom with oral sex, in past 12 months | 0.88 | 0.32 | -2.40 | 3.70 | 0.02 | 0.07* | 0.04 | -0.03 |
| Use of condom with anal sex, in past 12 months | 0.21 | 0.41 | 1.42 | 0.02 | -0.001 | -0.0001 | 0.10** | 0.10** |
| Ever used Ecstasy while having sex | 0.78 | 0.42 | -1.33 | -0.23 | 0.04 | -0.04 | -0.02 | 0.01 |

Note: Statistically significant differences indicated by * for $p \leq .05$, ** for $p \leq .01$, and *** for $p \leq .001$

Also, with the exception of these noted differences in the "adopted" Ecstasy-use-disorder criteria, there was no consistent pattern in the observed gender differences. Gender had a significant effect on most of the measures lumped into the Economic Factors domain. Females were more likely to report being "unemployed, last 12 months," $M_{F-M}$=.12, t=3.13, p=.002, and have a "total income below poverty level, last 12 months," $M_{F-M}$=.12, t=3.09, p=.002. Males, on the other hand, were more likely to report that they "had an illegal source of income, last 12 months," $M_{F-M}$=-.21, t=-6.04, p<.0001.

Similar results were observed for the measures constituting the Psychological Factors domain. For instance, females were more likely than males to report getting Ecstasy "from spouse or partner," $M_{F-M}$=.27, t=7.12, p<.0001, and sharing it "with spouse or partner," $M_{F-M}$=.10, t=3.16, p=0.002, while they were less likely than males to acquire Ecstasy "from dealing," $M_{F-M}$=-.14, t=-3.77, p=.0002, or "as a payment for service," $M_{F-M}$=-.16, t=-4.53, p<.0001.

For the measures categorized as Other Risk Factors, males were more likely than females to report that they "talked less than usual," $M_{F-M}$=-.15, t=-2.21, p=.0277. Conversely, females were more likely than males to report that they "had crying spells," $M_{F-M}$=.41, t=7.58, p<.0001. Males and females also differed with regard to the Sex Risk domain. In particular, while males were found to be more likely than females to have "had 3 or more sex partners, in the last 3 months," $M_{F-M}$=-.10, t=-

3.56, p=.0004, females were more likely than males to have "ever experienced forced sexual contact," $M_{F-M}$=.14, t=4.95, $p$ <.0001.

Taken together, the above findings suggested that male and female Ecstasy users may differ with regard to their Ecstasy consumption patterns and its consequences as well as over the behaviors that may place them at risk. However, it is unlikely these gender differences were preserved once aggregate scales were formed. As can be seen in Table 4.5, most of the composite indices employed in this study showed no statistically significant differences by gender. One exception is the psychological motivation subscale labeled "opportunity to get Ecstasy." This composite score was calculated based on four alternative ways to get Ecstasy other than paying money for it. Analyses indicated that males were more likely than females to report using three out of the four ways: "by stealing it," $M_{F-M}$=-.03, t=-2.03, p=.0423, "as a payment for service," $M_{F-M}$=-.14, t=-3.77, p=.0002, and "From dealing," $M_{F-M}$=-.16, t=-4.41, p<.0001. On the other hand, females more frequently obtained Ecstasy "for free" but not significantly more than males, $M_{F-M}$=.04, t=1.34, p=.1797. As a result, males scored significantly higher than their counterpart females on the overall subscale, $M_{F-M}$=-.30, t=-3.92, p<.0001.

Table 4.5 also shows slightly more site than gender differences for most of the variables just discussed. As shown, there were some marked site differences in all of the consumption pattern measures. Participants from Sydney were more likely to report greater number of Ecstasy pills used lifetime than their counterparts from St.

Louis, $M_{SL-SDY}$=-1.98, t=-5.10, p<.0001, and Miami, $M_{MI-SDY}$=-0.97, t=-2.30, p=.022, whereas Miami participants reported more lifetime number of pills used than those from St. Louis, $M_{SL-MI}$=-1.0, t=-2.66, p=.008. Moreover, while participants from St. Louis and Miami were comparable on the rest of the consumption measures, Sydney participants reported significantly more Ecstasy-use days in the past 30 days than those in St. Louis, $M_{SL-SDY}$=-1.85, t=-8.19 and p<.0001, and Miami, $M_{MI-SDY}$=-2.02, t=-8.88, p<.0001. Participants from Sydney also reported significantly more number of times they used Ecstasy in the past 30 days compared to St. Louis, $M_{SL-SDY}$=-1.02, t=-11.27, p<.0001, and Miami, $M_{MI-SDY}$=-0.92, t=-7.90 and p<.0001. Furthermore, Sydney Ecstasy users were more likely to be more recent in their use of Ecstasy than those in St. Louis, $M_{SL-SDY}$=-.47, t=-11.10, p<.0001, and Miami, $M_{MI-SDY}$=-0.45 with t=-9.43 and p<.0001.

There was also a clear site differences in the prevalence rates of DSM-IV criteria for Ecstasy dependence. Overall, Ecstasy users from Miami and Sydney were more likely to endorse a greater number of symptoms of Ecstasy-use disorder than their counterparts in St. Louis, while users at the Miami and Sydney sites did not show striking differences for endorsement of Ecstasy-related symptoms. Among the most noted site differences, participants from Sydney were more likely than participants from St. Louis to report tolerance, $M_{SL-SDY}$=-.12, t=-2.54, p=.0113, withdrawal, $M_{SL-SDY}$=-.13, t=-2.93, p=.0036, spend a great deal of time to acquire, use, and/or recover from Ecstasy, $M_{SL-SDY}$=-.14, t=-2.81, p=.0052, and reduce or give

up social, occupational, and/or recreational activities because of their Ecstasy use, $M_{SL\text{-}SDY}$=-.14, t=-3.09, p=.0022. Likewise, Ecstasy users from Miami were more likely than St. Louis users to report tolerance, $M_{SL\text{-}MI}$=-.13, t=-2.84, p=.0047, to use Ecstasy in larger amounts or over a longer period of time than was intended, $M_{SL\text{-}MI}$=-.11, t=-2.25, p=.0248, and spend great deal of time to acquire, use, and/or recover from Ecstasy, $M_{SL\text{-}MI}$=-.14, t=- 3.04, p=.0025. On the other hand, users at the Miami site were significantly different from only those in Sydney reporting withdrawal, $M_{MI\text{-}SDY}$=-0.10 with t=-2.01 and p=.0454, and reducing or giving up important activities because of their use of Ecstasy beach, $M_{MI\text{-}SDY}$=-0.10, t=-.2.05, p=.0409.

There were also significant site differences with respect to economic and psychological measures as well as in the levels of Other Risk Factors reported. More importantly, however, is the fact that these site differences appeared at both the item and composite score levels. Since only the aggregate indices (scales & subscales) were modeled in the SEM, the discussion will be limited from now on to these composite measures.

With regard to the economic measures, Sydney participants were at an advantage in terms of the resources available to them when compared to participants from St. Louis and Miami. Income (an index of social anomie), serving as a proxy measure of "purchasing power" or marginalization differed across sites. Ecstasy users from Sydney were more likely to be at a lower level of anomie than their counterparts in St. Louis, $M_{SL\text{-}SDY}$=.22, t=2.04, p=.0421, and Miami, $M_{MI\text{-}SDY}$=.18, t=2.0, p=.0513.

There was also no significant difference in the income index level between St. Louis and Miami sites. Additionally, substantial differences in the "monetary cost" (or unit price) per Ecstasy pill used were observed across the different sites. The unit price of a pill paid (in USD) in Sydney was significantly lower than the price paid in St. Louis, $M_{SL\text{-}SDY}$=.49, t=12.77, p≤.0001, and Miami, $M_{MI\text{-}SDY}$=.85, t=29.20, p≤.0001. On the other hand, the monetary cost per Ecstasy pill for Miami residents was significantly higher on average than the rate paid in St. Louis, $M_{SL\text{-}MI}$=-.36, t=11.41, p≤.0001. However, Ecstasy was less likely to be available for users in Sydney than for their counterparts in both St. Louis and Miami. Sydney participants were found to spend significantly more time and therefore paid higher "opportunity cost" to acquire Ecstasy than those participants from St. Louis, $M_{SL\text{-}SDY}$=-.18, t=-4.13, p≤.0001, and Miami, $M_{MI\text{-}SDY}$=-.12, t=-2.41, p=.0163. No significant difference was found between the "opportunity costs" incurred by Miami or Sydney participants.

Findings were somewhat mixed when examining site differences for the components of the Psychological Domain. Overall, Ecstasy users from St. Louis were less likely to report Motivation for their consumption based on "opportunities to get Ecstasy" than their counterparts from Miami, $M_{SL\text{-}MI}$=-.19, t=-2.15, p=.0321, or Sydney, $M_{SL\text{-}SDY}$=-.12, t=-1.84, p=.0448. Also, St. Louis participants reported significantly less motivation based on "places and/or people to get Ecstasy from" than those from Miami, $M_{SL\text{-}MI}$=-1.05, t=-5.27, p≤.0001, and Sydney $M_{SL\text{-}SDY}$=-1.07, t=-4.97, p≤.0001. There was however no significant differences in the reported

"opportunities to get Ecstasy" or "places and/or people to get Ecstasy from" between Miami and Sydney participants. Additionally, all three sites did not differ significantly in their "specific motivation to use Ecstasy."

Table 4.5 shows significant differences in the reported depressive symptoms across sites. In particular, three out of the four CESD depression parcels suggest that Ecstasy users from Sydney tended to endorse significantly lower levels of depression than their counterparts from the other two sites. Specifically, Sydney participants were less likely to report behavioral depressive symptoms than participants from St. Louis, $M_{SL\text{-}SDY}$=.28, t=3.22, p=.0014, and Miami, $M_{MI\text{-}SDY}$=.36, t=3.55, p=.0004. Likewise, Ecstasy users from Sydney were less likely to report affective and cognitive depressive symptoms than those from St. Louis [$M_{SL\text{-}SDY}$=.28, t=3.11, p=.0020, and $M_{SL\text{-}SYD}$=.34, t=3.46, p=.0006, respectively] or Miami [$M_{MI\text{-}SYD}$=.23, t=2.31, p=.0215, and $M_{MI\text{-}SYD}$=.39, t=3.61, p=.0004, respectively]. Conversely, no significant differences were found between St. Louis and Miami participants' scores for the same three depression subscales or for the fourth subscale tapping somatic depressive symptoms.

The proxy measure sexual risk captures individual differences in risk-taking and was comprised of 10 items. These items tap the propensity to engage in high-risk behaviors without planning or forethought including having sex without protection, multiple partners, having "forced" sex, and using drugs while having sex. Significant site differences were observed with participants from Sydney being more likely to

engage in sexual risk than participants from St. Louis, $M_{SL\text{-}SDY}$=.32, t=2.09, p=.0374, and Miami, $M_{MI\text{-}SDY}$=.31, t=1.95, p=.0536. There were however no statistically significant differences in the mean levels of sexual risk-taking between the participants from St. Louis and Miami.

Tests of Multicollinearity ---A commonly used approach to check for the presence of multicollinearity relies on the strength or magnitude of bivariate associations (or inter-correlations) between each pair of variables in the data. Large magnitude of association between any given pair would indicate not only empirical overlap, but also conceptual overlap, suggesting the two variables measure the same phenomenon. It is usually suggested that an absolute value of Pearson's $|r|$ less than .10 is "trivial," between .10 and .35 is "small" (or low), between .35 and .70 is "moderate," and greater than .70 is substantially "large" (or high). Based on this interpretation, multicollinearity should be a very serious concern when the inter-correlation between a pair of independent variables is large, $|r| > .70$, which generally means that there is considerable redundancy between the two items (Ferketich, 1991). On the other hand, construction of a well-defined and psychometrically reliable construct requires that the relations between its indicators (items, parcels or multi-item scales) be moderate to large (r = .45 to .60).

Given the type of data used in this study, both parametric (Pearson) and non-parametric (Spearman's rank-order) inter-correlations between all the measured variables and/or latent constructs developed within the five domains defined above

were examined for the full sample. With very few exceptions, the Pearson's correlations and Spearman's correlations for each pair of variables were identical. For this reason, only the former [Pearson's product-moment correlation coefficients ($r$)] and their corresponding level of significance are presented in Table 4.6. Also, because the correlation matrix is symmetric, only the upper triangle is presented. Additionally, the table includes "Adjusted Item-to-Total Correlation," measuring the correlation of each item with the total construct score based on the rest of the items contained in the same domain. This latter statistic should be reasonably large in magnitude to indicate sufficient conceptual overlap between the components, with some unique variability as well.

As Table 4.6 depicts, there are overall small to relatively moderate but significant inter-correlations between all the variables selected for the model. In particular, the inter-correlations between each pair of the indicators used to reflect the hypothesized latent construct Consumption were significantly positive (all $p$s$\leq$.001), ranging from a low correlation value of $r$=.26 to a high correlation value of $r$=.68 which is moderate but still in the acceptable range to imply little redundancy among the observed measures. On the other hand, the adjusted item-to-total correlations for the outcome construct Consumption ranged from a low of $r$=.53 to a high of $r$=.70, suggesting satisfactory magnitude of associations for the indicators of Consumption.

