Recovery Trajectories of Women with Co-Occurring Post-Traumatic Stress Disorder and Substance Use Disorders

By

Teresa López-Castro

A dissertation submitted to the Graduate Faculty in Psychology in partial fulfillment of the requirement for the degree of Doctor of Philosophy The City University of New York

2012

© 2012

Teresa López-Castro

All Rights Reserved

This manuscript has been read and accepted by the Graduate Faculty
in Psychology in satisfaction of the dissertation requirement
for the degree of Doctor of Philosophy.

Date	Denise Hien, Ph.D. Chair of Examining Committee
Date	Maureen O'Connor, Ph.D. Executive Officer, Psychology
	Elliot L. Jurist, Ph.D.
	Margaret Rosario, Ph.D.
	Paul Rinaldi, Ph.D
	Susan Tross, Ph.D. Supervisory Committee

THE CITY UNIVERSITY OF NEW YORK

ABSTRACT

RECOVERY TRAJECTORIES OF WOMEN WITH CO-OCCURRING POST-TRAUMATIC STRESS DISORDER AND SUBSTANCE USE DISORDERS

By

Teresa López-Castro

Adviser: Denise Hien, Ph.D.

Over the past ten years interventions utilizing an integrated model of treatment for co-occurring PTSD and SUD in women have emerged to address the links between trauma and addiction. To date, the largest of these behavioral trials has been conducted through NIDA's Clinical Trials Network (CTN) and serves as the current project's parent study. Despite promising results in the arena of PTSD symptom reduction, CTN investigators (Hien et al., 2009) found that that the trauma-informed group treatment, Seeking Safety, did not have an overall impact on substance use outcomes. Importantly, secondary analyses of the CTN data indicated that for particular subgroups the adjunct trauma treatment was associated with improvement in substance use symptoms during follow up (Hien et al., 2010). The present study utilized latent growth mixture models (LGMM) with multiple groups to estimate substance use patterns of 353 women dually diagnosed with SUD and PTSD in the 12 months following treatment. Results from the growth mixture analyses provided support for three distinct trajectories of use and recovery in the post-treatment year. Findings highlight the necessity of accounting for heterogeneity in post-treatment substance use and the relevance of incorporating methodologies like LGMM when evaluating treatment outcomes.

Keywords: substance abuse, posttraumatic stress disorder, substance use trajectories, latent growth mixture modeling, relapse

ACKNOWLEDGMENTS

To the 353 women who participated in the CTN-0015, who generously opened their lives to research questionnaires and lengthy interviews as often as twice weekly for more than a year, I thank you. I stand in admiration of your courage to seek change.

I am immensely grateful to Dr. Denise Hien, my dissertation adviser. Her decades of brilliant, focused work allowed for this study (and countless others) to take place. Her innovative research led me to the fascinating intersection of trauma and substance abuse and her tireless advocacy for women's mental health challenged me to contemplate the social and political consequences of our work. Ever my champion and advocate, she has served as an incomparable professional and personal role model. She has continually re-invigorated my faith in the necessity and utility of clinical research. But most of all she has shown me firsthand what is possible with determination, hope, and generosity. I am truly honored to call her my mentor.

Every Dante has his Virgil. I thank Dr. Mei-Chen Hu for serving as statistical consultant on my dissertation and deftly ushering me through the territories of Mplus and growth mixture modeling. I am indebted to her for her gift of time, patience, and wisdom to this project.

I would like to acknowledge the terrific committee that provided the "secure base" for this dissertation and the dynamic roundtable for its discussion. Seven years ago, Dr. Elliot Jurist helped me discover Henry Krystal and the world of affect regulation—I owe my interest in addiction to his illuminating presence in my academic life. It was a distinct privilege to have him take part in my final, capstone graduate project. Thank you to Dr. Margaret Rosario for her multiple re-readings of early drafts and her close, insightful commentaries of each. Her questions allowed for the vital refinement of the study's logic and scope. Drs. Susan Tross and Paul Rinaldi have stood as pillars in both my professional and personal life for the past two years.

Their varied contributions to the science and craft of addiction treatment have left an indelible mark on what I feel is mutative and essential in the field. My dissertation was deeply nourished by their continual advisement, humor, and perspective.

This study was greatly helped by the financial support of the FAR Fund dissertation award. I thank the selection committee and its donor for their vision and generosity.

My graduate school literally sits atop a steep, block-long hill. I give a heartfelt thank you to my fellow students and friends who climbed that hill alongside me. Surrounded by their creativity, intellect, and support, I was able to not only persevere but thoroughly relish the journey.

I am particularly thankful for the appearance of Luis Gispert in my life. His presence offered an unexpected source of playfulness and imagination precisely when I had resigned myself to the project's end without much of either. For his love and faith, however, I am forever grateful. To him I owe the magic of this work's completion—and the extraordinary promise of a future together.

And finally, I thank my parents, Dr. Teresa Castro-Rojas and Ruben López-Castro. It has been their unquestionable, remarkable support of me and whatever I cherish that has made this dissertation, my Ph.D., and numerous other seemingly unattainable dreams possible. Their unique grace and tenacity in the face of exceptional life circumstances have served as my most personal and powerful inspirations. This dissertation is dedicated to them, my mother and father, my lifelong emblems of hope, strength, and love.

TABLE OF CONTENTS

List of Figures **x**

List of Tables **xi**

Chapter 1: Introduction **1**

Overview of the Study 3

Study Aims 3

Chapter 2: Review of the Literature **6**

New Paradigms of Addiction Research 6

Adding Dimension and Depth: Career/Life Course Perspective 7

Reconsidering Illness and Cure: Chronic Disorder Model 12

Defining Recovery and Relapse: Cognitive Behavioral Model 14

Identifying Change: Latent Growth Mixture Modeling 17

Charting Multiple Pathways: Recovery Cycle Research 20

Victimization and Trauma: Impact on Addiction and Recovery 23

Interpersonal Violence, PTSD, and Substance Abuse: Evidence for a Gender-Specific Pathway 23

"The Telescoping Effect:" Traumatic Stress and Women's Addiction Trajectories 25

Complicating Change: PTSD's Impact on SUD Treatment Outcomes 27

Women and Recovery: Gender-influenced Factors 28

History of Women and Addiction Research 28

Socio-economic Considerations 30

Treatment Retention and Completion 31

Gender-Responsive Milieus 33

Statement of the Problem 34

Hypotheses of Study 35

Hypothesis 1 35

Hypothesis 2 35

Chapter 3: Methods 37

Participants and Setting 37

Procedures 42

Design 42

Treatments 43

Treatments as usual 45

Measures 45

Sociodemographics 45

Addiction Severity Index, Lite Version (ASI-Lite) 46

Clinician Administered PSTD Scale (CAPS) 47

Composite International Diagnostic Interview for DSM-IV (CIDI) 49

Substance Use Inventory (SUI) 51

Data Analyses 52

Mplus 54

Model Construction 54

Model Estimation 55

Chapter 4: Results 57

Unconditional Growth Mixture Models 59

Conditional Growth Mixture Models 62

Chapter 5: Discussion **68**

Summary of Main Findings 68

Multiple Trajectories in Recovery 68

Risk and Resilience between Subgroups in Recovery 70

Support for Developmental Paradigms in SUD Research 71

Significance of Trauma in Trajectory Modeling of Use 74

Clinical Implications 76

Limitations and Future Directions 80

Beyond the Confines of Extant Data: Present Limitations and Next Steps in Research 80

Limits of LGMM and Need of Integrative Analytic Approaches 84

Conclusion 86

Bibliography **87**

LIST OF FIGURES

Figure Number

1. Substance Use Outcome Modeled in a Latent Growth Mixture Model Framework 19

2. Diagram of Participant Flow through Study 37

3. Latent Growth Mixture model of Current Study's Latent and Measured Variables 53

4. Estimated Trajectories of 2-Class Model for Probability of Use in the 12 Months Following Treatment (Unconditional U-Part) 59

5. Estimate Trajectories of 3-Class Model for 30-day Frequency of Substance Use in the 12 Months Following Treatment (Unconditional Y-Part) 60

6. Estimated Trajectories for the two-part, 3-class Growth Mixture Model for 30-day Frequency of Substance Use in the 12 Months Following Treatment 61