**Table 4.6 Correlations* Among the 23 Observed Variables & Constructs Used in the PsychoEconomic Model (N=640)**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Outcome Measures** | | | | | | | | | | | | | | | | | | | | | | | |
| ***Consumption*** | | | | | | | | | | | | | | | | | | | | | | | |
| 1. Quantity of Ecstasy used lifetime | - | .26† | .33† | .26† | .40† | .23† | .34† | .21† | .38† | .31† | .20† | -.19† | -.01 | .22† | .48† | .52† | .52† | .29† | .11 | .06 | .02 | .09 | .20† |
| 2. X use days in past 30 days | | - | .58† | .60† | .13† | .11 | .10 | .11 | .08 | .18† | .08 | .03 | -.21† | .22† | .15† | .19† | .21† | .12 | .12 | .05 | .05 | .09 | .09 |
| 3. Times per X use day past 30 days | | | - | .68† | .20† | .11 | .13† | .09 | .14† | .20† | .12 | -.06 | -.19† | .17† | .16† | .24† | .25† | .09 | .09 | -.01 | -.01 | .05 | .08 |
| 4. recency of X use | | | | - | .12† | .11 | .09 | .09 | .08 | .16† | .11 | -.05 | -.20† | .14† | .10 | .20† | .20† | .05 | .03 | -.04 | -.03 | -.01 | .04 |
| ***Dependence*** | | | | | | | | | | | | | | | | | | | | | | | |
| 5. Tolerance | | | | | - | .27† | .33† | .26† | .37† | .35† | .18† | -.03 | .01 | .07 | .28† | .31† | .25† | .25† | .05 | .09 | .09 | .08 | .06 |
| 6. Withdrawal | | | | | | - | .31† | .25† | .34† | .26† | .21† | -.04 | -.04 | .05 | .18† | .20† | .17† | .24† | .08 | .10 | .12† | .14† | .04 |
| 7. Increased use over longer period | | | | | | | - | .38† | .43† | .33† | .20† | -.02 | -.01 | .10 | .24† | .27† | .26† | .24† | .07 | .13† | .05 | .10 | .07 |
| 8. Desire or inability to cut down | | | | | | | | - | .29† | .33† | .16† | -.02 | -.03 | .04 | .16† | .16† | .19† | .24† | .14† | .17† | .15† | .15† | .04 |
| 9. Great deal of time spent | | | | | | | | | - | .40† | .23† | .04 | .03 | .10 | .28† | .30† | .31† | .29† | .12† | .15† | .09 | .11† | .10 |
| 10. Reduce or avoid important activities | | | | | | | | | | - | .18† | -.004 | -.07 | .07 | .28† | .28† | .33† | .34† | .13† | .16† | .12† | .13† | .15† |
| 11. Continue to use despite problems | | | | | | | | | | | - | .04 | .001 | .03 | .09 | .18† | .17† | .19† | .02 | .10 | .04 | .03 | .04 |
| **Economic Factors** | | | | | | | | | | | | | | | | | | | | | | | |
| 12. Social Anomie (Income Index) | | | | | | | | | | | | - | .09 | .01 | -.03 | -.06 | -.07 | .003 | .03 | .05 | .05 | .06 | -.09 |
| 13. Unit price of Ecstasy pill | | | | | | | | | | | | | - | -.04 | .11 | .01 | -.05 | .04 | -.03 | .01 | .03 | .03 | .06 |
| 14. Opportunity cost | | | | | | | | | | | | | | - | .16† | .21† | .14† | .04 | .14† | .11 | .05 | .08 | .03 |
| **Psychological Factors** | | | | | | | | | | | | | | | | | | | | | | | |
| ***Motivation*** | | | | | | | | | | | | | | | | | | | | | | | |
| 15. Opportunity to get Ecstasy | | | | | | | | | | | | | | | - | .45† | .46† | .30† | .10 | .07 | .09 | .14† | .20† |
| 16. Places/People to get Ecstasy from | | | | | | | | | | | | | | | | - | .62† | .34† | .10 | .15† | .10† | .15† | .28† |
| 17. People to get/share Ecstasy with | | | | | | | | | | | | | | | | | - | .34† | .14 | .15† | .14† | .16† | .30† |
| 18. Motive to use Ecstasy | | | | | | | | | | | | | | | | | | - | .19† | .26† | .21† | .23† | .16† |
| **Other Risk Factors** | | | | | | | | | | | | | | | | | | | | | | | |
| ***Depression*** | | | | | | | | | | | | | | | | | | | | | | | |
| 19. Behavioral | | | | | | | | | | | | | | | | | | | - | .59† | .64† | .69† | .07 |
| 20. Somatic | | | | | | | | | | | | | | | | | | | | - | .70† | .66† | .13† |
| 21. Affective | | | | | | | | | | | | | | | | | | | | | - | .72† | .10 |
| 22. Cognitive | | | | | | | | | | | | | | | | | | | | | | - | .09 |
| ***Risk Taking*** | | | | | | | | | | | | | | | | | | | | | | | |
| 23. Sex risk | | | | | | | | | | | | | | | | | | | | | | | - |
| **Item-to-Total Correlation*** | .53 | .61 | .70 | .67 | .46 | .43 | .52 | .43 | .55 | .49 | .30 | .12 | -.06 | .24 | .51 | .59 | .63 | .40 | .71 | .72 | .81 | .82 | - |

* This is a measure of interassociation of each item with the total correlation adjusted/corrected for the items (all standardized) in the domain.

† Statistically significant levels at $p \leq .001$ (2-tailed)

Turning first to the measures of Consumption, the largest association was observed between times used per day in the past 30 days and recent use (r = .68) and the smallest association was observed between lifetime quantity and both number of days used in the past 30 days and recent use (r's = .26). Overall, the moderate associations between the different measures of consumption and the information from the adjusted item-to-total correlations (ranging from .53 to .70) indicate these different measures of use are likely tapping an underlying frequency/quantity dimension.

The inter-correlations between the seven indicators (i.e., DSM-IV diagnostic criteria) of Dependence were all positively correlated with one another and highly significant (all *p*s ≤ .001). Their values ranged from a low of *r* = .16 to a high of *r* = .43, again reinforcing that the values were in the small to relatively moderate range and confirmed the absence of empirical redundancy. The adjusted item-to-total correlations were also moderate, ranging from a low of *r* = .30 to a high of *r* = .55, suggesting that each criterion measure is a suitable representation of the hypothesized latent construct.

Turning next to the economic measures, there are three measures including economic well-being or "social anomie" (labeled income index), "unit price" indicating how much is actually paid for an Ecstasy pill, and "opportunity cost", assessing the amount of time required to obtain and use Ecstasy. It was not expected that there would be considerable overlap between these items as they tap distinct

economic facets driving drug consumption. Indeed, the inter-correlations between these items were very small in magnitude and none were significant. They ranged from a low of $r$ = .01 between "income and opportunity cost" to a high of $r$ = .09 between "income and unit price," and all of these associations were in the expected direction. In particular, the Pearson product moment correlation between unit price and opportunity cost was negative, indicating that users might have to search longer and expend more time traveling to obtain less expensive Ecstasy pills (The more time spent searching for Ecstasy, the higher the chance to buy it at lower price). The relatively small magnitude of association between the economic indicators supports the assumption of minimal redundancy among the three items (or measures) comprising this domain. Additionally, the adjusted item-to-total correlation for each of these measures was also small and further indicates there is no "latent" dimension underlying these associations.

A latent construct of Motivation from the "Psychological Factors" domain was hypothesized based on the assumed inter-relationships between four indicators: "opportunity to get Ecstasy," "places/people to get Ecstasy from," "people to get/share Ecstasy with," and "motives to use Ecstasy." The correlations between these indicators were positive and highly significant (all $p$s$\leq$.001). The absolute magnitude of these associations ranged from a low of $r$ = .30 between "opportunity to obtain Ecstasy and motive to use Ecstasy" to a high of $r$ = .62 between "people and places to get Ecstasy and "people to get/share Ecstasy with," suggesting a moderate

amount of conceptual overlap but limited empirical redundancy. Adjusted item-to-total correlations were also within an acceptable moderate range from a low of $r = .40$ to a high of $r = .63$, reinforcing the hypothesis that there is some conceptual similarity within the four indicators that reflect an underlying "impetus" for consuming Ecstasy.

A latent construct of Depression in the domain labeled "Other Risk Factors" for using Ecstasy was reflected by four indicators tapping "behavioral," "somatic," "affective," and "cognitive" symptoms. Inter-correlations between these four indicators ranged from a low of $r = .59$ between "behavioral and somatic" to a high of $r = .72$ between "affective and cognitive" and were significant (all $p$s $\leq .001$). The parcel containing affective symptoms was moderately related with both the indicator containing somatic symptoms ($r = .70$) and the one containing cognitive symptoms ($r = .72$). As far as benchmarks go, these values are respectively at the low end of the spectrum for "large" associations, suggesting that there may be a modest amount of conceptual overlap between the items used to construct these different indicators. Adjusted item-to-total correlations ranged from a low of $r = .71$ to a high of $r = .82$, indicating considerable overlap between the indicators and the hypothesized latent construct of Depression.

*Cross-Domain Associations* -- Overall, the cross-domain item-paired correlations [see highlighted (shaded) areas in Table 4.6] were generally small to moderate, but varied in magnitude, direction, and statistical significance, depending on the particular association that was examined. Relations between the three

measures from the economic domain ["social anomie" (or income index), "unit price," and "opportunity cost"] differed with the indicators of the two outcome latent constructs (Consumption and Dependence). Specifically, most of the associations between the three economic measures and the four indicators of Consumption were moderately small, significant, and in the expected direction. The associations between opportunity cost and the four indicators reflecting Consumption were consistent in magnitude ranging from a low of r= .14 for recent use to a high of r = .22 for quantity lifetime and number of days used past 30 days. Next largest in magnitude were the relations between unit price and the four consumption indicators, ranging from a low of r = -.01 for lifetime quantity to a high of r = .21 for number of days used past 30 days. Relations between social anomie and the four consumption indicators were much smaller in magnitude with the exception of quantity (r = -.19), the remainder were all quite small and none was significant.

The relations between the economic measures and the dependence indicators were all relatively small and none were significant. The largest magnitude was observed between increased use over a longer period and opportunity cost (r = .10). Only three of the possible 12 relations between economic measures and the indicators of motivation to use Ecstasy were significant, and all involved opportunity cost with "places and people to get Ecstasy" (r = .21), "opportunity to get Ecstasy" (r = .16), and "people to get and share Ecstasy" (r = .14).

With few exceptions, associations between the indicators of Motivation and indicators of Consumption were modest in size and significant. The non-significant relations were between motives to use Ecstasy and all three measures of recent use (but not lifetime use). The magnitude of relations between the indicators of Dependence and Motivation were similar in size and only one ("continued use despite problems" with "opportunity to get Ecstasy") did not achieve significance.

Relatively speaking, the bivariate associations between the components of "Other Risk Factors" ("Depression" and "sexual risk") and the indicators of Consumption and Dependence were smaller in absolute size and there was no observable pattern in their signs. The relations between indicators of Depression and Consumption were quite small and none achieved significance. The same relations between indicators of Depression and Dependence, respectively, were considerably larger in magnitude and 14 of the 28 achieved significance. Among the significant associations they ranged in magnitude from a low of $r = .11$ between "cognitive symptoms" and "great deal of time spent in activities looking for drug" and $r = .17$ between "somatic symptoms" and "persistent desire or unsuccessful efforts to cut down" (all $ps < .0001$).

On average the composite unit-weighted index of sexual risk-taking had a greater magnitude of association with indicators of Dependence compared to Consumption. The largest relation overall was between quantity (lifetime) and sexual

risk (r = .20) and this was followed by "reduce or avoid important social, occupation, or recreational activities" and sexual risk (r = .15), both *p*s < .001.

In contrast to these relatively small associations, sexual risk taking was more moderately associated with the indicators of Motivations. These associations ranged from a low of *r* = .16 for "motive to use Ecstasy" to a high of r = .30 for people to get/share Ecstasy with" (all *p*s <.0001).

To summarize, the preliminary statistical tests contained in this section helped verify that the data comforts with the underlying assumptions of normality and the absence of multicollinearity required for robust estimation of SEMs. In particular, univariate measures of kurtosis and skewness indicated non-significant departures of the item and scale distributions from normality. Additionally, the moderate associations of items or indicators within certain domains supported the hypothesized latent constructs. In the case of the four measured indicators of Depression, the associations among these measures are moderate and consistent suggesting they tap an underlying tendency of participants to consistently report a wide range of somatic, behavioral, cognitive, affective problems they experience when they feel depressed. Likewise the magnitude of association between items from the different domains, reinforces that the domains do not overlap conceptually and suggests there is a modest amount of conceptual "divergence" in the way these measures were constructed. Having established the suitability of the data using the traditional

approach of item level of analysis, the next step proceeded with the multivariate analyses intended to examine the fit of the sample data to the hypothesized model.

3. **SEM Testing Results**

This section contains two interrelated parts: (1) steps taken to construct and refine the conceptual model; and (2) empirical analyses of the hypothesized model.

Construction and Refinement of the Conceptual Model --- The research hypotheses address the potential importance of combining economic and psychological domains to predict Ecstasy Consumption and problems associated with consumption (labeled Dependence). Figure 2.1 (from Chapter II) provided a basic overview of the conceptual framework for the proposed psycho-economic model. The framework highlights the main relations between relevant economic measures, select measures of psychological risk (both observed and latent constructs), and the two outcome constructs (Consumption and Dependence). The steps taken to construct the model consisted of identifying measures (indicators) that suitably assess the latent constructs ("measurement component") and then specifying the hypothesized predictive relations among all the variables ("structural component"). Figure 4.1 presents the latent-variable structural framework, referred to as the refined conceptual psycho-economic model.

The measurement and structural portion of the model is separated by the stippled lines. The inner section in the upper portion of the Figure labeled "Measurement Component" details the framework for testing the hypothesized latent

constructs (indicated by large ovals) including Depression, Motivation, Ecstasy Use (or Consumption), and Dependence. Each latent construct is reflected by manifest (observed) indicators, shown by the rectangular boxes. To illustrate the model construction procedures, there are four observed indicators that reflect Depression (i.e., CESD-1=Behavioral, CESD-2=Somatic, CESD-3=Affective, and CESD-4 =Cognitive), four that reflect Motivation (i.e., MOTIVE-1=Ways to get Ecstasy, MOTIVE-2=Places to use or get Ecstasy from, MOTIVE-3=People to share Ecstasy with, and MOTIVE-4=Motives to use Ecstasy), four used to indicate Ecstasy Use [i.e., USE-1=When last time used Ecstasy (Recency), USE-2=Number of days past 30 days used Ecstasy (Frequency), USE-3=Number of pills per day (Quantity), and USE-4=Total number of Ecstasy pills used lifetime ("Addictive stock") ], and seven for Dependence (i.e., DEP-1=Experienced tolerance, DEP-2=Experienced Withdrawal, DEP-3=Used Ecstasy for a longer time than intended, DEP-4=Had the desire or was unable to quit, DEP-5=Spent great deal of time acquiring or using Ecstasy, DEP-6=Avoided important activities to use Ecstasy, and DEP-7=Continued to use despite the knowledge of problems related to Ecstasy use).

Both Depression and Motivation are considered "exogenous" constructs (and they can also be termed "predictors") and Ecstasy Use (Consumption) and Dependence are posited as endogenous constructs (or "outcomes"). The term exogenous and endogenous are used to indicate the hypothesized process through which one measure or latent construct influences or contributes to another (or

accounts for predictive variance). This causal flow is indicated by the single-headed arrows on straight lines leading from left to right in the figure. Stated differently, Depression and Motivation are hypothesized to contribute unique predictive variance to the endogenous latent constructs of Ecstasy Use and Dependence.

In contrast to the inner measurement component, the outer stippled box (encompassing the measurement component) in the Figure depicts the full "structural" portion of the model. The structural portion includes the measurement portion and then estimates the "effect" or influence of predictors on outcomes. The left-hand side of the model includes the manifest (observed) measures of economics, sexual risk, gender, age, race, education, as well as the two exogenous latent constructs (Depression and Motivation). The influence of these measures is estimated on the two latent construct outcomes (Ecstasy Use and Dependence). This model then becomes the formal statement of "theory" and is tested by positing these relations and comparing the fit between the sample variance/covariance matrix and the implied population model.

Outside of the designated stippled areas are measured (observed) variables that are used as indicators of the latent constructs in the measurement portion of the model. In the measurement model, each latent construct is hypothesized to statistically "cause" the association among the observed indicators. In the case of Depression, the four indicators assess behavioral, somatic, affective, and cognitive

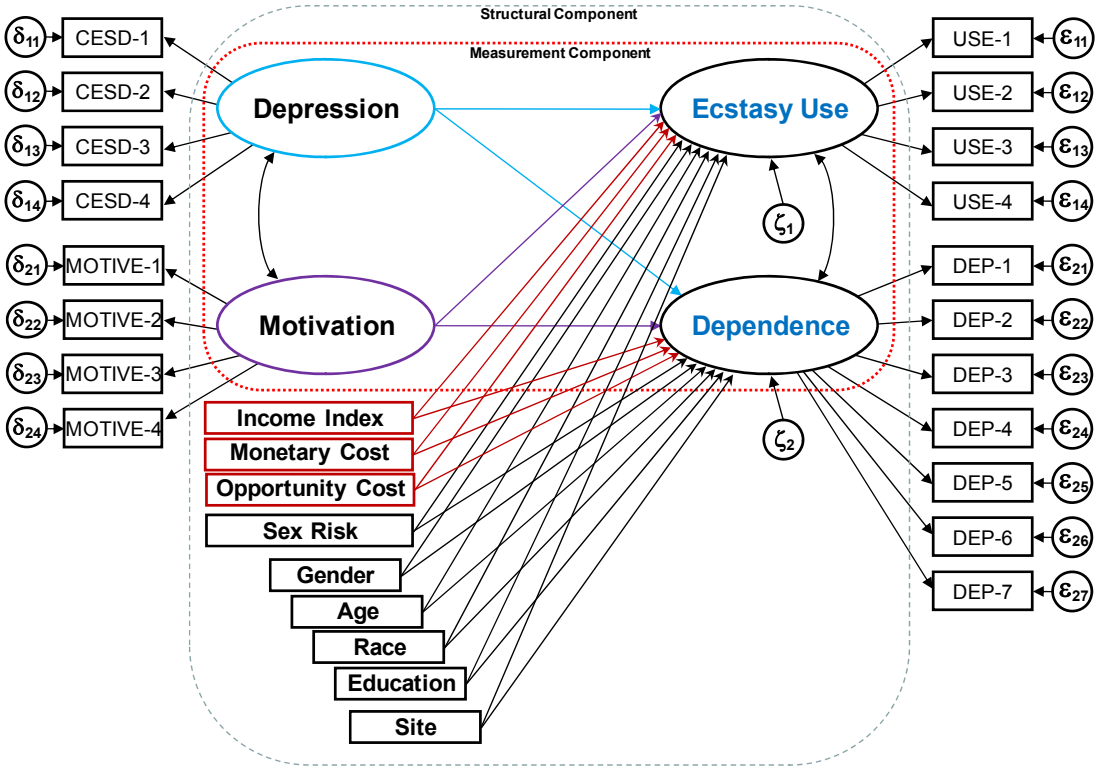



**Figure 4.1** The revised conceptual psycho-economic model

symptoms, but together they are all posited to tap Depression. Consistent with a standard equation for an ordinary least square model, there is an element of "error" associated with the prediction. These error terms are designated by the Greek symbol "theta" (δ) on the left-hand side of the model and "epsilon" (ε) on the right-hand side of the model. These respective error terms for the predictor latent factor indicators and those corresponding to the outcome or endogenous indicators capture non-factor determined variance or the residual variance in the indicator net of prediction by the factor. The usual interpretation given to a residual term for an indicator predicted by a latent construct is "measurement specific" variance that does not reflect the underlying factor. For instance, in the case of an indicator of Depression that assesses

affective symptoms, the residual term would reflect symptoms that are not behaviorally isomorphic with feeling blue, sad, or moody, but are still reported by participants.

When looked at its entirety, Figure 4.1 also graphically portrays the hypothesized "causal" model linking predictor variables (e.g., sexual risk) and latent constructs (e.g., Depression) on the left-hand side with two endogenous latent constructs. The flow of the model is portrayed using single-headed arrows on straight lines from the left-hand side pointing toward the right-hand side of the model. These are "paths" or regression effects and are estimated as beta (β) parameters or standardized regression coefficients. Each path coefficient reflects the influence of an independent variable or latent construct on a dependent construct and should be interpreted as the amount of "change" in the designated outcome for a unit change in the predictor.

Also shown in the upper "measurement portion" of the model are curved lines with double-headed arrows indicating correlations between constructs. To illustrate the meaning of this parameter, the curved line between Depression and Motivation reflects their association net of the contribution of the remaining manifest variables (e.g., income, monetary cost, etc.) that are on the left-hand side of the model. Likewise, the curved line between Ecstasy Use and Dependence reflects their association net of prediction from all of the measured variables and constructs on the left-hand side of the model. In addition, the straight lines coming from each latent

construct pointing toward a single rectangular box (observed or manifest indicators) are also regressions, but they are standardized factor loadings and designated "lambda" ($\lambda$) parameters in the model construction. These parameters indicate the strength of an item as a reflection of the underlying latent construct.

Each of the endogenous latent constructs also has a "disturbance" term that reflects residual or net variation after prediction ($\zeta_1$ and $\zeta_2$). In the model, these are allowed to covary freely as estimates of the relation between Consumption and Dependence after all the effects of all exogenous predictors have been accounted. When squared and subtracted from 1.0, these terms indicate the proportion of variance accounted for in the particular construct.

Empirical Analysis of the Hypothesized Psycho-Economic Model --- As mentioned previously, the model testing procedure followed a two-step process recommended by Anderson and Gerbing (1988). The first step includes specification of the psychometric model. This portion of the model is used to ascertain if the latent constructs are statistically reliable and are hypothesized correctly in terms of their respective indicators. In addition, the CFA model provides a means to inspect the error-free correlations between the latent constructs, a procedure that would not have been available using exploratory factor analytic techniques (Hair et al., 1998).

The CFA model is then followed by a structural path regression model that incorporates the findings from the measurement portion of the model. The structural model tests whether measures and constructs on the left-hand side (Figure 4.1) can

account for significant variance in the designated constructs on the right-hand side. This portion of the model is a direct test of the research hypotheses and provides a means to evaluate the unique contribution of economic measures to the outcomes and also their unique predictive variances when controlling for psychological measures (and latent constructs).

The structural portion of the model was also tested in a series of integrated steps. The first structural model examined the effects of economic measures (income index, monetary cost, and opportunity cost) on Ecstasy Use. Conceptually speaking, this is termed the 'unbiased' model, because it provides a picture of whether the economic measures are even statistically related to Ecstasy consumption in a multivariate framework (when their contributions are considered simultaneously) in the absence of any other measures. The same model was then estimated with the addition of the latent construct of Dependence (and the association between the two endogenous constructs is also estimated). Specification of an association between disturbance terms for the endogenous latent constructs is appropriate for a cross-sectional model where any efforts to infer causation would be at best tenuous.

The next series of models in the sequence incrementally specified latent constructs tapping Motivation, and then Depression, and this was followed by the inclusion of sexual risk-taking as predictors of Ecstasy Consumption and Dependence. This model retained the economic measures and addresses whether the economic measures maintain their predictive variance while controlling for the

domain of psychological risk. At this point in the sequence, the model testing procedure included empirical specification searches to capture any nonstandard relations that were not hypothesized a priori. Nonstandard relations (sometimes called "uniquenesses") capture relations between measured variable predictors (i.e., economic measures or sexual risk taking) and indicators of endogenous latent constructs as well as indicators of exogenous predictor constructs and indicators of endogenous constructs. These were not part of the original model nor are they "theory-driven" but their inclusion can approximate the "true model" (MacCallum, 1986). Failing to include these associations would lead to model misspecification and produce a biased or poor fitting model.

At this point in the model testing procedure, and in light of the obtained mean differences in the preliminary descriptive analysis, other control measures were added. These measures include gender, age, race, and education, and study site. Estimation of the models specifying demographic characteristics provides an opportunity to examine whether the obtained parameter estimates for the economic and psychological factors dramatically change with the inclusion of these controls. All of the control measures were dichotomously scored for comparison purposes [for site the comparison include the US (St. Louis and Miami combined) vs. Sydney].

The parameters in both the measurement and structural models were estimated using the Maximum Likelihood estimation (MLE) method for SEM provided in the EQS statistical program (Bentler, 1995). MLE has been shown to be robust especially

in the presence of normality violations (Newcomb & Bentler, 1988). Several statistics were employed to gauge the overall performance of each model. The large sample chi-square ($\chi^2$) statistic was examined to determine how well the estimated sample covariance matrix in the hypothesized model reproduced the population covariance matrix. As discussed earlier, Satorra-Bentler $\chi^2$-statistic (SB $\chi^2$) was applied instead of the traditional $\chi^2$ to adjust for any possible multivariate non-normality. A smaller $\chi^2$ indicates a better model fit, and the corresponding shrinkage in $\chi^2$ when contrasting nested models indicates superior fit as well. Several other commonly used goodness-of-fit indices that were discussed earlier were also used to evaluate model fit. These included the comparative fit index (CFI: Bentler, 1990), the root mean square error of approximation (RMSEA: MacCallum, Browne, & Sugawara, 1996; Steiger & Lind, 1980), and the Adjusted Goodness of Fit Index (AGFI: Arbuckle, 1997). The benchmark or "threshold" level conventionally required for "acceptable" model fit using these statistical measures are: CFI $\geq$ .9 (range 0 to 1.0), indicating how much variance and covariation is accounted for in the sample data by the implied population model, an RMSEA $\leq$ .08 (where close to .05 indicates a good model fit), and an AGFI $\geq$ .9 (Bentler, 1992; Hu & Bentler, 1998; Jöreskog & Sörbom, 1996).

Results of the Measurement Model --- As noted earlier, the CFA model consisted of 19 observed items (or indicators) used to measure four latent constructs: Depression, Motivation, Consumption (or "Ecstasy Use"), and Dependence. The first three constructs (Depression, Motivation, and Consumption) were measured by four

different indicators each, while Dependence was reflected by seven indicators. A first-order factor structure was estimated to assess the statistical reliability of each construct and obtain the standardized loadings for the entire sample.

*First-Order Factor Model* -- In the first-order CFA, simple structure was specified allowing only one non-zero loading per factor and thus no cross-factor loadings (an indicator for Depression could not load on Motivation) and the latent constructs were allowed to correlate freely. This means all six relations between the four latent constructs were estimated without any constraints. After this model was estimated, a constrained model was tested that fixed the latent construct correlations to unity (r = 1.0). The constrained model (compared to the maintained or less restrictive model) assesses whether the relations between the constructs are "perfect" and there is total conceptual overlap (this provides a test of construct validity). The nested likelihood $\chi^2$ difference test comparing the constrained to the less restricted or unconstrained model indicates the suitability of the constraints (i.e., whether the correlations are different from 1.0).

Table 4.7 contains fit indices for the constrained and unconstrained models. The base measurement model, provided an adequate fit to the data, $\chi^2$ (146) = 555.13, $p \leq .001$, NFI=.877 (not reported in Table), CFI=.906, GFI=.922, AGFI=.899, SRMR=.080 and RMSEA=.063. The base model posits four latent constructs, but allows them to freely correlate. Another way to structure this model is to fix the correlations between latent constructs to r = 1.0 and test the adequacy of this fit

against the less constrained model by a nested likelihood difference test. The nested $\chi^2$ difference test indicates the unconstrained model provides a better fit, $\triangle\chi^2(6) = 2022.19$, $p > .001$. The CFI is .906 for the unconstrained model and .442 for the constrained model. The higher the value of the CFI, the better the fit (.906 means the hypothesized model accounts for 90% of the variances and covariances in the sample data). The SRMR, which measures the average difference across the residual variances and covariances between the predicted and observed covariance matrices, is .138 in the constrained model and .08 in the unconstrained model. Again, smaller numbers indicate a better fit (8% of residual variation is left in the off-diagonal of the covariance matrix by the hypothesized model).

The AGFI, which shows the relative amount of the population variability predicted by the covariance matrix specified by the model after adjusting for the degrees of freedom, is .574 in the constrained model and .899 in the unconstrained model (higher values are better). The ratio of $\chi^2$/df for the unconstrained model is 3.80 whereas the same comparison for the constrained model is 16.95. In general, this ratio, as a gross measure of fit, should be closer to 2.0 (where < 4.0 is acceptable). Taken together, these findings provided ample evidence that the correlations between latent constructs are different from one. Therefore, the constrained specification of the measurement model was rejected.