LIST OF TABLES

Table Number

1. Covariate Analyses Variables 36

2. Baseline Participant and Diagnostic Characteristics by Treatment Group for the Intention-to-Treat Sample 41

3. Model Fit for Unconditional and Conditional Growth Mixture Models 58

4. Distribution of Covariate Means and Equality Tests of Means across Latent Trajectory Classes of Primary Substance Use Using Posterior Probability-Based Multiple Imputations in 3-class LGMM (N=288) 63

5. Covariates of Trajectories of Alcohol/Substance Use in the 3-Class Conditional LGMM Model (N=266) 65

CHAPTER 1: INTRODUCTION

Overview of the Study

For a great number of women with substance use problems, the centrality and relevance of trauma to both their addiction and recovery is undeniable. Through systematic research conducted since the mid 1980's, violence and victimization have been shown to be major contextual factors in the lives of women struggling with addiction. The past two decades of addiction research have documented high rates of post-traumatic stress disorder (PTSD) in community samples of women seeking substance abuse treatment. PTSD is one of the various consequences individuals may face when exposed to chronic traumatic stress. It is estimated that roughly 80% of women who seek treatment for substance abuse problems have lifetime histories of being victimized sexually and/or physically (Miller, Downs, Gondoli, & Keil, 1987; Brady, Killeen, Saladin, Dansky, & Becker, 1994). Substance abusing women who have been exposed to interpersonal trauma and violence thus represent a common and yet exceptionally vulnerable population. Women with trauma histories and substance use disorders are likely to have more severe and complicated clinical presentations, are more difficult to engage and retain in treatment, relapse faster and have generally poorer treatment outcomes than their non-traumatized counterparts (Brady, Dansky, Sonne, & Saladin, 1998).

Over the past five years, interventions utilizing an integrated model of treatment for co-occurring PTSD and SUD in women have emerged to address the links between trauma and addiction. Early clinical trials of the integration of cognitive behavioral therapies for trauma with substance abuse interventions reported positive initial findings: significant reductions in PTSD and SUD symptoms were observed when compared to treatment as usual (Hien, Cohen, Miele, Litt, & Capstick, 2004). To date, the largest of these behavioral trials has been conducted

through NIDA's Clinical Trials Network (CTN). The current study will build on the findings from CTN's trauma-informed intervention for 353 women dually diagnosed with SUD and PTSD by identifying common trajectories of substance use recovery in the year following treatment.

The CTN's randomized clinical trial for the treatment of women with co-occurring substance use disorders and post-traumatic stress disorder was modeled under the CTN's mission to heighten the effectiveness of new treatment models by testing interventions "in the trenches"—in community-based settings and to a diverse patient population. As such, the CTN study investigated how an integrated cognitive behavioral approach to PTSD and SUD treatment, Najavits's Seeking Safety (SS; Najavits, 2002) would impact women's issues with trauma and addiction. Following a blended research-to-practice model, the CTN trial was conducted using rigorous research methods such as randomization to treatment; standardized, repeated assessments by blind raters; manualized treatments; and adherence standards for therapists. To test the efficacy of interventions in real life settings, the study took place at 7 outpatient substance abuse programs across the United States with a number of treatment-as-usual components: community-based counselors as the main interventionists, the inclusion of sub-threshold PTSD, and women at different points in their addiction treatment. The trial also included an active comparison group, a psychoeducational course on women's health (Women's Health Education, WHE; Miller, Pagan, & Tross, 1998). In an additional effort to simulate real-world treatment experiences, both treatments were delivered in a group format with open, rolling admission.

The preliminary findings of the CTN study (Hien et al., 2009) serve as the empirical starting point for the current study. Despite promising results in the arena of PTSD symptom

reduction, the authors found no overall effects of time or treatment on substance use outcomes. The absence of overall improvement in the realm of substance use in this large, randomized clinical trial replicated the troublingly common findings of addictive behavior researchers: the heterogeneity and chronicity of substance use disorders in the face of multiple treatment efforts (e.g. Project MATCH). Since relapse remains the modal outcome in follow-ups of intervention trials for SUD, identifying and understanding potential trajectories of recovery and barriers to the recovery process in co-occurring SUD and PTSD stand as crucial areas of investigation.

Over the past decade, studies with extended follow-up periods have begun to highlight that for many, addiction and its treatment is best understood as nonlinear, dynamic phenomena with multiple cycles of recovery and relapse (Hser, Anglin, Grella, Longshore, & Prendergast, 1997; Hser, Longshore, & Anglin, 2007; Witkiewitz, van der Maas, Hufford, & Marlatt, 2007). The current study will review these innovations in the field of longitudinal research on addiction and test their use on the subpopulation of women suffering from alcohol and substance use disorders and PTSD. Using statistical methodologies (latent growth mixture modeling) that treat the recovery/relapse process as a nonlinear dynamic system, the current study will perform secondary analyses of the CTN data with the aim of (a) identifying varying patterns of recovery and relapse during the first year following PTSD and SUD treatment and (b) re-testing the original CTN hypotheses concerning efficacy of integrative treatment for PTSD and SUD in reducing post-treatment substance use.

Study Aims

Findings of high rates of relapse, heterogeneity, and nonlinearity in substance use following treatment (Anglin, Hser & Grella, 1997; Walitzer & Dearing, 2006; Scott et al., 2005; Witkiewitz et al., 2007) have suggested the need for clinical research to move beyond solely

binary (abstinent or relapsed) models of SUD outcome and focus on longitudinal trajectories of growth or decline. Efforts to map the biological, psychological, and social factors at play in addiction have underscored the presence of multiple subpopulations afflicted by SUD. Investigators in the field of alcohol addiction have noted several common subgroups, or "classes," of drinking behavior following treatment (Wu & Witkiewitz, 2008; Witkiewitz & Masyn, 2008). The current study will be the first study to test the saliency of trajectory modeling for a commonly encountered clinical population: PTSD-diagnosed women dependent or abusing alcohol and/or drugs. In the present study, it is hypothesized that three distinctive trajectories will be found during the first year following treatment: one group of women using drugs and/or alcohol heavily; a second group with highly inconsistent or "bouncing" levels of use; and a third group with moderate or infrequent drug or alcohol use.

The second aim of the study takes its impetus from longitudinal research on SUD that emphasizes the multidimensional and developmental features of the disorder (Hser et al., 1997). Trajectory-focused research has shown the utility of integrating addiction and treatment career traits to the analysis of current outcome effects (Anglin et al., 1997; Hser et al., 2007). In addition, the importance of assessing treatment response during the active treatment phase as well as after-care efforts when evaluating treatment outcome has been shown (McLellan, 2002; McLellan, McKay, Forman, Cacciola, & Kemp, 2005). For women with co-occurring PTSD and SUD, the effects of trauma and gender-specific factors upon the presentation and trajectory of their substance use disorders are of particular importance. The relevance of PTSD symptomatology to women's treatment response and prognosis has been well documented (Hien et al., 2009) and gender-responsive treatment research has stressed that recovery variables differ across gender (Grella, 2008). It is expected that the classes of substance use patterns following

treatment will reflect proximal and distal factors pertaining to the history and present status of the participants' dual diagnoses. It is predicted that those in the heavy use class will exhibit heightened proximal and distal risk factors whereas inconsistent substance users will report a unique mixture of proximal and distal resiliency and risk factors.

The third and final aim of the study will focus on advancing the understanding of the treatment outcomes from the original study (Hien et al., 2009). The original CTN study compared the effectiveness of a trauma-informed intervention, SS, to an active control group consisting of a psychoeducational course on women's health, WHE; primary analysis indicated that SS was no more effective than WHE in impacting overall SUD and PTSD outcomes (Hien et al., 2009). The present study will re-address the original efficacy hypothesis with specific attention paid to the nonlinearity and multi-modal nature of substance use outcomes following treatment. The study will employ two-part latent growth mixture modeling to detect varying substance use outcomes based on intervention assignment. The study's third aim will test whether the relationship between PTSD severity and class trajectories (growth factors) is influenced by assignment to either SS, the trauma-informed treatment, or WHE, the active control.