**Table 4.7 Comparative fit of The Measurement Model (N=640)**

| *Four First-Order Factor Structure Model* | *Chi-Square* $\chi 2$ | *Degree of Freedom df* | *Chi-Square Test* $\chi 2/df$ | *Chi-Square Difference* $\Delta\chi 2\ (\Delta df)$ | CFI | GFI | AGFI | SRMR | RMSEA |
|---|---|---|---|---|---|---|---|---|---|
| **Constrained** | 2577.32 | 152 | 16.96 | N/A | .442 | .659 | .574 | .138 | .158 |
| **Unconstrained** | 555.13 | 146 | 3.8 | 2022.19(6)** | .906 | .922 | .899 | .080 | .063 |

Note: 1. CFI = Comparative Fit Index; GFI = LISREL Goodness of Fit Index;
AGFI = LISREL Adjusted Goodness of Fit Index;
SRMR = Standardized Root Mean-Square Residual
and RMSEA = Root Mean-Square Error of Approximation.
2. **Statistically significant at $p \leq .01$

Although the unconstrained model provided a superior fit, it is worth pointing out that the $\chi^2$-statistic for the base model was statistically significant, implying poor overall fit of the model. This should not be unexpected when testing SEMs because the large sample $\chi^2$ statistic is sensitive to sample size and does not adjust for model complexity (Marsh et al., 1988). It is well known that large sample sizes can have excessive Type I error rates (Bollen, 1989; Browne & Cudeck, 1989; Marsh, 1994). Thus, trivial deviations between the sample data and the implied population model will cause the model to produce a significant $\chi^2$ statistic. Bollen (1989), among others (Bentler 1992; Byrne, 1994) suggest using a modified version of this statistic that takes into account the sample size, such as the ratio of $\chi^2$ points to the model degrees of freedom ($\chi^2$/df). Therefore, while the $\chi^2$-statistic was significant, the relative (or normed) $\chi^2$ was still within the acceptable threshold of less than 4 times the degrees of freedom established for this study, $\chi^2$/df =3.80 (Schumacker & Lomax, 2004; Ullman, 2001).

*Second-Order Factor Model* -- Even though the CFA findings indicated there was acceptable support for the unconstrained model, several of the goodness-of-fit indices exceeded their respective benchmarks. In particular, both the RMSR=.08 and RMSEA=.06 exceeded the .05 threshold. There are several model modifications that can be used to "tighten" up a model and enhance its overall fit. One such modification involves testing a higher-order structure based on the moderate associations between the first–order latent constructs. In other words, this model posits whether a single "second-order" latent construct can statistically account for the moderate associations among the first-order latent constructs (Gribbons & Hocevar, 1998). The fit of this model was adequate, $\chi^2(148, N=640) = 559.245$, $p \leq .001$ (or $\chi^2/df = 3.78$), NFI=.876, CFI=.905, GFI=.922, AGFI=.900, RMSR=.082 and RMSEA=.066 but did not improve on the fit of the first-order model, $\triangle\chi^2(2) = 4.115$, $p > .05$.

A careful examination of the second-order model findings shows that the standardized factor loadings corresponding to the first-order latent constructs Depression, Motivation, Consumption, and Dependence were .265, .881, .430, and .724, respectively. Such a wide range of estimates indicates lack of communality shared among the first-order factors. As a result, the first-order factor structure with its freely estimated factor inter-correlations provided the best fit of all the alternative models tested. Importantly, implementations of any further model refinements (e.g.,

elimination of weak items or freeing cross-construct loadings) were reserved for a later point in the model testing procedure with the fully conditioned SEM.

*Factor Reliability* – The loadings of the various indicators on their respective latent constructs provide another indication of the suitability of the model. These standardized factor loadings indicate the "strength" of the observed measures as an indicator of the hypothesized latent construct. This provides, in many respects, an alternative means to assess the internal consistency (reliability) of the four latent constructs. The reliability of any indicator is defined as the square of its loading on the latent factor (Bollen, 1989). In other words, the loading of any item is the square root of its reliability. Ideally, for construct reliability, the factor loading estimates should be above .5 to be reliable. Furthermore, the product of factor loadings of any two items on the same construct defines their inter-correlation. Cronbach's alpha ($\alpha$) is essentially an average of the inter-item correlations underlying a construct. However, Cronbach's alpha assumes that the observed items are perfectly measured without error. In order to separate measurement errors from model structural errors, Werts, Linn and Jöreskog (1974) proposed instead an error-disattenuated (measurement-error-free) formula for computing alpha. A disattenuated coefficient alpha of .7 or higher is commonly recommended for an adequate internal consistency of construct.

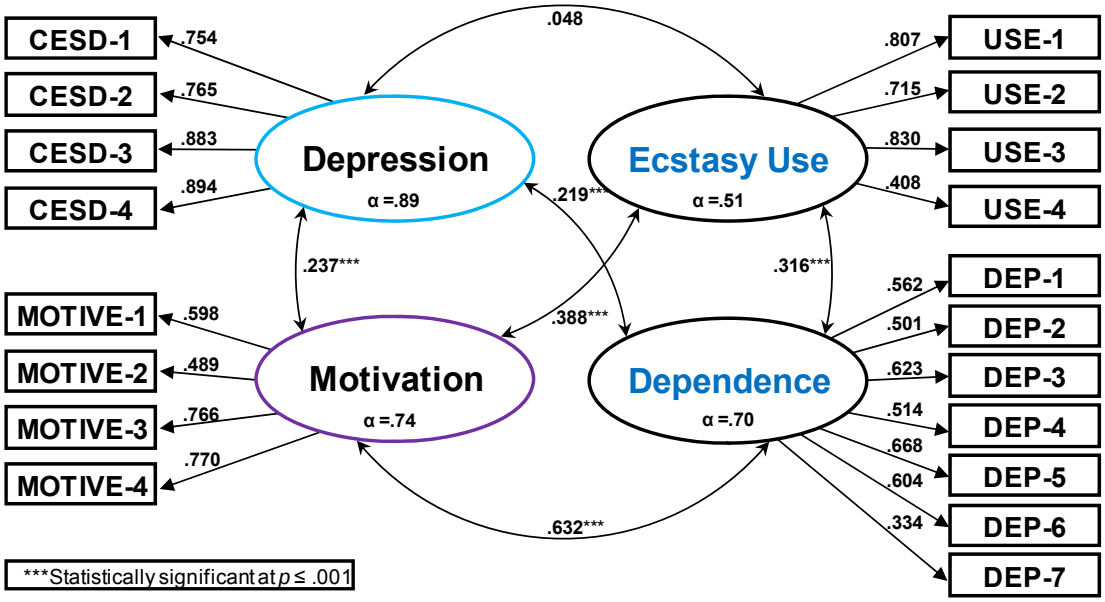



**Figure 4.2** Measurement model depicting four hypothesized latent factors.

*Standardized Parameter Loadings* – As depicted in Figure 4.2, with minor exception, standardized parameter loadings from the CFA model were significant and above the .5 critical threshold. Loadings for the Depression construct ranged from a low of λ = .754 for behavioral symptoms (CESD-1) to a high of λ = .894 for cognitive symptoms (CESD-4), with an average λ = .824. Loadings for the Motivation construct ranged from a low of λ = .489 for "motive to use Ecstasy" (MOTIVE-1) to a high of λ =.770 for "places where Ecstasy is used" (MOTIVE-4), with an average λ = .656. Loadings for the Ecstasy Use (i.e., Consumption) construct ranged from a low of λ = .408 for "lifetime quantity of Ecstasy pills used" (USE-4) to a high of λ = .830 for "number of times used Ecstasy per day past 30 days" (USE-3), with an average λ = .691. Loadings for the Dependence construct ranged from a low

of $\lambda = .334$ for "continued use despite persistent physical or psychological problems" (DEP-7) to a high of $\lambda = .668$ for "great deal of time spent obtaining, using, or recovering from substance use" (DEP-5), with an average $\lambda = 544$.

*Interfactor Correlations* – Of the six possible estimated correlations only the one between Depression and Ecstasy Use failed to achieve significance ($r = .048$). Of the remaining associations, Depression was associated with higher Motivation ($r = .237$, $p \leq .001$) and more Dependence ($r = .219$, $p \leq .001$). Motivation was associated with higher levels of Ecstasy Use ($r = .388$, $p \leq .001$) and more Dependence symptoms ($r = .632$, $p \leq .001$). Ecstasy Use and Dependence were moderately and positively associated ($r = .316$, $p \leq .001$).

Overall, these results indicated that each of the four latent constructs was statistically reliable. The coefficient alphas, ranging from .51 to .89, showed that the indicators adequately represented the underlying factors of Depression ($\alpha = .89$), Motivation ($\alpha = .74$), and Dependence ($\alpha = .70$). The reliability for Ecstasy Use was somewhat lower ($\alpha = .51$) after adjusting the measurement errors in its indicators. Overall, however, the findings of the CFA provided support for the proposed measurement model.

Results of the Structural Model --- Having obtained a suitable measurement model that provided adequate psychometrics for the four specified latent constructs, the next step in the analysis involved testing the theorized psycho-economic model. As shown in Figure 4.1, the structural model specified the predictive relations as

pathways from the left-hand side of the model to the two outcome latent constructs (Consumption and Dependence). The predictors included two latent constructs (Depression and Motivation), two composite variables (income index and sexual risk-taking), two 'single" item economic measures (monetary cost or unit price and opportunity cost), and five "control" measures (gender, race, age, education, and site). The process of testing the SEMs involved a series of sequential models (not nested) that specifically addressed the research hypotheses. Each model was reviewed and evaluated first by examining the sign, magnitude, and statistical significance of the estimated path coefficients and second by the various model fit indices. For purposes of comparison, summary model fit statistics from the different SEMs are presented in Table 4.8. Table 4.9 contains the corresponding standardized parameter estimates for the different models tested in the sequence.

*Economic Model* -- The first SEM examined the hypothesized economic component of the conceptual psycho-economic framework, using the three economic measures (income, opportunity cost, and unit price) as predictors of the latent construct outcomes (referred hereafter as the "Economic Model").

The Economic Model was tested in two steps. In the first step the model included the three independent economic measures (income index, monetary price, and opportunity cost) as predictors of Ecstasy Consumption only. Even though this model is considerably pared down from the hypothesized psycho-economic model (and not nested with any more complex or subsequent models), it provides an

opportunity to examine unbiased parameter estimates resulting from the regression of Ecstasy Use on the economic indicators.

By all indications, a model positing only the economic measures (referred to above as 'unbiased' model) did not provide an optimal fit to the data (results not shown in Tables), $\chi^2(11) = 69.40$, $p \leq .001$ ($\chi^2/df = 6.31$), NFI = .922, CFI = .932, SRMR = .049, RMSEA = .091, and AGFI = .924. Specifically, the $\chi^2$ was large and statistically significant and the $\chi^2/df = 4$ exceeded the upper bounds of acceptable upper limits for this fit index. Furthermore, although the Comparative Fit Index (CFI $\geq$ .9) and the Adjusted Goodness of Fit Index (AGFI $\geq$ .9) meet the criteria for adequate model fit, the RMSEA was greater than .05, indicating there was substantial variation left in the sample data unaccounted for by the hypothesized model. Turning to the model parameters, the index of social anomie (income index) did not significantly predict Consumption ($\beta$=-.041, $p > .10$). Monetary (or unit price) was negatively associated with Consumption (reflecting the basic law of demand), $\beta$ = -.226, $p \leq .001$.

On the other hand, "time spent obtaining Ecstasy" (assessing opportunity cost) was positively associated with Consumption (i.e., more time is required for less expensive Ecstasy that leads to more use), $\beta$=.212, $p \leq .001$. Correlations among the exogenous predictors indicated that higher levels of income (reflecting social power, available discretionary income or the opposite of anomie) was positively associated with lower levels of unit price ($r = .085$, $p \leq .05$). Stated in different terms, it would

appear that lower income drug users search for lower Ecstasy prices. As a follow-up test, and as a means of testing for suppression (this also has been termed 'interpretational confounding' by Burt, 1973; 1976), the Economic Model was also specified and tested just modeling the income index as a predictor of Consumption (essentially constraining to zero the effects associated with opportunity cost and price). This model also showed that neither unit price nor opportunity cost was "masking" the relation between income and Consumption. The estimated path coefficient maintained roughly the same magnitude, there was no reversal of sign, and the parameter was not significant, $\beta$=-.036, $p > .10$.

The next Economic Model specified Dependence as a second endogenous construct along with Consumption and included the three exogenous economic indicators (referred to as "SubModel 1"). Model fit statistics (see Table 4.8) also showed a less than optimal fit by several criteria, $\chi^2(70) = 274.09$, $p \leq .001$ ($\chi^2/df = 3.92$), NFI = .875, CFI = .890, RMSR = .071, RMSEA = .068, and AGFI = .919. Of all three exogenous predictors (see Table 4.9), "time spent locating Ecstasy" (i.e., opportunity cost) significantly predicted Ecstasy Use ($\beta = .214$, $p \leq .001$) and Dependence, $\beta = .126$, $p \leq .01$, while unit price (i.e., monetary cost) predicted Ecstasy Use, $\beta = -.226$, $p \leq .001$.

Among the specified correlations (both for the exogenous and endogenous parts of the model), the positive association between income and unit price remained intact ($r = .085$, $p \leq .05$) and as expected higher Consumption was associated with

more reported problems from Ecstasy use (i.e., Dependence criterion), r = .30, $p \leq$ .001. Overall, the economic component of the structural model explained about 14% of the variance of Consumption ($R^2$ = .135) and 12% of the variance in Dependence ($R^2$ = .117). The income index was not a significant predictor of either outcome latent constructs.

*Psychological Model* -- The next SEM specified pathways (see Figure 4.1 above) indicating all possible predictive relations between the hypothesized non-economic "Risk Factors" and the two endogenous outcome constructs: Consumption and Dependence. This model does not include the economic measures and also provides an opportunity to examine the influence of psychological risk on Consumption and Dependence. The domain labeled "Risk Factors" included psychological functioning (Depression), situational motivations to use drugs, and sexual risk-taking, the latter serving as a proxy of the Ecstasy user's risk taking behavior. This model was referred to as the Psychological Model. Results of this model are reported in Table 4.8 and Table 4.9 under the heading of "SubModel 2."

The Psychological Model showed a fairly adequate fit, $\chi^2(161) = 565.13$, $p \leq$ .001 ($\chi^2$/df = 3.51), NFI = .877, CFI = .908, SRMR = .078, RMSEA = .063, and AGFI = .902. In particular, the $\chi^2$ was large and statistically significant, and the $\chi^2$-ratio was lower than 5.0 but still larger than the acceptable level of 2.0 indicating superior model fit ($\chi^2$/df = 4). With the exception of the NFI, the overall goodness of fit measures (CFI and AGFI) exceeded their critical thresholds of .90, but only

slightly. Although the RMSEA was below its acceptable level, SRMR was just near its cut-off value of .08.