CHAPTER 2: REVIEW OF THE LITERATURE

The following literature review is organized into three parts. The first section introduces several paradigmatic shifts in how addiction disorders and their treatments are understood and empirically investigated. Drawing from literature on the sequelae of traumatic stress, the second section examines the impact of victimization and trauma on the development, presentation, and trajectory of women's substance use problems. The third and final section highlights findings from gender-specific mental health research and discusses variables particularly associated with the pathways to addiction and recovery for women.

New Paradigms of Addiction Research

During the past two decades, an emerging body of evidence has recognized the chronicity of addiction in a subset of individuals: men and women for which treatment or social support groups do little to reduce their cycle of use, treatment, abstinence, and relapse. In contrast to substance users who categorically benefit from professional interventions or self-help strategies, a number of individuals go on to relapse after treatment, and in some cases, appear to "cycle through" treatment efforts and relapse for extended periods of time. Chronicity in addiction has been often been associated with psychiatric comorbidity, when drug dependence comprises only one part of a complex diagnostic picture (McKay & McLellan, 1998). This characterization of chronic addiction may well suit women with a history of interpersonal violence wherein addiction may be one element of a multifaceted, trauma-related presentation. The following section will outline the efforts of a series of researchers who have studied the cyclical nature—treatment, improvement, relapse, treatment—of chronic addiction and subsequently called for a paradigmatic shift in both treatment and research methods.

Adding Dimension and Depth: Career/Life Course Perspective

In an effort to conceptualize chronic addiction, many have proposed applying a developmental, long-range perspective to research on drug use and its treatment. In a landmark study, Anglin and his colleagues at UCLA investigated 10,010 DATOS clients utilizing a longitudinal perspective (Anglin et al., 1997). They followed participants from the time of treatment entry until completion of treatment. The study was the first to explicitly focus on the utility of considering long-term trajectories in relation to drug use and treatment. In doing so, the study pioneered a developmental, pathway-based framework coining the terms "addiction career" and "treatment career" to describe the long-term trajectory addiction can embody.

Three findings from the study provided the empirical foundations for the career framework. Firstly, Anglin and researchers found a high level of heterogeneity in the trajectories of drug use and treatment, indicative of multiple subgroups with varying pathways of addiction and use of services. Secondly, a markedly long delay between the start of an addiction career (start of problematic use) and the beginning of a treatment career (time of first intervention) was observed. For the average DATOS participant, first treatment occurred 7 years after the beginning of her/his drug problems. In line with previous findings, this lag time suggested that treatment was typically sought only after addiction had become a way of life. Such a delay hinted at grave implications for the efficacy of a single dose "cure" to a longstanding condition.[1] Thirdly and perhaps most importantly, Anglin and his colleagues demonstrated an association between more severe addiction profiles and more extensive treatment histories. This relationship between addiction severity and more treatment exposure provided evidence for the

[1] Notably, Anglin et al. (1997) indicated that in those with a previous treatment history, no association was found between type of drug dependence and the number of previous treatment episodes, or the total time in treatment prior to present intervention.

characterization of addiction as chronic and relapsing for a subset of sufferers.[2] Moreover, in this sample, extensive treatment histories were related to a host of negative characteristics such as unemployment, high-risk sexual behaviors, and criminal activity. Anglin and collaborators stressed that in their estimation, the association did not automatically connote treatment failure. Rather, the researchers suggested that these findings reflected that change may have occurred in stages and that those with a prior treatment experience may have been gaining motivation for change at each treatment exposure. These findings signaled a simple, yet as of then, unarticulated and documented point: previous treatment exposures affect future treatment entry and length (see Hser et al., 1997).

Anglin and colleagues' empirical findings regarding the heterogeneity and longevity of addiction and its treatment were elaborated upon in a series of conceptual papers by Y. I. Hser and her collaborators at UCLA. Hser and her co-researchers argued that employing a career perspective was critical due to the documented chronic nature of addiction and the extensive burden it places on social services. As defined by Hser and her collaborators (Hser, Grella, Chou, Anglin, 1997; Anglin et al., 1997), the career framework conceptualized addiction and its treatment as multidimensional and dynamic processes. The model's basic tenet proposed that for some, substance use, its effects, and treatment should be optimally conceptualized and researched with a longitudinal/developmental approach that encompasses an individual's history and the whole of its contextual richness—biological, psychological, and social elements. Such an approach would allow for the detection and investigation of key factors which impacted substance use and treatment *over time*.

[2] Anglin and researchers (Anglin et al., 1997) acknowledged that since the DATOS sample was a treatment sample it was logically missing an important population: those that received treatment and did not return after relapse.

Hser and other proponents of a career framework (Hser et al., 1997; Anglin et al., 1997; Hser, Longshore & Anglin, 2007; Grella, Scott, Foss, & Dennis, 2008) argued that longitudinal data on the chronically addicted—such as the sort collected by Anglin and colleagues—demanded that addiction be conceptualized as a complex disorder with a dynamic trajectory involving cyclical periods of treatment, cessation, and relapse. The association between severity of addiction and treatment career profiles had indicated that one treatment episode would not be likely to address the breadth of needs of drug dependent individuals. Chronic addiction, they argued, may necessitate "staged recovery efforts" (Anglin et al., 1997). Further, the "small and often short-lived effects" (Hser et al., 1997, p. 544) reported from single outcome studies were understood as expectable, given addiction's chronicity. Importantly, Hser and her colleagues noted that the reality of multiple treatment exposures was also a product of a social service system beset by problems in retaining and adequately serving the addicted. High rates of attrition in treatment facilities, the brevity of treatments in most settings, and the lack of comprehensive services to address the substantial amount of comorbidity in this population severely limit the effect of a single treatment. Instead, the career framework proposed that a series of treatment episodes be understood as a sequence of dynamic processes rather than repeated failures. Intervention periods should be considered as chains within an ongoing process and as such, seen as "cyclical, incremental, and interactive" (Anglin et al., 1997, p. 309). Hser and her collaborators' model questions the utility of traditional research's focus on single treatment outcomes, suggesting instead a broadening to "career-focused" investigations, capable of analyzing the additive/cumulative gains made by multiple treatment exposures.

By taking a long view, the career approach is equipped to investigate a set of developmental questions regarding the patterns of addiction over time, the patterns of treatment

over time, the relationship between these two, and lastly, the impact of both addiction and treatment careers upon outcome. Hser and her associates identified a series of parameters that captured the multidimensionality of a career approach and may help characterize distinctive patterns of drug use and treatment: participation, frequency, type, length, intensity, and perception/attitude. Each of these parameters may refer to either the addiction or treatment career.

Conceptually, Hser's longitudinal model of addiction and treatment rested on a cross-disciplinary body of literature which understood change as occurring in a developmental fashion. In her 1997 formulation of the career perspective, Hser drew mainly upon closely paralleled career models in the fields of employment research and criminology (Hser et al., 1997). In both the study of employment careers and criminal careers, researchers have found that individuals progress through "complex developmental patterns by stages, within which skills, attitudes, and behaviors evolve" (Hser et al., 2007, p. 545).

In a recent reassessment of their model, Hser and her collaborators (Hser et al., 2007) expanded the original framework to include research from the fields of public health and health, renaming their approach a "life course perspective."[3] The life course perspective privileged "time, timing, and temporal processes" (Hser et al., 2007, p. 518): the inherent interplay between stability and change through repeated transitions, and transitions' great impact on future pathways. Life course research on human behavior has emphasized how life transitions—graduation from college, childbirth, or retirement—presses for the adaptation to new demands and the acquisition of necessary, novel skills. Despite being finite in length, these transition periods have long-term repercussions for further development. Literature has suggested the

[3] In addition to encompassing a broader range of issues, the UCLA group (Hser et al., 2007) noted that the term "life course perspective" avoided the earlier "career" term's potential suggestion of addiction as something desirable or positive.

presence of critical developmental periods or "opportunity windows" in the acquiring of new skills, the majority of which occur earlier in life, and the grave consequences of missing these windows. Hser and her collaborators noted that an individual's capacities and choices should not be the sole focus in a life course perspective, but rather an authentic life course approach should explicate the continuous, complex interaction between the person and the environment. In sum, pathways of drug use and treatment should be investigated as the product of interactions between individual agency and social processes.