**Table 4.8 Goodness of Fit for The Structural Model (N=640)**

| | *Goodness of Fit Measures* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Competing Model for Ecstasy Use & Dependence*** | *Chi-Square* $\chi 2$ | *Degree of Freedom df* | *Chi-Square Test* $\chi 2/df$ | NFI | CFI | GFI | AGFI | SRMR | RMSEA |
| SubModel 1 | 274.09 | 70 | 3.92 | .875 | .890 | .946 | .919 | .071 | .068 |
| SubModel 2 | 565.13 | 161 | 3.51 | .877 | .908 | .925 | .902 | .078 | .063 |
| Full Model | 671.23 | 206 | 3.26 | .860 | .898 | .923 | .897 | .071 | .059 |
| Refined Model | 607.70 | 200 | 3.04 | .879 | .916 | .932 | .906 | .065 | .055 |
| Conditioned Model | 1042.51 | 272 | 3.83 | .829 | .869 | .901 | .868 | .081 | .071 |

Notes: 1. SubModel 1 = Model with economic measures only (Income, Price, & Opportunity Cost)
SubModel 2 = Model with psychological factors only (Motivation, Depression, & Sex-Risk)
Full Model = SubModel 1 and SubModel 2 combined
Refined Model = Full Model + allowing for nonstandard effects
Conditioned Model = Full Model + controling for demographics (Gender, Age, … etc) and site
2. NFI = Normative Fit Index; CFI = Comparative Fit Index;
GFI = LISREL Goodness of Fit Index; AGFI = LISREL Adjusted Goodness of Fit Index;
SRMR = Standardized Root Mean-Square Residual; and
RMSEA = Root Mean-Square Error of Approximation.

An examination of the standardized parameters estimated for this model (see Table 4.9) showed that not all path coefficients were significantly different from zero ($p > .05$). Neither Depression nor sexual risk-taking significantly predicted Ecstasy Use (Consumption). However, Depression was significantly associated with Dependence, $\beta = .078$, $p \leq .001$. Sexual risk-taking was not significantly associated with Consumption but negatively and significantly associated with Dependence ($\beta = -.110$, $p \leq .01$). It is worth noting also that of all the psychological risk measures Motivation had the largest influence on both Consumption ($\beta = .417$, $p \leq .001$) and Dependence ($\beta = .654$, $p \leq .001$).

**Table 4.9 Parameter Estimates (Standardized Coefficients) of the Psycho-Economic Model (N=640)**

| | *Competing Models for Ecstasy Use & Dependence* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *SubModel 1* | | *SubModel 2* | | *Full Model* | | *Refined Model* | | *Conditioned Model* | |
| ***Explanatory Variables*** | *(1)* | *(2)* | *(1)* | *(2)* | *(1)* | *(2)* | *(1)* | *(2)* | *(1)* | *(2)* |
| ***Economic Factors*** | | | | | | | | | | |
| Income Index | -.043 | -.009 | | | -.028 | .013 | -.017 | .028 | -.015 | .011 |
| Monetary cost | -.226*** | -.018 | | | -.234*** | -.033 | -.245*** | -.012 | -.250** | -.018 |
| Opportunity cost | .214*** | .126** | | | .137*** | .024 | .102** | .026 | .100* | .050 |
| ***Psychological Factors*** | | | | | | | | | | |
| Motivation | | | .417*** | .654*** | .384*** | .661*** | .386*** | .647*** | .310*** | .659*** |
| ***Other Risk Factors*** | | | | | | | | | | |
| Depression | | | -.056 | .078*** | -.054 | .076* | -.055 | .085* | -.020 | .067† |
| Sex Risks | | | -.047 | -.110** | -.024 | -.107* | -.024 | -.104* | .017 | -.078* |
| **Control Variables** | | | | | | | | | | |
| Gender | | | | | | | | | -.033 | -.108** |
| Age | | | | | . | | | | -.064 | .150*** |
| Study Site | | | | | | | | | .479*** | .086 |
| R-Squared | .135 | .117 | .155 | .414 | .216 | .411 | .237 | .428 | .365 | .460 |

Notes: 1. SubModel 1 = Model with economic measures only (Income, Price, & Opportunity Cost)
SubModel 2 = Model with psychological factors only (Motivation, Depression, & Sex-Risk)
Full Model = SubModel 1 and SubModel 2 combined
Refined Model = Full Model + allowing for nonstandard effects
Conditioned Model = Full Model + controling for demographics (Gender, Age, … etc) and site

2. For each model (1) referres to Ecstasy Use (or consumption) and (2) Dependence

3. Statistically significant levels are indicated by † for $p \leq .10$, * for $p \leq .05$, ** for $p \leq .01$, and *** for $p \leq .001$

Furthermore, there were several significant associations among the predictor measures and constructs. Depression was significantly associated with sexual risk-taking (r = .110, $p \leq .05$), as was Motivation with sexual risk-taking (r = .362, $p \leq .001$), and Motivation was significantly associated with Depression (r = .231, $p \leq .001$). The psychological component of the structural model explained (see Table 4.9) about 16% of the variance in Consumption ($R^2 = .155$) and 41% of the variance in Dependence ($R^2 = .414$).

*Specification of the Full Model* -- The next in the series of SEMs tested the influence of both the economic and psychological domains in fully saturated model (and predicting both latent constructs of Ecstasy Use and Dependence). Estimates of the "Full Model" path coefficients were derived in an ordered sequence, starting with the Economic Factors (income index, monetary price, and opportunity cost) and adding incrementally the three risk factors (Motivation, Depression, and sexual risk-taking). Running the model incrementally helps to identify problems with convergence and optimization as well as detect any suppression. The sequential nature of model testing also provides a means to compare the direct effects of each risk factor from a specific domain before and after controlling for measures from other domains.

An acceptable fit was obtained when the model included both the economic and psychological components, $\chi^2(206) = 671.23$, $p \leq .001$ ($\chi^2/df = 3.26$), NFI = .860, CFI = .898, SRMR = .071, RMSEA = .059, and AGFI = .897. Despite the fact that

the $\chi^2$ was statistically significant, the $\chi^2$/df ratio achieved an acceptable level ($\chi^2$/df ≤ 4). Also, while both the CFI and the AGFI statistics did not clearly meet their required criteria (CFI ≥ .90 together with AGFI ≥ .90), they were still both well within their acceptable .90 range. On the other hand, the SRMR and RMSEA were both below their recommended benchmark of .08. Furthermore, the fully saturated structural model accounted for 22% of the variance in Consumption and 41% of the variance in Dependence (see Table 4.9).

To further assess the contribution of combining key economic and psychological measures to account for Ecstasy Use and Dependence, two additional models were directly compared with the Full Model (referred to in this test as "Parent Model"), using the $\chi^2$ nested difference test. The importance of the three economic factors (income, price, and opportunity cost) was tested first. In this test, the "Parent" Model with its freely estimated parameters was compared to a structural model that constrained the paths corresponding to the economic measures to zero. This model essentially posits there are null effects for the economic measures when juxtaposed against measures of psychological risk and structurally nested with the Parent Model. The nested comparison of these two models was significant, $\Delta\chi^2 = 2610.21 - 671.23 = 1938.98$ ($\Delta$df = 209 - 206 = 3), $p \leq .001$, indicating that at least some of the constraints were not tenable. In other words, specifying paths from the economic measures to Consumption and Dependence improves the fit of the model over a model that constrained these paths to zero.

Following this test, the Parent Model was compared to a nested model that constrained the path coefficients estimating the effects of the psychological factors to be zero. These constraints resulted in a significantly poorer fit than when the same parameters were freely estimated, $\Delta\chi^2(\Delta df = 3) = 2191.76$, $p \leq .001$, suggesting that the psychological factors were also needed to explain the use of Ecstasy and its related consequences. On the basis of the above findings, it was apparent the integration of economic and psychological factors was deemed essential.

The Final Model parameter estimates are reported in Table 4.9 and displayed in path diagram in Figure 4.3. Because the estimated factor loadings, correlations between constructs, and error terms were almost identical to those reported for the measurement model in Figure 4.2, they are not presented here. Also, for purposes of clarity, only the structural components of the Full Model with statistically significant coefficients corresponding to paths and correlations are illustrated in Figure 4.3.

As shown in Figure 4.3, among all the hypothesized relations between the exogenous economic and psychological predictors and the endogenous constructs (Consumption and Dependence), the income index did not significantly predict either Ecstasy Use ($\beta = -.028$, $p > .10$) or Dependence ($\beta = .013$, $p > .10$). However, opportunity cost (time spent seeking drugs) was significantly related to Ecstasy Use ($\beta = .137$, $p \leq .001$) and monetary cost (unit price) was inversely and significantly associated with Ecstasy Use (cheaper prices were associated with more consumption: $\beta = -.234$, $p \leq .001$). Among the psychological risk factors, Motivation was associated

with greater consumption (β = .384, $p \leq .001$) and also with more problems from consumption (β = .661, $p \leq .001$). Interestingly, and in contrast to the previous model findings (see SubModel 2 results), Depression was not significantly related to either of the two endogenous constructs, albeit there was a trend for more depressive symptoms to be associated with more problems from consumption (β = .076, $p$ = .051). Sexual risk-taking was inversely and significantly associated with association with Dependence (β = -.11, $p \leq .05$).

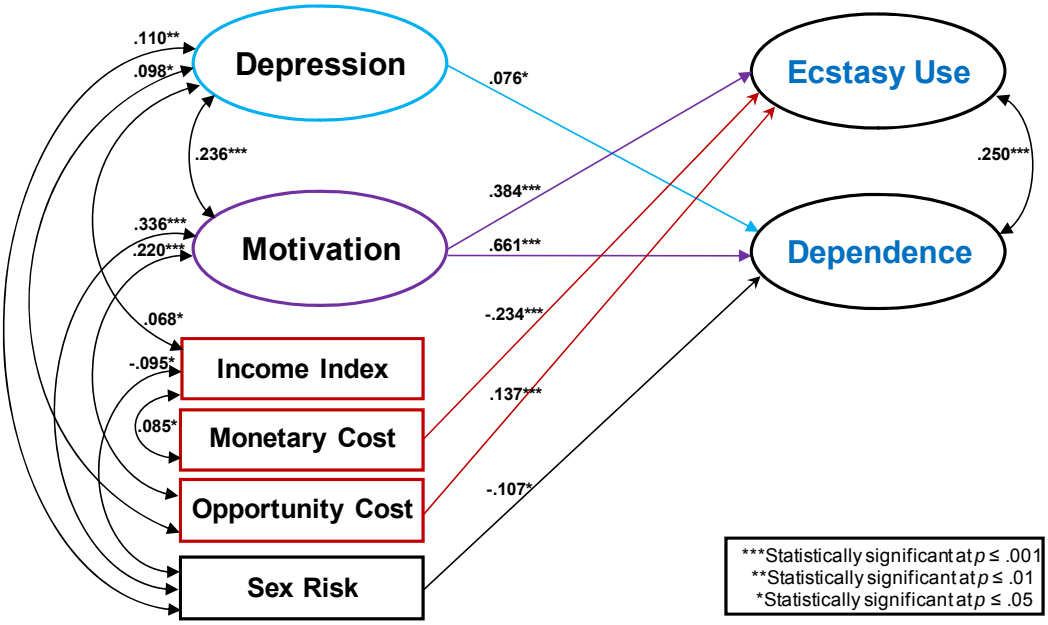



**Figure 4.3** Final SEM depicting influence of both economic and psychological factors on Ecstasy use and dependence (Only significant paths are showing).

The Full Model also contains significant correlations between several of the exogenous predictors. The largest of these includes an association between Motivation and sexual risk-taking (r = .336, $p \leq .001$), followed in order of decreasing

magnitude by associations between Depression and Motivation (r = .236, $p \leq .001$, Motivation and opportunity cost (r = .220, $p \leq .001$), Depression and sexual risk-taking (r = .110, $p \leq .01$), Depression and opportunity cost (r = .098, $p \leq .05$), and income with sexual risk-taking (r = -.095, $p \leq .05$: more financial displacement is associated with higher risk-taking), monetary cost (r = .085, $p \leq .05$), and Depression (r = .068, $p \leq .05$). Overall, these eight correlations help clarify the overlap between the economic measures and psychosocial risk. The only other parameter remaining of interest is the association among disturbance terms for the two endogenous constructs (Ecstasy Use and Dependence), which reflects their association net of all predictor effects (r = .25, $p \leq .001$).

*Post-Hoc Specifications and Model Refinement* – At this point it made sense with all of the specified predictors included in the model to run empirical specification searches to detect any additional 'nonstandard' effects (or associations in this case, given the cross-sectional nature of the data) that may help improve the overall model fit. Theoretically speaking, the full model specified very general predictive relations; however, there are other less obvious relations that exist within the data that may be sample specific, but were not hypothesized as part of the psycho-economic model. These also help to uncover the "true" model. The specification searches include any "indicators" of a predictor construct that influence either an endogenous latent construct or the indicator corresponding to an endogenous construct. In addition, nonstandard relations can include exogenous constructs that

influence indicators of endogenous constructs and that were not specified a priori. [See Leamer (1978) for a thorough discussion of specification searches in the context of economic theory].

Although post-hoc empirical specification searches are conducted "after the fact" they are tested in a very systematic fashion. The Lagrange Multiplier test in the EQS statistical program produces modification indices (MIs) that indicate the magnitude and direction of an expected parameter change and corresponding change in likelihood ratio $\chi^2$ value for the model that accompany freeing an individual parameter (Bentler, 1995). Inclusion and specification of nonstandard parameters essentially takes a parameter fixed at zero and freely estimates this parameter in the context of other obtained nonzero relations.