This model's simultaneous attention to both individual and system traits and their interplay appears highly relevant and conducive to investigating chronic addiction. It has been established that chronically dependent individuals are in frequent contact with a host of service systems in addition to specialty drug treatment such as mental health, justice, welfare, and primary health care (Joe, Simpson, & Broome, 1999; Grella et al., 2008). Since an individual's drug use and treatment trajectory cannot be divorced from her interactions with other social service systems, a life course perspective compels researchers to fully accept the implications of the association between drug use, its treatment, and other service systems. Citing literature on the relationship between chronic addiction and repeated service exposure, Hser and fellow researchers (Hser et al., 2007) proposed that a life course perspective's emphasis on timing, order, and intensity may help elucidate the reciprocal relationship between addiction and other social services. Research into the interplay between the two may improve our understanding of the "service mix" and how it impacts outcome. Ultimately, such a perspective may provide the integrative and consolidated framework needed to tackle addiction and its comprehensive care.

Reconsidering Illness and Cure: Chronic Disorder Model

In addition to the research and theory contributions made by UCLA psychologists and their colleagues, A.T. McLellan has been both a forerunner and leading proponent of a chronic disorder model of addiction. Drug dependence, McLellan and collaborators proposed in an early position paper, must be "insured, treated, and evaluated like other chronic illnesses" (McLellan, Lewis, O'Brien, & Kleber, 2000). A highly respected figure in the field, developer of one of the most widely used measures in addiction assessment, the Addiction Severity Index (McLellan, Luborsky, Woody, & O'Brien, 1980), and editor for the past decade of the *Journal for Substance Abuse and Treatment*, McLellan has sought to reconcile the gap between what addiction research has consistently observed in the past three decades and the prevailing set of beliefs that continue to dictate addiction research and practice.

McLellan and his collaborators (McLellan et al., 2000; McLellan, 2002; McLellan et al., 2005) have explored the repercussions of considering drug dependence as an acute condition, and alternately, weighing the benefits of a taking a chronic condition approach to addiction. Importantly, they have examined the conceptual and practical effects each assumption—acute versus chronic—and what each brings to bear on how addiction is treated and its treatments evaluated. McLellan and colleagues (McLellan et al., 2000) has compared drug dependence to three common chronic medical illnesses (diabetes type 2, asthma, and hypertension). In terms of hereditability, etiology, physiological effects, treatment adherence, and prognosis, they found an astonishingly high rate of congruence between substance dependence and the three chronic illnesses. An individual's genetic predisposition, environment, and personal agency were found to play equivalent roles in the development, course, and management of all four conditions. In order to argue for a pathophysiological similarity between conditions, authors cited the extensive

literature on the impact of addictive substances on the brain's neurochemistry, stress response system, and reward circuitry as evidence of its long-lasting physical effects. Furthermore, the rates of adherence to treatment and relapse for addiction were comparable to those suffering from chronic asthma, diabetes, and hypertension. Moreover, McLellan and collaborators noted that the established predictors of poor prognosis were curiously similar across chronic disorders. Psychiatric comorbidity, poverty-related issues, and deficits in social support were found to be strongly associated with negative trajectories for not only drug dependence but all three of the "control" chronic illnesses.

Importantly, McLellan (2002) has also emphasized the implications for evaluation research demanded by a shift to a chronic disorder model. Within chronic illness research, the focus is placed on the step-wise diminishing of symptomatology and the maintenance of incremental gains. From this vantage point, a large part of efficacy in treatment evaluation research is measured by comparing the severity of symptoms before to that of *during* treatment. Chronic disorder treatment research does not automatically assume that gains will persist once the intervention has ended. This perspective stands in stark contrast to traditional substance abuse research in which importance is placed *exclusively* on pre- and post-treatment comparisons. Furthermore, in chronic disorder treatment research, the reappearance of symptoms once treatment has ceased is considered evidence for the intervention's effectiveness, rather than proof of its failure. McLellan has noted that because of the substance abuse field's emphasis on post-treatment functioning, little attention has been paid to the simple, yet invaluable question of whether individuals are engaged and improving during treatment. Improvement during substance abuse treatment cannot be automatically assumed but rather, must be evaluated rigorously during the active treatment process.

Defining Recovery and Relapse: Cognitive Behavioral Model

The previously discussed theoretical developments arose from concern over the ubiquity of substance use following treatment. Another outgrowth of this observed trend has been the loss of consensus over what constitutes health for those struggling with substance use problems. How to define recovery, with or without specifically undergoing substance use treatment, is hotly debated within the field of addiction treatment and research (The Betty Ford Institute Consensus Panel, 2007). Undoubtedly, this, too, impacts how empirical investigations conceptualize and measure treatment gains and failures for addictive disorders. In the past 20 years, the necessity of sobriety, as defined by full abstinence from all substances, to the notion of recovery (most commonly associated with a disease model of addiction) has come under harsh questioning. Proponents of the harm reduction model (Tartarsky, 2007) have openly challenged the widely held assumption that abstinence is the only—or best—goal of recovery. With the theoretical backdrop of incremental stages of change (Prochaska & DiClemente, 1982), the harm reduction model argues that lessening the negative impact of problem substance use to the largest degree possible *at any given moment* is an effective and acceptable goal for substance abuse treatments. In the paradigm shift suggested by harm reduction, recovery is considered unique to each individual by taking into account addiction's consequences on a continuum rather than on a dimensional scale.

Potentially related to the disagreement over what recovery looks like, treatment outcome assessment in the field of addictive disorder research has lacked systematization and has been notoriously varied. A range of dimensions and measures have been utilized, from singular attention paid to the quantity and frequency of substance use to the consideration of secondary outcome variables such as reduction in negative impact on areas like personal health,

relationships, and professional life. When discussing substance use, studies have differed significantly in the definition and utilization of outcome measures. For instance, abstinence has been defined as differently as no drug use in 30 days prior to assessment (Hser, Huang, Teruya & Anglin, 2003) and as no use during year following treatment (Greenfield, Manwani & Nargiso, 2003). There also exists a range of formulas to assess the amount and frequency of substance use (e.g. percent of using days and percent of "heavy use" days).

One very critical element in the issue of substance use treatment outcome assessment is the term "relapse." The term has historically been multiply defined across treatment outcome studies. Relapse has described the first episode of use following treatment—or any other specified amount of time—as well as the return to pretreatment levels or patterns of use. Relapse has also meant the use of a substance in lieu of the previously used substance or the emergence of new patterns of use of the same or new substance (Hubbard, Flynn, Craddock & Fletcher, 2001). These substantially varying definitions of relapse make the discussion of the phenomenon across studies challenging. Nonetheless, high rates of relapse—as defined as return to pre-treatment use level—have been consistently documented after any given intervention (Hser et al., 1997; Simpson et al., 1999; Dawson, Goldstein, & Grant, 2007). Most of the published data on relapse rates comes from treatment samples due to a paucity of research on general population samples. In an effort to evaluate the stability of remission and relapse rates, Walitzer and Dearing (2006) reported that relapse rates in the first months following treatment were generally around 40 to 60%, roughly 30% when assessed in 2-years or longer, and importantly with 25% to 50% of individuals reporting multiple shifts from remission to relapse.

With various innovations since its development in the 1980s, the cognitive behavioral model of relapse is uniquely equipped to conceptualize the variability in substance use treatment

outcomes and the multiple meanings of relapse within recovery. In a foundational paper outlining the cognitive behavioral approach to relapse, Brownell and his co-authors (Brownell, Marlatt, Lichtenstein, & Wilson, 1986) expressed the pressing need for a "natural history of relapse" and standardization of its terminology (p. 766, 1986). They cited the problematic use of the term relapse to define both an outcome—addicted or not—and a process, one element within the complex process of behavioral change. Rather than relapse, proponents of a cognitive behavioral model of relapse suggested that the term "lapse" be understood as the process, event, or behavior involving a "back-tracking" or "slip" (Marlatt & Gordon, 1985). The importance of such a distinction is that lapse allows for multiple outcomes. The negative outcome of a lapse would be relapse (defined as a return to prior levels of use/abuse); the alternative outcome would be prolapse, a return to movement towards positive behavioral change.