Specification searches were conducted in a very straightforward and methodical manner to assure model consistency (e.g., Silvia & MacCallum, 1988). First, each recommended parameter change were checked for theoretical consistency (addressing whether the proposed change in model parameterization was consistent with prior reported empirical findings) and then the sign of the parameter was examined in the context of the given zero-order bivariate relations. If a recommended change involved specification of a path involving a factor, the signs of the proposed parameter were checked against all of the indicators reflecting the factor. This procedure protects against suppression and inconsistent models. Given the primary interest rests with the significance of economic indicators in the context of important

psychosocial measures, the search for nonstandard relations concentrated on identifying effects from economic predictors on observed indicators of the two endogenous constructs (Consumption and Dependence).

Based on the systematic search outlined above, six nonstandard relations involving the three economic indicators and two endogenous constructs were detected, satisfied the criteria for inclusion, and added to the Full Model. These included a path between the income index and number of pills used/day past 30 days ($\beta = .07$, $p \leq .05$) and a path from opportunity cost (time spent obtaining Ecstasy) and number of pills used/day past 30 days ($\beta = .09$, $p \leq .01$). In addition, opportunity cost was significantly associated with lifetime quantity ($\beta = .15$, $p \leq .001$) and the index of income was significantly associated with lifetime quantity ($\beta = -.18$, $p \leq .001$). Coding of the income index indicated that less financial means were associated with less lifetime Ecstasy use. In addition, monetary cost (unit price) was associated with lifetime quantity ($\beta = .11$, $p \leq .01$) and with an indicator of dependence ($\beta = -.07$, $p \leq .05$). The latter relation indicated greater cost was associated with less dependence. The Revised Model with the addition of these paths fit the data reasonably well, $\chi^2(200) = 607.70$, $p \leq .001$ ($\chi^2/df = 3.04$), NFI = .879, CFI = .916, RMSR = .07, RMSEA = .05, and AGFI = .932. Specifically, the $\chi^2/df$ ratio was smaller and below the critical 4.0 threshold. All three relevant model fit indices met their joint critical thresholds of "good fit" (CFI $\geq$ .9 together with a RMSEA $\leq$ .08 or with an AGFI $\geq$ .9). The Revised Model explained 24% of the variance in Consumption ($R^2 = .237$)

and 43% of the variance in Dependence ($R^2 = .428$). At this point, there were no more post-hoc additions that reflected unequivocal influence of economic indicators on the endogenous components and the overall model change in $\chi^2$ points was not appreciable enough to warrant inclusion of additional specific relations.

*Simulation and Bootstrap Analyses* – On the basis of the above findings (see Table 4.9), a bootstrap analysis was undertaken to determine whether the obtained parameter estimates were stable or consistent. Bootstrapping is a nonparametric method usually used for both inferential and descriptive purpose based on the data-driven sampling distribution of estimates (Efron & Tibshirani, 1994). In this study, the bootstrap procedure consisted of re-sampling from the available data repeatedly and re-estimating the model parameters. One thousand random "bootstrap samples" with a subset of 500 observations each were drawn with replacement from the actual sample data. The model selection for these bootstrap simulations was the Full Model as it was the most conceptually relevant specification of the proposed psycho-economic model. From the empirically estimated sampling distribution, the parameter mean estimates, standard errors, and the ratio of the mean parameter estimate to its standard errors were computed and reported along with the actual Full Model parameter estimates in Table 4.10.

The bootstrap approach assumes that the model is theoretically correct, but that the estimates drawn through re-sampling sample data are not precisely accurate. They are approximation of the "true" (or population) values of the parameters and

given the hypothesized model. The ratio of the mean parameter estimate and standard error functions as a t-test or critical z-ratio statistic indicating the significance of the estimate. It should be noted that for a good approximation of the "true" parameter value, the ratio should be greater than two (1.96 is formally the critical z-ratio limit for a two-tailed hypothesis test).

Table 4.10 contains the results of the bootstrap procedure. Overall, the mean bootstrap estimates and the Full Model parameter values were very close with very trivial deviations (.001 in many cases) and also relatively small standard errors (this indicates the estimates are quite efficient). Across the 1000 replications, Motivation (t = 6.326), monetary cost (t = -5.167), and opportunity cost (t = 2.906) were the more consistent predictors of Consumption, while Motivation (t = 8.691), Depression (t = 2.250) and sexual risk-taking (t = -2.167) were the more consistent predictors of Dependence. The income index was not a consistent predictor of either endogenous constructs (Consumption or Dependence). Of particular interest was the parameter estimates for the association between sexual risk-taking and Ecstasy Use. The absolute value of this parameter was very small but between the sample and bootstrap model's flipped signs. Of the 1000 bootstrap simulation results, 58% of its values were positive and the remainder was negative perhaps indicating suppression. Therefore, although the results from this bootstrap analysis confirmed that in general the parameters of the full hypothesized model were stable (and efficient) over the

1000 replications, variables such as income, Depression and sexual risk-could perhaps be dropped to improve the fit of the model.

**Table 4.10 Sample and Bootstrap of Model Parameter Estimates (1000 Replication, N=640)**

| | *Ecstasy Use* | | | | Dependence | | | |
|---|---|---|---|---|---|---|---|---|
| ***Predictors*** | *Sample* | *Bootstrap* | *SE* | *t-Value* | *Sample* | *Bootstrap* | *SE* | *t-Value* |
| ***Economic Factors*** | | | | | | | | |
| Income Index | -.004 | -.003 | .015 | *-.221* | .007 | .008 | .012 | *.612* |
| Monetary Cost | -.181 | -.182 | .035 | -5.167 | -.019 | -.021 | .026 | *-.816* |
| Opportunity Cost | .110 | .109 | .037 | 2.906 | -.014 | -.016 | .028 | *-.584* |
| ***Psychological Factors*** | | | | | | | | |
| Motivation | .145 | .146 | .023 | 6.326 | .186 | .189 | .022 | 8.691 |
| ***Other Risk Factors*** | | | | | | | | |
| Depression | -.020 | -.018 | .0186 | *-.968* | .021 | .022 | .010 | 2.250 |
| Sex Risk | -.006 | .012 | .0119 | *1.008* | -.019 | -.020 | .009 | -2.167 |

Notes: 1. The model used in these simulations was the originally hypothesized "Full" model and did not include any non-standard effects/associations
2. Sample = ML non-standardized solution, Bootstap = Mean bootstrap results, SE = Estimated standard errors for bootstrap estimates, and t-Value = Mean bootstrap estimates to estimated SE (z-critical ratio)

*The Conditioned Full Model* -- The final step in the model testing procedure involved estimation of the Full Model with demographic control variables. Inclusion of these control measures was based partly on the findings from the earlier descriptive and variance decomposition analysis that had reinforced clear gender, age, and site differences in model variates. Usually, the best way to evaluate the influence of exogenous "control" measures requires splitting the sample for each variable and conducting multiple group comparisons. In the case of gender, for example, a sample variance/covariance matrix would be generated separately for male and female participants and various equality constraints tested across these models. However, splitting the sample would result in highly uneven groups for most of the control measures (particularly race, age, education, and site), the comparison would be highly underpowered, and strain the robustness of the statistical methods. An alternative

approach is to dummy code the control measures (male=1, female=0) and add them to the "Full" model as exogenous control measures (their influence is treated as "covariates" and the model assesses whether these measures "condition" the parameter estimates).

*Demographics Control* – An initial conditioned model included gender (male coded as "1"), race (white coded as "1" and 'racial minorities' coded as "0"), age ('less than 21' coded as "1" '21 and older' coded as "0"), and education ('less than high school' coded as "1" and 'high school and beyond' coded as "0") to examine whether they dramatically change the model fit and its parameter estimates. A model specifying these control measures indicated a "decrement" in fit from the "Full" model previously reported, $\chi^2(296) = 1063.19$, $p \leq .001$ ($\chi^2/df = 3.59$), NFI = .814, CFI = .849, RMSR = .07, RMSEA = .06, and AGFI = .895. Although the $\chi^2/df$ was still acceptable ($\chi^2/df = 4$), the remaining model fit indices did not met their joint critical thresholds (CFI $\geq$ .9 together with a RMSEA $\leq$ .08 or with an AGFI $\geq$ .9). Also, of all the demographic variables added to the model only education marginally predicted Consumption ($\beta = .10$, $p = .05$). On the other hand, gender (male participants reported less problems than females, $\beta = -.10$, $p \leq .05$) and age (younger users reported more problems than older ones, $\beta = .16$, $p \leq .01$) significantly predicted Dependence.

*Site Comparisons* – A second conditioned model added all the demographic measures along with site into the Full model (participants from Australia coded as

"1" and those from St. Louis and Miami coded as "0"). Again these additions led to a decrement in model fit, $\chi^2(321) = 1356.42$, $p \leq .001$ ($\chi^2/df = 4.23$), NFI = .760, CFI = .803, RMSR = .09, RMSEA = .07, and AGFI = .841. Furthermore, there was also additional evidence of "suppression" because certain parameter estimates (income index and monetary cost) reversed signs predicting both Consumption ($\beta = .01$, $p > .10$ and $\beta = .30$, $p > .10$, respectively) and Dependence ($\beta = -.01$, $p > .10$ and $\beta = -.02$, $p > .10$, respectively). Indeed, based on earlier bivariate analysis, both race and education were strongly associated with site (see Table 4.1). Since neither variable reached the nominal alpha level for significance, they were candidates for elimination.

A third and final conditioned model examined the effect of gender, age and site on both Consumption and Dependence. Although this model showed a better fit than the two previous models, it was only marginally acceptable (reported in Tables 4.8 and 4.9), $\chi^2(272) = 1042.51$, $p \leq .001$ ($\chi^2/df = 3.83$), NFI = .829, CFI = .901, RMSR = .08, RMSEA = .07, and AGFI = .868. Of all three control variables added to the model, only site was a strong and significant ($\beta = .479$, $p \leq .001$) predictor of Ecstasy use or Consumption, indicating that, holding all else constant, Ecstasy users in Australia consumed more pills that their counterparts in St. Louis and Miami. On the other hand, gender ($\beta = -.11$, $p \leq .01$) and age ($\beta = .15$, $p \leq .001$) were the only significant predictors of Dependence. At this point there were no further statistical tests that could be applied to ascertain the validity of the research hypotheses.

# CHAPTER V: DISCUSSION AND CONCLUSIONS

The chapter begins with a review of the purpose of the study, continues with discussion of the study rationale, and then summarizes the findings with respect to the main research hypotheses. The chapter also revisits ways in which the current study improves upon and refines existing research on drug consumption. The chapter then discusses the strengths as well as the limitations of the data noting in particular its source, data collection methods, data manipulations, and transformations. The chapter concludes by discussing the potential implications of these findings and provides recommendations for future research.

## 1. **Purpose of the Study**

For centuries, philosophers have engaged considerable debate over whether man acts in a rational or irrational manner in making certain decisions. For the most part, these different views of "thought" have fueled considerable discussion with different disciplines weighing in at different times. Among the many disciplines investigating human behavior, economists take the view that humans are entirely rational and their behavior can therefore be examined through traditional market-price mechanisms (i.e., invisible hand). The success of this approach has gained earnest respect and models have been developed to explain production and consumption of goods and services, as well as many other aspects of day-to-day economic activity. Interestingly, drug use is one of many activities engaged by

humans; however, it has not come under scrutiny by economists until recently. This is most likely because most economists would regard drug use as the end product of "irrational behavior."

This seeming neglect changed entirely with the publication of the Rational Addiction Model (RAM) by Nobel laureate Gary Becker. According to Becker, man is purely rational, forward thinking, and seeks to maximize his utility (or satisfaction) subject to a budget constraint. In dramatic fashion, Becker then argued this approach can be used to account for drug use, which can readily be explained by "market factors." As powerful an argument as this may seem there are considerable issues that need to be addressed when behavior is approached from the RAM perspective. One in particular is that economists traditionally assume explicitly or implicitly the "ceteris paribus" clause (i.e., hold all other factors constant) as pure market factors are used to account for behavior. The idea that one can artificially control important influences may present an impoverished view of behavior because in real life there are many factors that drive consumption and that go beyond price, opportunity cost, and income. In fact, people are dynamic and quite complex, always deliberating about a host of factors when making decisions. It is thus overly simplistic to suggest that price alone dictates choices over consumption when other "factors" also seem relevant.

Psychology is one of several alternative disciplines that have spent considerable time attempting to explain behavior and looking into the role of these

"other factors." Some of the more prominent concepts used to explain drug use behaviors have included motivation, desire, craving, urges, attitudes, beliefs, and affective experiences. From this brief accounting it should be apparent that economists and psychologists have two very unique approaches to explain behavior and while both seem necessary neither explanation alone is sufficient. After all, drug users consume drugs not only because they are cheap, but also because of their own desire and interest in the drug and their anticipated effects. It should be apparent then, that both arguments provide valid explanations for drug use behavior and should perhaps be considered together. The purpose of this study is to assess the theoretical importance of combining key factors from economic and psychological theories into a model of Ecstasy use and dependence.

Contribution of this Study --- There are several ways in which the current study improved upon previous research. First, as powerful as Becker's model of drug consumption may seem, it has mostly been applied with legal or "licit" substances like alcohol and cigarettes. In fact, no extensions of the RAM have ever fully been tested with "illicit" drugs. In the present study, the existing RAM was applied to an "illicit" substance that may not be bound by the same market factors used to explain licit drug use.

Second, the existing RAM did not consider factors that may influence drug consumption from outside the economic domain. Thus only market factors were considered as vital predictors of consumption. In the present study, additional

"psychological" measures were included that may enhance the prediction of drug consumption. These measures represent key etiological risk mechanisms that have been linked with various forms of drug use but are especially important in the consumption of Ecstasy.

Third, the psycho-economic model also incorporated hypothesized "latent constructs." Reliance on "unobserved" constructs as opposed to measured or "manifest" variables attenuate measurement error and improve model precision. The latent constructs modeled reflected both predictors and outcomes and enabled a more parsimonious test of whether economic measures remained vital predictors of consumption when juxtaposed against psychological risk mechanisms.

Fourth, the RAM considered only consumption as a reflection of drug behavior. However, many drug users experience side effects or consequences from their drug use that can influence or regulate their consumption. These subtle relations have not been traditionally modeled in economic models of consumption and have also been neglected when modeling psychological risk. The present study modeled a latent construct of "problems from Ecstasy use" reflecting currently diagnostic nosology, termed Dependence, in addition to consumption.