Emerging from growing dissatisfaction over the disease model of addiction, the cognitive behavioral model of relapse was first developed as the foundation for an intervention to prevent and manage relapse in patients treated for alcoholism (Chaney, O'Leary, & Marlatt, 1978). A process-oriented focus was taken to elucidate the interaction of psychological, biological, and environmental factors that contribute to post-intervention drinking outcomes. Interested in the situations that initiated post-treatment drinking, Marlatt (1978) gathered qualitative data on 70 male alcoholics who had been treated in an inpatient treatment center and developed taxonomy of high-risk situations. The taxonomy reflects the model's eight person and environment-centered subcategories of relapse determinants: affect, coping, self-efficacy, outcome expectancies, social influences, access to substance, and cue exposure. Each of the subcategories is considered to complexly interact with one another to produce a high-risk situation.[4] The

[4] As a treatment, relapse prevention (RP; Marlatt & Gordon, 1985) aims to help individuals identify and predict their own high-risk situations, manage lapses when they do occur, and avoid complete full relapses.

cognitive-behavioral model of relapse has been further revised to stress that high-risk situations are multiply determined and that psychological (cognitive and affective), physiological, and environmental factors play critical roles in the processes prior, during, and following high-risk situations (Witkiewitz & Marlatt, 2004).

As a means of organizing the host of factors implicated in the relapse process, Shiffman (1989) and others (Donavan, 1996; Witkiewitz & Marlatt, 2004) have suggested the classification of factors based on predisposing (distal) and precipitating (proximal) risks. Distal risks encompass stable, constant factors such as severity of SUD severity, age of SUD onset, and psychiatric history (Shuckit, 1992; McKay, Rutherford, Alterman, Cacciola, & Kaplan, 1995; McKay, Merikle, Mlvaney, Weiss & Koppenhaver, 2001) that increase the susceptibility of relapse following treatment. Proximal risks, on the other hand, are understood as time-sensitive catalysts to substance use which can vary widely between and within individuals such poor coping skills and negative affect (Timko, Finney & Moos, 2005; Litt, Kadden, Cooney, & Kabbela, 2003). The combinations of proximal and distal risks are countless for each individual and suggest a highly individualized recovery processes that contradict the conservative, 2-class trajectory model—abstinent or relapsed—of change. In the following section, an alternative to the 2-class model will be introduced.

Identifying Change: Latent Growth Mixture Modeling

Alongside the paradigmatic changes occurring in the definition and assessment of substance abuse recovery, social scientists have begun to apply new research models to the analysis behavioral change. Particularly in the arena of substance abuse research, the utility of linear regression models has come under question due to their poor record of predicting change across time. If recovery is to be understood as a nonlinear, dynamic phenomenon the application

of statistical methodology able to fully model the heterogeneity and nonlinearity of human behavior will be required.

One of the alternative longitudinal data analytic techniques currently being proposed is latent growth mixture modeling (LGMM). Moving beyond traditional fixed-effects models, LGMM offers investigators greater flexibility in accounting for heterogeneity within a population and in contrast to structural equation models, LGMM can integrate person- and variable-focused approaches. LGMM identifies different types of trajectories in the population as well as variability within trajectories (Muthén & Shedden, 1999; Muthén & Muthén, 2000). Figure 1 provides an example of how treatment outcome can be understood within a latent growth mixture model framework.

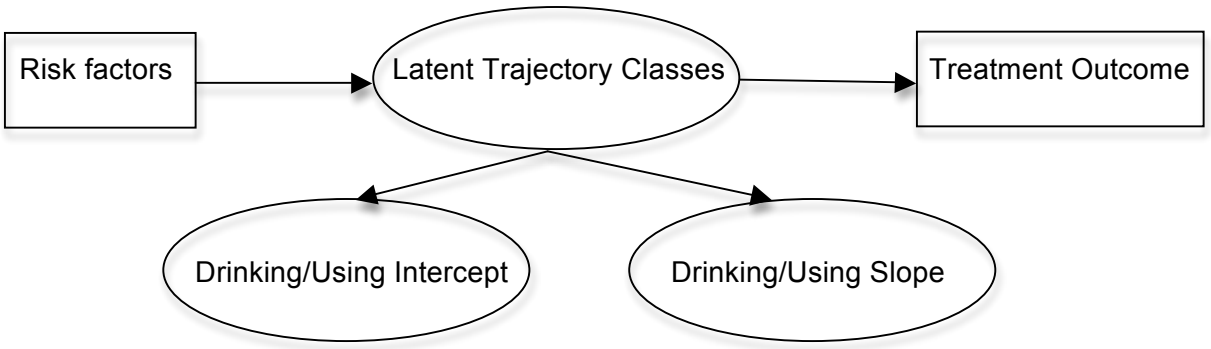

Figure 1. Substance use outcome modeled in a latent growth mixture model framework.

With the LGMM approach, substance use outcomes can be illustrated as a model of risk factors, individual growth, and latent class growth. LGMM can help us answer such relevant questions as how does an individual transform their drinking and drug use following treatment? How much of the intra-individual change variability can be attributed to proximal and distal risk

factors? And lastly, can individual trajectories of change be captured by class trajectories of change that group individuals with similar patterns of growth?

To date, several studies have employed LGMM in identifying meaningful growth trajectories following treatment in alcohol abusing samples (Colder, Menta, Balanda, Campbell & Mayhew, 2001; Hill et al., 2000; Muthén & Muthén, 2000). Of interest when expanding recovery to involve lapses, Witkiewitz and Masyn (2008) investigated the drinking patterns of individuals to understand what occurs *after* a lapse (defined as the first use following treatment). Although often the subject of much theorizing, the authors noted that the trajectories of alcohol use following a first lapse had never previously been empirically examined. Witkiewitz and Masyn (2008) followed 523 alcohol abusing and dependent individuals (41.2% female, 58.8% male) from the time of their first drinking lapse following treatment to a year post-treatment. With the use of LGMM, Witkiewitz and Masyn identified 3-classes of relapse drinkers each with their own distinct trajectory: frequent, heavy drinkers (6%), a "prolapsing" class in which the first lapse led not to a full blown return to original levels, but to an initial increase in drinking followed by less regular drinking (12%), and the most likely trajectory, a less usual, moderate drinking pattern (84%). Covariate analyses of pretreatment characteristics revealed that the severity of alcohol dependence was predictive of the time to first lapse, the amount of drinking at the time of first lapse, and membership in one of the three post-lapse drinking classes. Consistent with previous findings, individuals with a more severe dependency profile lapsed sooner, had the poorest drinking outcomes within their group, and were most likely to be classified in the frequent, heavy drinkers group. This study lends support to the understanding of the recovery—and relapse—process as distinctly variable between individuals.

Charting Pathways: Recovery Cycle Research

In spite of the previously highlighted theoretical, clinical, and empirical support for the re-conceptualization of addiction's trajectory as dynamic, developmental and nonlinear, research utilizing such a theoretical model remains sparse. In addition to trajectory modeling, one of the few existing areas of research has been the charting of frequency and patterning of transitions from one point to another (treatment, abstinence, relapse, incarceration) in the addiction/recovery cycle (Scott et al., 2005; Grella et al., 2008). Traditional reporting of recovery statistics without a path analysis component would, hypothetically, state that 40% of a sample was using 6 months post-treatment and 40% were using at time two, one year post-treatment. This percentage, however, would not indicate who composed the 40% at time one and at time two—the same or different individuals? Secondly, path analysis research has been able to identify factors connected with these shifts in a novel manner, by taking into account the directionality of a transition. Namely, that what may be connected to relapse may not be what is related to entering treatment or what is associated with continued abstinence. The benefits of approaching addiction research from a path analysis perspective are potentially impressive: the more which is understood about how individuals move through a cycle of addiction, recovery, and relapse and the context of those transitions, the more successfully monitoring and interventions efforts may be.

In an innovative example of this research, Scott and her collaborators (Scott et al., 2005) studied the addiction/recovery pathways of 1,326 men and women seeking substance abuse treatment at 12 different Chicago treatment facilities. Over a three year period divided into 12-month increments, they collected data on the substance abuse status of participants (recovering, relapsed, in treatment, incarcerated, or in some cases, deceased) and on a widely acknowledged

range of variables associated with addiction and recovery in the literature. The investigators divided these predictor variables into those that were stable (age, gender, ethnicity, start of drug use age, number of prior treatments, and number of prior arrests) and time-dependent (assessment of mental health, extent of legal problems, homelessness, level of recovery-focused social support, weeks of treatment during interval period and number of attended 12-step sessions in interval period).

The findings of Scott et al. (2005) further established the ubiquity of cyclical movements in the recovery of addiction. 83% of the group transitioned from one point to another at least once in the three year period, 36% did so twice, and 14% three times. Not considering those in treatment or incarcerated, roughly half of those in the community had transitioned to either using or abstinence by the end of the 3 year interval. The authors noted a dominant pattern of increased abstinence in the group at each interval period, with 29.9% reporting abstinence at 6 months, 39.0% at 24 months, and 41.2% at 36 months. Nevertheless, despite this slight increase on the group level of percentages (approximately 30% to 40% of individuals were abstinent at any assessment period), only 10.6% who were not using in the community at the 6 month follow up remained abstinent at the two and three year marks. The authors noted a similar occurrence at the opposite end of the spectrum: only 16.2% of those who were using in the community at the 6 month follow up were remained so after three years. Both findings highlighted the chronicity and dynamic nature of addiction.

With regard to the predictors of various pathways, Scott et al. (2005) reported several notable findings. As expected, predictors were found to differ based on the transition point and the directionality. Gender, arrest history, treatment history, legal issues, homelessness, social support, and 12-step attendance predicted relapse whereas age of first use, mental health, legal

issues, social support, and treatment history were associated with abstinence. Developing a sensitivity to the different factors critical for maintaining abstinence and those which trigger a transition to relapse could prove vital in the tailoring of interventions which support movement down optimal pathways (transitions from negative to positive points, or the continuation of positive transitions). Lastly, Scott and her fellow researchers reported that most of the variables involved in transitions were of the time-dependent kind, suggestive of the force of contextual, environmental factors upon addiction and recovery. Both findings lend support to the importance of aftercare as discussed by McLellan (2002), particularly the growing need for a sophisticated model of monitoring once formal treatment has ended.

In this section, several innovations to how addiction is understood and researched have been discussed. The section's cited literature has centered on the growing awareness of the potential for chronicity in addiction and the nonlinearity and heterogeneity of the recovery process. The terms addiction history, treatment history, and a life course perspective were introduced as part of a developmental, dynamic model that privileges a longitudinal, bio-psycho-social contextual focus to the study of substance abuse and treatment. In the previously discussed research, an observed heterogeneity in both substance use trajectories and treatment service utilization led to a series of recommendations for future research: the use of distal and proximal risk variables which capture the scope and multidimensionality of an individual's addiction; the utility of tracking response during interventions; the expectation of multiple subgroups of SUD individuals; and lastly, the use of statistical modeling such as LGMM that can treat recovery as multimodal and nonlinear. The present study draws directly from these recommendations in the design of its methodology.

Victimization and Trauma: Impact on Addiction and Recovery

Addiction researchers have historically noted trauma as a frequent backdrop in the lives of substance abusers. A large body of evidence has documented that substance abusers, whether male or female, are more likely than non-abusers to have been exposed to traumatic stress and exhibit higher rates of PTSD than the general population.[5] Estimates of traumatic stress exposure in substance using populations have been reported as high as 95% (Hien, 2009). In SUD treatment samples, rates of current PTSD have been documented between 30% and 59% with estimates of lifetime prevalence of PTSD ranging between 55% and 80% (Najavits, Weiss, & Shaw, 1997; Dansky, Saladin, Brady, Kilpatrick & Resnick, 1995). Studies have reported that anywhere from 20% to 65% of those seeking treatment for substance abuse report histories of physical or sexual assault (Brown & Anderson, 1991; Brown, Recupero, & Stout, 1995). The following section will discuss relevant research from the extant trauma literature to elucidate the impact of trauma on the etiology, presentation, and trajectory of women's substance use disorders.

Interpersonal Violence, PTSD, and Substance Abuse: Evidence for a gender-specific pathway

Research has demonstrated the existence of a relationship between the kind of traumatic stress exposure and the likelihood of developing PTSD. Trauma exposure is typically divided into three categories based on the level of human intent and involvement: non-human causes (such as natural disasters, illnesses), non-intentional human causes (car accidents), and intentional human causes (physical or sexual crimes, acts of terrorism) (Hien, Litt, Cohen, Miele & Campbell, 2008). A host of epidemiological studies examining the rates of PTSD in various settings, such as cities affected by natural disasters and high-crime urban areas, have consistently

[5] Traumatic stress exposure can result in a variety of psychiatric presentations, most recognizably and frequently, in the development of PTSD but also in a host of affective and anxiety-related disorders.

found that interpersonal violence carried a significantly higher risk for the development of PTSD than natural catastrophes or non-injuring accidents (Breslau, Davis, Andreski, & Peterson, 1991; Norris & Slone, 2007). Estimates range from 15% to 80% of sexually assaulted individuals meet criteria for PTSD and that 13% to 23% of physically assaulted individuals develop PTSD (Breslau, 2009).

From the vantage point of addiction, findings from the National Comorbidity Study suggested that for women, an addictive disorder was often preceded by another psychiatric condition (Kessler et al., 1994; Kessler et al., 1997; Kessler et al., 1995). Studies of treatment-seeking individuals have indicated that PTSD typically preceded the onset of an addictive disorder in women with 60% to 75% of women having a diagnosis of primary PTSD whereas for men, a primary substance use disorder diagnosis—roughly 65%—was the norm (Sonne, Back, Zuniga, Randall, & Brady, 2003; Deykin & Buka, 1997). The type of interpersonal violence involved in traumatic stress exposure may offer a possible explanation for the gender differences observed in the comorbidity between SUD and PTSD (Kilpatrick, Acierno, Resnick, Saunders, & Best, 1997; Kilpatrick, Resnick, Saunders, & Best, 1998). Whereas men are most likely to develop PTSD in response to combat or crime-related experiences, women most frequently arrive at a PTSD diagnosis following multiple experiences of victimization, such as childhood sexual and physical assault (Hien, 2009). In both population rates and SUD treatment-seeking samples, women reported higher rates of sexual and physical abuse than men (Grice, et al, 1995; Chatham, Hiller, Rowan-Szal, Joe, & Simpson, 1999; Messina, Wish, & Nemes, 2000; Sonne et al., 2003; Wallen, 1992).

Of particular interest to the study of women and addiction has been the exploration of the pathways from trauma to addiction. The complex, reciprocal, and reinforcing relationship

between traumatic exposure and addiction has yet to be fully understood and a number of competing models have been proposed. In an influential analysis of the association between trauma and the development of SUD, no relationship was observed between traumatic stress exposure and addiction (Chilcoat & Breslau, 1998). However, Chilcoat and Breslau (1998) found that a prior diagnosis of PTSD predicted the later appearance of a substance problem thus supporting a self-medicating hypothesis for dually diagnosed PTSD and SUD. The high rates of childhood abuse and repeated victimization in women treated for substance abuse has prompted many to suggest the existence of a specific pathway for co-occurring addictive disorders and PTSD. The sequelae of repeated traumatic stress exposure—developmental disruptions on the level of cognition, affect, and personality—are often manifested as PTSD but also in more chronic forms of dysregulation. These, in turn, may provide the basis for a heightened vulnerability to substance use and abuse (Hien, Cohen, & Campbell, 2005).

"The Telescoping Effect:" Traumatic Stress and Women's Addiction Trajectories

An explanatory model such as the self-medication hypothesis may help researchers integrate the biological, psychological, and social components in women's presentation and trajectory of substance use disorders. Despite beginning to use substances and experience substance-related problems at a later age then men (SAMSHA, 2009), women move faster from first substance use to problems related to use (Randall et al., 1999; Schuckit, Anthenelli, Bucholz, Hesselbrock, & Tipp, 1995) and from regular substance use to first treatment experience (Dawson, 1996; Schuckit, Daeppen, Tipp, Hesselbrock, & Bucholz, 1998; Hernandez-Avila, Rounsaville, & Kranzler, 2004; Johnson, Richter, Kleber, McLellan, & Carise, 2005; Orford & Keddie, 1985; Piazza, Vrbka, & Yeager, 1989; Randall et al., 1999). In the literature investigating the development of addictions in women, the rapid progression to

addiction has been identified as the "telescoping effect" (Johnson, Richter, Kleber, McLellan, & Carise, 2005). This phenomenon was first evidenced in the context of women's alcohol abuse and dependence. Studies repeatedly found that women became addicted with lower levels of use and proceeded to alcohol dependence and the development of co-occurring disorders in a briefer period of time than their male counterparts (NIAA, 1999).