Rationale for the Study --- Any time youth become involved in psychoactive drugs there is considerable cause for alarm. Not only are psychoactive drugs illegal, they interfere with successful role socialization, impair cognitive functioning, and detract from living fully. Illicit drugs are also responsible for neurological problems,

physical harm, and can derail youth from achieving their full potential. For these and other reasons concern is raised when new drugs become available and appear attractive to youth. One drug in particular that has raised considerable concern is Ecstasy, which has seen an upsurge in use by all ages across the lifespan, but mostly among youth. Ecstasy is known for its hallucinogenic properties and for its ability to break down interpersonal inhibitions or social barriers. Users of Ecstasy report feeling interpersonally close, able to read other people more accurately, and warm to sensations and emotional feelings they don't normally have. Many people use Ecstasy to electrify their sexual experiences, hoping the drug will open portals of perception during physical contact. This has led several writers to coin the phrase that Ecstasy is the "love drug."

Considerable field work now shows that many young people use Ecstasy in combination with other substances while attending raves, all night dances held in large open spaces or warehouses where they can experience the constant grind and rhythm of music. The effects of the Ecstasy can last several hours. Both laboratory and naturalistic studies of Ecstasy users indicate serious medical and psychological complications from even limited use. Side effects include hyperthermia, jaw clenching, racing heart and elevated pulse, some cognitive impairment including memory loss, and potentially harmful and often irreversible bodily effects.

Special Features of the Data --- There are several strengths to the data used for this research that should be noted. First, the parent NIDA-funded study (CDSLAM)

was intended to examine the utility of DSM-IV diagnostic criteria for substance use disorders and their extension to club drugs, including Ecstasy use. As a result, extensive self-report information was collected that detailed the prevalence and patterns of Ecstasy consumption including consequences that arise from use and factors that regulate its consumption. Second, participants were extensively probed regarding their consumption patterns of not only Ecstasy but other licit and illicit drugs. This included their use and the effects of club drugs other than Ecstasy and what factors may have prompted their drug involvement. Fourth, participants were also asked questions about whether they engage a wide range of other high risk behaviors that may relate to drug use. The ability to collect such extensive and rich data and conduct secondary analysis provides a cost-effective opportunity to learn more about drug etiology (and test the psycho-economic model) without expending large financial resources to collect the information needed for this study.

Furthermore, the parent study was conducted by a team of highly respected and well qualified researchers, guided by Dr. Linda Cottler and the EPRG group. This led to the development of excellent and reliable measures, as well as strict adherence to research protocols, minimizing any bias in the data from uncontrolled sources. The data was also obtained from areas that had been identified by epidemiological surveillance methods with indications of high prevalence for Ecstasy use. Data were obtained from a relatively youthful community sample of drug users (mean of 23 years), all of whom reported both lifetime use and current (recent) drug use patterns.

Additionally, the participants were not involved currently with drug treatment and they voluntarily consented to provide their information. This makes it more likely that the information they provided is a true reflection of what happens to people when they are involved in illicit drug use, including Ecstasy, and makes it more likely the information they provided would generalize to the larger population of drug users.

The field methods used to recruit users and retain them in the study is easily replicable and familiar to the epidemiology literature. Minimal intrusion was used and subjects were compensated for their time and inconvenience. In addition, the sample was quite heterogeneous coming from three geographically dispersed sites, two located in the US (Miami and St. Louis) and one internationally in Sydney, Australia. Using data from such heterogeneous places provides a tremendous opportunity to examine cultural influences, along with other demographic features of a sample that can influence consumption (i.e., race, education, and income). The sample was predominantly white but included sufficient representation of racial minority groups to adequately sample their behavior. The sample characteristics also represented a wide range of age groupings ensuring that drug use was not an artifact of youthfulness or trend related. There was equivalent proportion of both sexes ensuring that any trends in drug consumption did not merely reflect gender specific socialization, which has been a factor contributing to differences in rates of alcohol consumption, among other drugs.

The parent study also included economic, epidemiological, psychological as well as psychiatric diagnostic information thus providing a broad assessment of factors that may increase or decrease consumption. While individually these measures may be parts of other studies it is rare they are collected under the umbrella of a single study and with such extensive data collection on the same person. Once these data were obtained several steps were taken to ensure their suitability for the proposed multivariate statistical analysis. These preliminary steps included extensive checks and data manipulations at the item level. Each item or measure was checked for normality using key indicators of central tendency such as skewness and kurtosis. In all cases, the variables met the recommended criteria and were deemed suitable for analysis. In addition, steps were taken to summarize the large number of variables available for analysis into a more manageable set. In most cases, items were unit-weighted and summarized into composite scores, which were then subject to further analysis. When these procedures are used higher composite scores indicate greater risk.

The study also used latent-variable structural equation modeling techniques which is considered a gold standard in procedures for theory testing. This is because the goal of SEMs is to evaluate the concordance between sample data (variances and covariances) and an implied population model. The closer the "fit" between the hypothesized model and sample data, the more likely a researcher has specified the "true" model. The precision of models can be assessed by a wide range of inferential

model fit indices, allowing a researcher to discard poor or "ill" fitting models. Such procedures are the backbone of logical positivist themes in science and a major part of "falsification" (Popper, 1959). In addition to these considerations, the models also contained latent constructs hypothesized based on multiple indicators. Overall, this specification provides a wider net to assess behavior (more measures can be included in a single model), improves model precision by reducing measurement error, and increases statistical power.

Of the four latent constructs included in the SEM, two (Depression and Motivation) were specified as exogenous predictors and two (Ecstasy Use and Dependence) were specified as endogenous outcomes. This was in no way meant to infer "causation" but rather developed and tested to ascertain "unique" variance contributions in a predictive framework. This particular procedure offers another refinement on previous research because it requires simultaneous multivariate estimation of multiple predictors whose effects are estimated on multiple outcomes. Also included in the model there were observed measures primarily assessing economic market forces and high-risk behaviors and their relations were also estimated as unique predictors of the outcome constructs.

One other refinement in the modeling procedure included testing nested models comparing a constrained model with restricted parameters fixed to zero, against a less restricted model (with freely estimated parameters). The nested comparison for each degree of freedom difference provided a means to ascertain

whether the restricted model offers a more parsimonious and superior fit. This model testing procedure represents a further refinement on prior empirical tests of drug etiology, particularly with respect to economic measures and psychological risk as predictors of Ecstasy consumption.

To summarize, while numerous studies have investigated the effects of economic measures and separately psychological risk factors on drug use, few have combined these two approaches into a single comprehensive model. In addition, a good deal of research and empirical inquiry with regard to "rational" economic models has emphasized licit drugs (i.e., alcohol and tobacco), where regulatory measures like taxation and other measures to encourage production or restrict consumption can gain traction. This study extended this inquiry to include an illicit drug that has stimulated tremendous public health concern because of its deleterious effects but not received the same level of attention. Furthermore, economic models specify "consumption" as the sole outcome of interest, but problems from consumption may also play an important role determining how much of a drug a person consumes. Toward this end, this study included several measures of consequences that arise from consumption and modeled the predictive contributions of both economic measures and psychological risk factors in one conceptual framework, referred to as the psycho-economic model.

With regard to the selection of economic measures, prior models have included at most income and price, but have not directed much attention to the

amount of time a person spends finding sources for the drug, a factor that can severely affect consumption. By necessity, the actual time spent either searching and/or negotiating the purchase of an illicit drug can dampen enthusiasm when this commitment of personal resources impairs other role obligations. To address this, the current study included "opportunity cost" as a direct measure of time spent locating the drug. Finally, prior research was limited to exploratory statistical modeling leaving no way to "confirm" the study findings or test a specific theory. The present study relied on confirmatory modeling techniques for both the measurement and structural component using SEM technique, and provided a host of inferential fit statistics to examine the precision in modeling fit between sample data and an implied population model.

2. **Overview of the Study Findings**

The study was guided by three hypotheses. The first hypothesis concerned whether economic measures including income, unit price, and opportunity cost would directly influence Ecstasy consumption and problems from its consumption (or dependence), controlling for psychosocial factors and other control measures. Findings showed that only two of the economic measures, unit price and opportunity cost, were efficient predictors of consumption. The magnitude of the path from price to consumption was slightly larger than the one from opportunity cost to consumption. Income was not a determinant factor for Ecstasy use. On the other hand, only opportunity cost was a significant predictor of dependence.

The second hypothesis stipulated that psychological measures (e.g., motivation) and other intra-individual characteristics (i.e., depression and risk-taking) would influence both Ecstasy consumption and dependence, controlling for economic factors and other control measures. Findings showed that only motivation for drug use significantly influenced consumption and this was the largest effect overall in the model. In the part of the model predicting dependence, motivation was once again the largest effect overall, however, both depression and sexual risk taking were also significant predictor of problems from consumption.

The third hypothesis stipulated that the combination of adding psychological and economic measures into a model of drug consumption will improve the overall fit of the model and will increase significantly the overall proportion of variance accounted for by each respective set of measures. Finding showed that when specified as predictors of consumption, the economic measures accounted for $R^2$ = 13.5% of the variance. When the psychological measures were specified as predictors they accounted for $R^2$ = 15.5% of the variance in consumption. When both sets of measures were simultaneously specified they accounted for $R^2$ = 21.6% of the variance indicating an increase in predictive variance. Also, when both economic measures and psychological risk are posited simultaneously, the regression coefficients from each respective domain diminish in size but did not lose their significance. In fact, there was an increase in the overall variance explained by each set of predictors.

Overall, the results confirms the proposed psycho-economic model of Ecstasy use and dependence to be a valid conceptual representation of the determinants of consumption as well as the consequences that may arise from continued drug use. Notably, the economic measures were smaller in magnitude compared to the effects of psychological risk factors but still retained their overall significance. Of all the parameters modeled, motivation accounted for the most variance in the outcomes, attesting to the strength of internal psychological states as impetus for drug use and dependence. One way to think about the balance between the different domains of influence is that while psychological factors might explain the "wanting" or desire to use Ecstasy, the economic measures facilitate or make this process possible. This study also confirms that, among the economic measures considered, Ecstasy users not only pay attention to price but they also pay attention to how much personal resources must be expended in order to procure the drug.

Although not specified as a main research hypothesis the same question regarding incremental variance can be posed for dependence. In other words, does the addition of psychological risk factors to a model positing only economic measures increase the proportion of variance accounted for in problems associated with consumption. The results once again reinforce the additive value of having both sets of measures in one model. In this respect, the $R^2 = 11.7\%$ in the model with economic predictors of dependence increased to $R^2 = 41.1\%$ with a model specifying both economic and psychological predictors.

There were a number of other findings from the model testing procedures that help clarify the etiology of Ecstasy use. These points are broken down into (1) findings from the measurement model; (2) findings from the empirical specification searches; (3) findings from the bootstrapping; and (4) findings from the model including demographics.

Findings from the Measurement Model --- The results of the measurement model showed that the latent constructs were correctly hypothesized and were all statistically reliable. The correlations between all four constructs indicated divergent validity ensuring there was unique variance associated with each construct. The measurement model contained a total of six correlations between the latent constructs. Motivation and dependence shared the most variance, attesting to the large role played by "psychological impetus" in participant's continued drug use. Next in size was the relation between motivation and consumption. Motivation taps into "social milieu" and the various anticipated enhancements from using Ecstasy that clearly point toward the social functions of using this drug. Ecstasy has been noted to be very popular among young adults who use the drug as part of their attendance at all night dance raves. The drug is also reported to increase feelings of interpersonal closeness and enhance sexual experience. Thus, it is not surprising that motivation and Ecstasy use were moderately related.

The correlation between Ecstasy use and dependence was somewhat smaller in magnitude but still reinforced that continued use of the drug created certain

problems. Relations between motivation and depression and likewise between depression and Ecstasy use were smaller in magnitude perhaps attesting to the fact that mental health problems are not a prominent feature of the "drive" to consume this particular drug. The relatively small association between depression and dependence also reinforces that chronic use of drugs carries certain "risks" and can lead to impairment at many levels. The fact is that Ecstasy users reported feeling blue, sad, having suppressed appetite, trouble concentrating and feeling lethargic and these feelings were associated with tolerance, withdrawal, using more of the drug, not being able to cut down, spending a lot of time trying to get the drug, giving up activities to be further involved in drug use, and continued use despite problems (physical and psychological) from use. It should also be noted that one of the criterion for dependence includes continued use despite psychological problems, which may reinforce that there is a "self-medication" function even to Ecstasy use.

Findings from the Empirical Specification Searches --- The final model reflects all of the hypothesized paths that support testing the research hypotheses. However, hidden in the data are non-standard relations that represent "true" variance but were not conceived *a priori*. To illustrate these relations, consider that the three economic measures were hypothesized to influence consumption and problems from consumption at a very general level. However, it is also possible that economic measures can account for predictive variance in one or more specific features of consumption (lifetime vs. recent use). These relations go beyond the factor

determined variances and capture "specific" relations. Models testing these relations were restricted (restricted empirical specification searches) to the economic measures and the two outcome latent constructs (a broader search may have uncovered relations between psychological risk and consumption that are not theoretically defensible).

Overall six relations were added that "augment" the overall model fit (capture meaningful variance that was relegated to the residual matrix). One of these involved income and number of pills used in the past 30 days and another involved income and lifetime quantity. In all of the other models income was not a significant predictor of consumption. However, once a search mechanism was implemented that attempted to identify variation beyond factor-determined variance income became integral part to the model. This means that available financial resources or budget constraints actually do factor into the decision to use drugs (both lifetime and in recent use) but not at the general level of consumption as hypothesized (rather at a more specific level looking at quantity). This may arise because as stated previously, the loadings for the latent construct of consumption pulled toward "recent use." In other words, income serves a form of budgetary constraint limiting overall lifetime consumption but conveys less influence with regard to whether a person has used Ecstasy recently.

On the other hand, how much time a person spends searching for a drug also mattered in terms of how many pills they consumed in the past 30 days. Price also mattered in terms of lifetime quantity, reinforcing the importance of economic

measures in the decision process to consume drugs. Overall, the addition of these few modifications improved the fit of the model, adding meaningful variance and bringing the model closer to the true population model as indicated by its goodness-of-fit indices.