The medical field originally attributed the telescoping effect to women's specific biological vulnerabilities to alcohol.[6] However, significant doubt has been shed on a purely biological rationale for women's accelerated course. A number of studies have reported a similar telescoping effect with substances in which physiological gender differences have not been observed. Research has demonstrated that women are more quickly addicted than men to opioids and cocaine (Anglin, Hser, & McGlothlin, 1987; Haas & Peters, 2000), and that women experience shorter periods of time between first use and first treatment for cocaine (Griffin, Weiss, Mirin, & Lange, 1989; McCance-Katz, Carroll, & Rousanaville, 1999) as well as heroin (Longshore, Hsieh, & Anglin, 1993). Importantly, the telescoped progression of substance use disorders in women has posed a variety of challenges to practitioners and providers accustomed to the trajectory of addiction in men. Of particular importance has been the smaller window of opportunity for effective intervention prior to women's experiencing of serious adverse consequences (Brady & Randall, 1999). Hernandez-Avila et al. (2004) suggested that exposure to repeated traumatic stress played a role in the accelerated pace of women's substance dependence at the level of neurobiology—e.g. chronic disruptions to the HPA-axis system may

[6] Since women possess less total body water than men of equal size, they necessitate less alcohol than men to reach the point of intoxication. Women also produce smaller quantities of gastric alcohol dehydrogenase—the enzyme which metabolizes alcohol in the stomach. As a result, in women, more alcohol circulates to the kidneys, liver, and bloodstream, leading to a higher susceptibility of alcohol-related organ disease in alcoholic women (Smith, Cloninger, & Bradford, 1983). Not only are women three times as likely as men to suffer from cirrhosis of the liver, cirrhosis occurs with smaller amounts of alcohol and in a shorter period of time in alcohol-dependent women (Saunders, Davis, & Williams, 1981; Tuyns & Pequignot, 1984). Higher rates of alcohol-related brain damage have also been reported in women (Jacobson, 1986).

heighten the risk for addictive behavior. A growing number of findings have implicated trauma's effect on the HPA axis system and its functional sensitivity to stress (Schore, 2001; Yehuda, 2001; van der Kolk, 2001).

Complicating Change: PTSD's Impact on SUD Treatment Outcomes

Of particular relevance to the current study is the effect of PTSD symptomatology upon substance abuse treatment outcomes of the dually diagnosed. Independent findings from parallel literatures have confirmed the powerful impact of PTSD on SUD's recovery process. Research has consistently found that PTSD-sufferers have poorer SUD treatment outcomes than those with only SUD (Read, Brown, & Kahler, 2004). Studies have indicated that individuals with PTSD are at an increased risk of SUD relapse than those without PTSD (Ouimette, Ahrens, Moos, & Finney, 1997, Brown et al., 1995). In line with these findings, Coffey and collaborators (Coffey et al., 2002) demonstrated through a laboratory-based test of cue-reactivity to trauma-images that individuals with co-occurring SUD and PTSD showed an increase in cravings in response to trauma cues.

It has been proposed that PTSD sufferers may experience more high-risk situations due to PTSD symptoms as well as diminished coping strategies (such as difficulties with dealing with negative emotion and conflict resolution). In support of this understanding, PTSD sufferers were found to use more alcohol and drugs than non-PTSD sufferers in situations which either echoed their PTSD symptoms or where coping was potentially comprised because of their PTSD (Sharkansky, Brief, Peirce, Meehan, & Manix, 1999). When discussing relapse, many studies have suggested PTSD's deleterious impact on affect regulation. In a comparison of high-risk triggers across two types of substance dependence (alcohol and cocaine), individuals with PTSD used greater levels of both substances when confronted with negative situations—physical and

psychological—than those without PTSD (Waldrop, Back, Verduin, & Brady, 2007).

In a secondary analysis of the CTN data, Hien and her collaborators (Hien et al., 2010) tested the temporal course of improvement in PTSD symptomatology and substance use disorder during the 6-week study period as well as the relationship between PTSD improvement and substance use symptoms over the 12-month follow-up period. The authors compared the improvement of those women in the active treatment, SS, to those who received WHE (the active control group). Results indicated that maintained PTSD improvement was related to subsequent substance use improvement. Of specific importance to the current study of subgroups of trajectories, Hien and colleagues (2010) found that the trauma-informed treatment was significantly more effective than WHE in obtaining substance use improvement for women with severe levels of PTSD and SUD.

Although much of the interplay between PTSD and SUD still remains uncharted, research has supported the claim that PTSD's biological, psychological, and interpersonal sequelae severely complicate SUD recovery. It also serves to underscore the importance of specific research and treatment avenues for this subgroup of SUD individuals.

Women and Recovery: Gender-influenced Factors Associated with Recovery and Relapse

The previous two sections have elaborated on new approaches to the study of substance abuse treatment and to the impact of trauma on the development and trajectory of SUD. In this final section, contributions from a developing literature on gender-related issues in substance abuse and its treatment will be highlighted.

History of Women and Addiction Research

Traditionally, research on substance abuse and its treatment was conducted on largely male samples or on mixed samples in which gender differences were not investigated. On the face of

the issue, the focus was dictated by majority rule: men comprised a larger part of the problem and suffered in larger numbers than women. Moreover, logistical issues, such as the possibility of pregnancy during a clinical trial, made women's participation in studies problematic for even those researchers inclined to include them. Because of the omission of women from mainstream investigations and a lack of attention paid to possible differences between men and women, the findings from substance abuse and treatment research were of considerably limited applicability to women.

Watershed changes began in the late 1980s. The shift was born with an outcry from clinicians and researchers for attention to the unique plight of women suffering from substance abuse problems (Schmidt & Weisner, 1995). After several seminal governmental mandates in the early 1990's (FDA, 1993; FDA, 1994) for the inclusion of women and minorities in future investigations, the dearth of gender-specific research on substance use and abuse began to be addressed. Government support for research devoted to identifying, understanding, and accommodating for gender differences increased multifold. Since the mid-1990's, the field has seen an exponential rise in the number of studies focusing on the impact of substance use on women as an at-risk population with unique characteristics and treatment.[7]

Studies with representative samples of women have replicated a core set of what has been established about substance abuse treatment for men. Most importantly, evidence from the past two decades of research indicate that women *do* improve with substance abuse treatment despite questioning from some about the current standard of SUD care and its usefulness for women (Hodgins, el-Guebaly, & Addington, 1997). Moreover, an extensive review (Greenfield et al., 2007) of the published studies pertaining to gender and treatment outcome concluded that *gender*

[7] See Greenfield et al.. (2007) for an extensive review of treatment outcomes for women with substance use disorders.

alone did not impact an individual's likelihood of recovery.

Despite the convergence of findings that suggest that gender per se does not predict treatment outcome, research has consistently reported on a cluster of person-, subgroup- and program-level characteristics significantly related to SUD treatment outcomes (Wechsberg, Craddock, & Hubbard, 1998). The following section will discuss three factors shown to be critical in the recovery from SUD, that have been observed to function differentially for men and women, and are particularly relevant to women dually diagnosed with PTSD and SUD: socioeconomic variables, retention and completion of treatment, and gender-responsive treatment milieus.

Socio-Economic Considerations

In a study of 155 men and 81 women receiving outpatient substance abuse treatment services, women's outcomes were predicted by a series of economic, demographic, and life history characteristics in addition to treatment completion; for men, predictors were related to the severity of substance use, medical, and mental health issues (Green, Polen, Lynch, Dickinson, & Bennett, 2002). For women, non-treatment predictors included adjusted income, education level, and number of children in the home, veteran status, family history of drug or alcohol abuse, and legal/work referrals. From an investigation of comprehensive services on the recovery of 3,142, men and women (secondary analyses from the National Treatment Improvement Evaluation Study) the provision of housing, educational, and income support was associated with lower rates of substance use for both men and women (Marsh, Cao, & D'Aunno, 2004).