Findings from the Bootstrapping --- At various points in the modeling process, a few parameters showed indications of switching signs, diminishing in sheer magnitude or losing their significance. These examples of suppression are likely statistical artifacts of the sample data and suggest some concern for the stability of these effects with such a modest sample. The procedure for testing the stability of parameters either involves cross-validation or bootstrapping with replicate samples. A test of 1,000 replicate samples with 500 randomly drawn cases (with replacement) indicated that four of the parameters were unstable. These included the path from sexual risk-taking to consumption, income to both outcome constructs, and depression to consumption. These paths appear fragile and not likely to represent the true population model given they appear as null effects in the bootstrapping procedure.

There are many factors that can contribute to a fragile effect with randomly simulated samples. One thought is that these paths indicate activity for a subset of the sample where this predictive variance represents true behavior (e.g., some participants take sexual risks and this is related to consumption). The key features of sexual risk included frequency of various forms of sexual activity, age of onset

(younger age coded as greater risk), multiple sex partners, forced sexual contact, frequency of condom use, and having sex while under the influence. Providing an accurate count of these behaviors only pays limited attention to a host of underlying "motivations" for sexual behavior. For instance, there is evidence that personality disposition (tendency to engage in deviant or unconventional behaviors) may encourage some youth to engage in sexual behaviors and there is evidence that drugs impair decision-making and lead to poor judgment, including using sex as a ploy to get more drugs. Drugs also have "aphrodisiac effects" and can relax inhibitions, a feature of Ecstasy that has been reported in the literature. On top of these suggested motivation for Ecstasy use, drug users often associate within a social milieu that inculcates liberal values and attitudes, and trading sex for drugs is generally not discouraged.

Given these explanations, an economist also might conjecture that trading sex for drugs relaxes certain budget constraints, allowing the individual to generate income or its equivalent to build addictive stock. The long and short of a 'rational' perspective is that the drug user reduces both opportunity and monetary cost anyway they can. However strong these relations may be from a theoretical perspective, they are not reflective of the overall tenor of the behaviors in the sample. Only a few of the participants endorsed these behaviors and when examined from an aggregate statistical level, they were not sufficiently strong to represent a stable and consistent effect throughout.

*Findings from the Model including Demographics* --- Data were obtained from three distinct study sites, each containing unique cultural, ethnic (racial), and social influences that may affect consumption practices. Earlier variance decomposition analyses had indicated relatively equivalent representation of gender at the different sites, ensuring that socialization practices should not play a large role in any observed differences in drug consumption practices. However, the Miami site had fewer white participants and a much greater proportion of Hispanic participants. The St. Louis site, on the other hand had more African-American participants, all of which may presage any observed difference in the operation of economic or psychological factors. For instance, fewer participants from Sydney were in the lower income bracket and more Sydney participants were working full time and fewer were unemployed than participants from the US sites.

There were also some significant differences in consumption patterns across the three sites. In particular, participants from St. Louis were older when they first started using Ecstasy and were much newer to the drug in terms of the gap between when they started and last used it (or used more recently). These same individuals from St. Louis had lower mean levels of consumption than Miami or Sydney participants. Sydney participants had used Ecstasy more recently, were more "regular" users, and had higher daily intake of Ecstasy based on quantity and frequency indicators. Miami participants had fewer drug use days per month. Overall, these and related differences suggest that important site differences may influence

relations between economic measures and consumption practices that would go undetected unless they are examined empirically.

The conditioned models were tested in stages. This was done in order to detect any subtle relations that may be produced by the participants' gender, age, race, education, and location. The assumption here is that higher educated, older, males earn more than others. In fact, this might have masked the true effects of income and opportunity cost. The model including all control measure with the exception of site provided an inferior fit compared to the full model (the CFI went from .898 down to .849).

When site was added to the full set of demographic measures, the model slightly improved. However, by all indication it still provided a poorer fit than the full model. This perhaps underscores that race and education were confounded by site. In other words, Sydney had a disproportionate representation of higher-earning participants and white drug users, while the remaining sites had relatively more African-American and Hispanic participants earning less. Site is essentially capturing the effect of race and education and along with these demographics possibly income.

A model trimmed of race and education and only including the remaining demographic measures (gender and age) and site fit reasonably but showed a slight decrement in fit. In fact, there is evidence of confounding indicating conditioning of the relations between race, age, education, and consumption. In order to tease these apart, a trimmed model was tested with site, gender, and age.

While there was no evidence that age or gender factor into consumption practices, both influenced reporting dependence symptoms. On the other hand, site factored into consumption but not dependence, indicating that market factors such as price and time spent locating drugs (or negotiating their price) may vary geographically. It also may reflect subtle differences in the drug "culture" at the different sites. These differences were also noted in the mean levels of consumption that varied by site, with Sydney participants reporting more consumption and cheaper drugs.

3. **Limitations of this Research**

As with any secondary data analysis there are limitations associated with the research. The measures used were gathered for the purposes of a different study, emphasizing reliability and validity of diagnostic information and there were limited measures assessing economic matters. In addition, there was also a limited set of measures used to assess psychological risk for drug use, although this was the widest set of measures by far. Still, depression is one of several mental health measures that could be used to account for drug use; others would include anxiety, antisocial behavior, personality or thought disorders (i.e., psychosis or delusions).

In addition, the data were cross-sectional, which limits making any causal inferences. Inclusion of longitudinal data, where temporal precedence can be established, would lead to more precise tests of whether economic measures contributed unique predictive variance to consumption. This type of model requires

the conditions of causation be met by establishing association, temporality, and proper statistical controls to rule out spuriousness. A model such as this one would include economic measures and psychological functioning at baseline, and then repeat the same measures at follow-up. This type of "trend" analysis would provide a rigorous means to assess whether any one of the economic measures either individually or all of them together predict "future" consumption controlling for contemporaneous psychological functioning.

The specified relation between Dependence and Consumption constructs illustrates this problem well. The model construction posited a covariance between these two terms because it is hard to specify whether consumption causes problems or conversely that certain problems lead to more consumption. Common sense would dictate that using more drugs leads to problems including run-ins with the law, family disputes, relationship turmoil with significant others, and so forth. In addition, there are medical considerations that may arise from overuse of drugs, and psychological problems that can go undetected including depression, anxiety, psychotic thinking, and identity disruption (drugs disrupt the acquisition of requisite skills during critical stages of development). However, a more careful look shows this representation is overly simplistic. For instance, it is also possible that by becoming dependent on a drug, which includes physiological indicators of tolerance and withdrawal, a drug user increases his/her consumption to diminish or forestall these negative experiences.

Tolerance means taking more of the drug to obtain the same effect or to get "high." Economists generally consider tolerance as the result of prior drug consumption or what they term "addictive stock." In other words, past consumption is a predictor of future consumption because the individual builds up a "history" of drug use that reinforces and even guides future use. In the current model, tolerance was specified as an indicator along with several other "consequences" that are features of dependence. The difference between these two views is that tolerance is part of dependence, representing a compilation of multiple problems that may stem from consumption whereas in the RAM tolerance would have been a predictor of consumption.

Withdrawal, on the other hand, results because the absence of the drug causes a physiological (or cellular) response where the body demands more drug. During withdrawal, users experience headaches, profuse sweating, they become febrile, shake, and lose concentration, to name a few key symptoms. Again, problems that arise from continued use serve as the stimulus for more consumption. It would be problematic then, to specify these relations as 'causal' because more of the drug leads to more symptoms and more symptoms generate the need for increased consumption. Here, a causal relation is at best tenuous and the better way to represent the relation between consumption and dependence it to allow them to freely associate.

In addition, some of the measures may not be adequate or reliable thus diminishing their predictive validity. For instance, there was clear evidence that the

latent construct of consumption tilted toward "recent" use and diminished the importance of "lifetime" use. An economic view would posit that consumption should really reflect "addictive stock" and go further back in time to capture the full spectrum of use (i.e., lifetime consumption as a measure of cumulative use), rather than relying on a more recent window. One way to avoid creating a bifurcated construct would be to increase the valence of "recent" use items by splitting the construct into two measures, one capturing addictive stock while the other assesses more recent use (they may be correlated but not perfectly).

Income too can fall prey to this situation and limit predictive variance. One possibility is that the measure of income needs to be strengthened by additional information. Future studies may want to include an assessment of family financial resources, weekly pay (using pay stubs), a wider network of alternative income sources, and information on the precise methods of purchasing drugs, and a breakdown of expenses for the individual. This will serve to cast a wider net on the measure of social anomie to include accepted measures of poverty (based on Federal guidelines) and other indicators that tap feelings of marginalization that can accompany low income status. A second important consideration that may have limited the role of income is that most of the participants earned relatively the same (given their youthful age), which restricted the variance for income and lowered correlations between income and other measures in the model.

Furthermore, there may be concerns that accompany categorization of measures used to form composites. There is some loss of information when a continuous measure is categorized, leaving open the possibility that some true and meaningful variation is lost. Notwithstanding this concern, dimensional approaches were used with four latent constructs. However, additional dimensional assessments would improve the overall psychometric properties and the ecological validity of the model. As stated previously, one suggested area of refinement would include improving the measure of social anomie to encompass a wider set of measures (precise quantification of government or family support) that capture a more "veridical" picture of young people's earnings.

Finally, although the sample size was considered appropriate for obtaining proper parameter estimates, it was near impossible to conduct multiple group comparisons given the sample would be less than halved in some cases. Doing so, in order to compare models by gender or site, would strain the robustness of these methods. This is because with increasingly smaller samples there is a corresponding increase in the size of standard errors with concomitant greater influence of sampling error. This would increase the probability of making a Type I error. In SEM, the significance of a parameter estimate is calculated by the ratio of the nonstandard parameter divided by its standard error. Larger error terms would reduce the likelihood of statistically significant findings and lead to acceptance of the null when it is false. The alternative approach sought to establish whether gender and site

"condition" model results and conclude that the model findings are thus moderated by important demographic characteristics.

Although not necessarily a true limitation of the current study, some decisions were made in the model testing strategy that may influence the final results. For instance, a decision was made to leave non-significant paths in the full model. An alternative model testing procedure might drop the paths that did not achieve significance and re-estimate the model. One consideration is that the procedure of fixing paths to zero does ultimately "bias" the remaining paths, because this approach specifies a prior relation as "null." Offsetting this proposed change to model testing procedures is, however, the observation that when these effects are trivially small, as was the case with sexual risk taking and income, the resulting bias is typically small as well.

4. **Implications of this Research**

The findings from this study underscore the continuing need to better understand drug user's behavior. As stated earlier, drug use and its related consequences is complex and multi-faceted. In this study, multiple tests of the psycho-economic model were performed to examine whether a model combining key elements from economic and psychological theories can sufficiently explain Ecstasy consumption and its related problems.

One important finding of this research was that market indicators (income and price) play a crucial role in the decision to consume drugs. For other commodities

(licit drugs included), this finding alone would argue strongly for and provide support in the formulation of drug policy based uniquely on market price mechanisms. In fact, increasing the price of illegal drugs has been considered as an important objective of the US drug and law enforcement agency. The logic behind interdiction was that reducing illegal-drug supply and providing economic aid to illicit drug producing countries would reduce the drug availability on the streets, increase drug prices, and therefore discourage consumption. So far however, such a strategy has not been very successful. More drugs are available now than ever before and the prevalence of use has continued to rise, especially among young adults. Such an outcome of a drug policy based uniquely on reducing supply surely proves that economic principles may be less relevant than thought. This is particularly true for a product that is not only illegal, but also whose continued use produces dependence, which translates into an inelastic demand.

What this study does support is the contention that economic factors do have an effect on a drug user's decision whether or not to purchase a drug. However, economic factors are not the only factors that shape this decision. Other factors play a role as well. In particular, psychological factors, reflected by the ways people get Ecstasy, people from whom they get it, places they go to use drugs (raves, clubs, and bars), people they share drugs with, and internal self-regulatory cues all have a larger effect on drug consumption than income and prices alone. Combining both economic

measures and psychological motivations augments the overall model and accounts for a larger proportion of variance than when either set is considered alone.

## 5. **Conclusions**

Allegories are figurative ways to represent meaning and truth. They take shape as literary stories, various forms of artwork including paintings and sculpture, and visual symbolic representations that convey something special about life and the human perspective. There is an allegory for everything, even scientific research. An appropriate allegory for the current study is the three blind men and the elephant (Kuo & Kuo, 1976). One day, three blind men sat by the side of a road engaged in conversation. As they spoke one blind man said to the others, "I have heard that elephants are queer animals." He went on to add that his blindness prevented him from knowing whether this is true. It was then that all three blind men agreed they lacked the good fortune to know about this strange animal. It was also at that point that one of the blind men suggested that just feeling the elephant would satisfy his curiosity.

A merchant happened to be walking by with a herd of elephants and overhead their conversation. He offered them a chance to "touch" an elephant and satisfy their curiosity. He then helped each one of them to walk over to an elephant and touch it. The first blind man reached out and touched the elephant's left leg and then his right. He ran his hands over each leg slowly and then with a beaming face, turned to his blind friends and said "So, the queer animal is just like that." He then walked back to

where his friends were seated and joined them. It was the second blind man's turn and he walked to the elephant with the assistance of the merchant. He reached out and touched the elephant's tail and blurted out "truly a queer animal." He then returned and sat beside his friends.

It was the third blind man's turn and he walked to the elephant whereupon he touched its trunk, swaying back and forth from side to side. He blurted out "That's it! I've learned." Each blind man then graciously thanked the merchant and went on their merry way. They were excited to share their new knowledge about the elephant. Soon they sat under a tree at which point the second blind man blurted out, "this queer animal is like our straw fans swinging back and forth to provide a breeze." It is, he continued "rather wispy in touch and feel." The first blind man shouted in disagreement, "No, no, this queer animal is like two big trees that have no branches." Without hesitating, the third blind man stated, "this queer animal is like a snake, long, round, and very strong."

The story of drug abuse is also a matter of perspective. That is, if the story teller is economically minded analyst, market factors like income, unit price, and the considerable time one spends locating a drug accurately foretell consumption practices. However, when the world is viewed through a psychologist's lenses other factors like motivation or the underlying desires that foster drug use appear to matter. Clearly, the combination of perspectives provides a better view of the "elephant" and allows each of the blind men to see the true animal.

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