Greenfield and collaborators (Greenfield et al., 2003) were especially interested in examining the association between educational attainment and other socio-economic and clinical factors that mediated the effect of education on treatment outcomes. 101 alcohol dependent

individuals (59 men and 41 women) from a Boston inpatient substance abuse treatment program were recruited to explore the relationship between educational attainment and recovery and relapse (Greenfield et al., 2003). Greenfield et al. (2003) found that individuals with only a high school diploma stood at greater risk of relapse after treatment, had higher percentages of both drinking and heavy drinking days, and a shorter period before their first drink and relapse. Relationship between educational attainment and treatment outcome remained after controlling for other socio-demographic variables such as marital status, co-occurring depression, and gender. Moreover, Greenfield and her co-authors reported that the association between education and relapse persisted after accounting for characteristics such as early onset of drinking and family history of alcohol abuse which could have hindered the possibility of attaining more education. The authors hypothesized that individuals with a high school degree or less were less likely to make use of available substance abuse programs, whether because of the possibility of cognitive impairments or program's being geared towards individuals with higher verbal and literacy abilities.

Treatment Retention and Completion

Findings in the literature have documented a strong association between treatment retention, treatment completion, and favorable outcomes. Messina and fellow researchers (Messina et al., 2000) conducted a randomized controlled trial that examined predictive factors of treatment outcomes. Participants (412 in total, 116 women and 296 men) were recruited from a District of Columbia sample of men and women admitted to one of two year-long therapeutic communities of differing inpatient and outpatient treatment length. (Therapeutic communities originated in the 60s as an alternative means of treatment for male heroin addicts. Length of stay ranged from 15 to 24 months. Population was predominantly white and male.) Clients were

admitted to either a standard therapeutic community program which consisted of 10 months of inpatient treatment followed by 2 months of outpatient treatment or an abbreviated inpatient program of 6 months inpatient followed by 6 months of outpatient care and additional services. Investigators conducted follow-up assessments with clients an average of 19 months post-treatment. They reported a notably high follow up rate (93%). Authors found that individuals who completed the 12-month program had significantly more positive outcomes at the 19-month follow up than non-completers. Results indicated that treatment completion predicted reduction in drug use for both men (treatment completion was the only variable associated with post-discharge drug use) and women (a history of sexual abuse was the other variable associated with post-discharge drug use, more likelihood it would be positive). Completing treatment also reduced the likelihood of post-treatment arrest for both genders. Those who completed the program were also more likely to be employed at follow-up. Importantly, Messina and her colleagues reported that women were especially helped by the standard in-patient care condition. For women in the study, the 10-month inpatient care with subsequent 2-month outpatient treatment was associated with greater reduction in drug use and higher employment rates at follow-up. Their finding that women appeared to benefit from longer stays within a highly structured residential facility suggests the importance of social support and monitoring in women's recovery.

In another large scale prospective study, Hser and her colleagues (Hser et al., 2003) collected data on 511 clients—266 men, 285 women—attending 19 different drug treatment programs in Los Angeles County (programs were selected by stratified random selection). Study examined gender differences in outcomes and predictors of substance abuse treatment outcomes. Drug use and associated behaviors were assessed at baseline and at 1 year post-treatment. Hser

and collaborators found that for both men and women, longer stays in treatment were related to drug abstinence (no drug use in 30 days prior to follow-up assessment, corroborated by urine analysis) and crime desistence.

Green and researchers (Green et al., 2004) conducted a prospective study of West Coast HMO members (155 men and 81 women) who were recommended for and initiated outpatient substance abuse treatment. Completing treatment was the only shared predictive factor of favorable outcome shared by men and women. Nevertheless, treatment completion was a stronger predictor outcome for women: women who completed the treatment were 9 times more likely to be abstinent (binary variable, yes if no drug use in 30 days prior to follow-up interview) then other women, whereas men were 3 times as likely to be abstinent.

Gender-Responsive Milieus

Lastly, it has been argued that the milieu of substance abuse treatment centers must be modified to accommodate the specific clinical backgrounds and concerns of women substance users (Grella, 2008; Covington, 2002; Brown & Melchior, 2008). Women are faced with a double-bind: strong ties to a drug-abusing lifestyle but less social acceptance and support for the treatment and recovery from addiction (Lex, 1991; El Bassel & Schilling, 1994; Amaro & Hardy-Fanta, 1995; Grella & Joshi, 1999). Researchers (Gomberg, 1988; Green, 2006) have theorized that women suffer from harsh social strictures against drug use, making the acknowledgement of addiction more socially stigmatizing than for men. Caught between the socially idealized role of mother and the disgracing realities of addiction, mental health channels may offer women a potentially less shaming help-seeking experience. Indeed, many have proposed that women's low rates of specialized SUD treatment utilization reflect a trend towards women seeking help in venues outside the traditional substance abuse clinic context, particularly

in mental health or primarily health settings (Weisner, 1993; Weisner & Schmidt, 1992; Schober & Annis, 1996; Green et al., 2002; van Olphen & Freudenberg, 2004; Greenfield et al., 2007; Kelly, Blacksin, & Mason, 2001).

As previously noted, a staggeringly high percentage of women in treatment-seeking samples report a history of traumatic stress exposure and that women are more likely to be victims of sexual abuse and domestic violence than men recommended for outpatient substance use treatment (Green et al., 2002). In addition to the complexity of dual diagnoses, the interpersonal sequelae of past sexual and physical abuse have been thought to clash with the confrontational approaches of some treatment modalities or mixed-gender group settings (Copeland, 1997).

The two interventions tested in the CTN study emerge from the context of this section's emphasis on the need for gender-responsive treatment. Both conducted in women-only group formats, the trauma-informed and health education adjunct treatments created a space within the traditional substance use programs where women's particular stressors and vulnerabilities may be recognized and addressed.

Statement of the Problem

The previous literature review section presented the theoretical and empirical research that provides the rationale and context for the present study. A majority of the women entering treatment for SUD suffer from a history of violence and victimization. SUD treatment models that incorporate trauma interventions have established that addressing the sequelae of trauma may bolster treatment outcomes. Nevertheless, behavioral trials have historically reported disappointingly low abstinence, high relapse rates, and heterogeneous substance use rates. New conceptual models that broaden our understanding of recovery and relapse as a dynamic,

developmental phenomenon may enable researchers to reframe past and present findings and find otherwise "hidden clues" to resiliency and recovery. The purpose of the current study is to identify common substance use trajectories in the year following treatment and examine the relationship between PTSD symptomatology, trauma-informed treatment and substance use outcomes during the first 12-months of post-treatment.

Hypotheses of Study

Hypothesis 1

3-classes of trajectories can be utilized to describe the heterogeneity in substance use behavior during the 12-months treatment. One common trajectory will include women with a state of heavy drug use; a second, common trajectory will include women whose use is inconsistent or "bouncing"; and a third, common trajectory will include women who use infrequently, moderately.

Hypothesis 2

Addiction and treatment career traits, PTSD severity and symptomatology, and response to present adjunct treatment will differentiate trajectories of substance use following treatment. Individuals who use heavily following treatment will report higher levels of proximal and distal risk factors. Those with inconsistent use following treatment will report a unique mixture of proximal and distal resiliency and risk factors. Table 1 provides the complete list of variables utilized in the covariate analyses.

Table 1

Covariate Analyses Variables

Category	Variables
Distal Factors	• Baseline PTSD severity (baseline CAPS score) • # of years of PTSD diagnosis • # of previous psychiatric treatments • Baseline SUD severity • Total lifetime years of alcohol and drug use • # of previous SUD treatments
Proximal Factors	• CTN intervention attendance • % of change in CAPS score • # of post-intervention psychiatric treatments • # of post-intervention SUD treatments

CHAPTER 3: METHOD

Participants and Setting

The present study conducted secondary data analysis on a large, multi-site randomized trial of psychosocial treatments for women with co-occurring PTSD and substance use disorders conducted by the National Institute on Drug Abuse's Clinical Trial Network.

Figure 2 depicts the flow of participants from screening through 12-month follow-up.

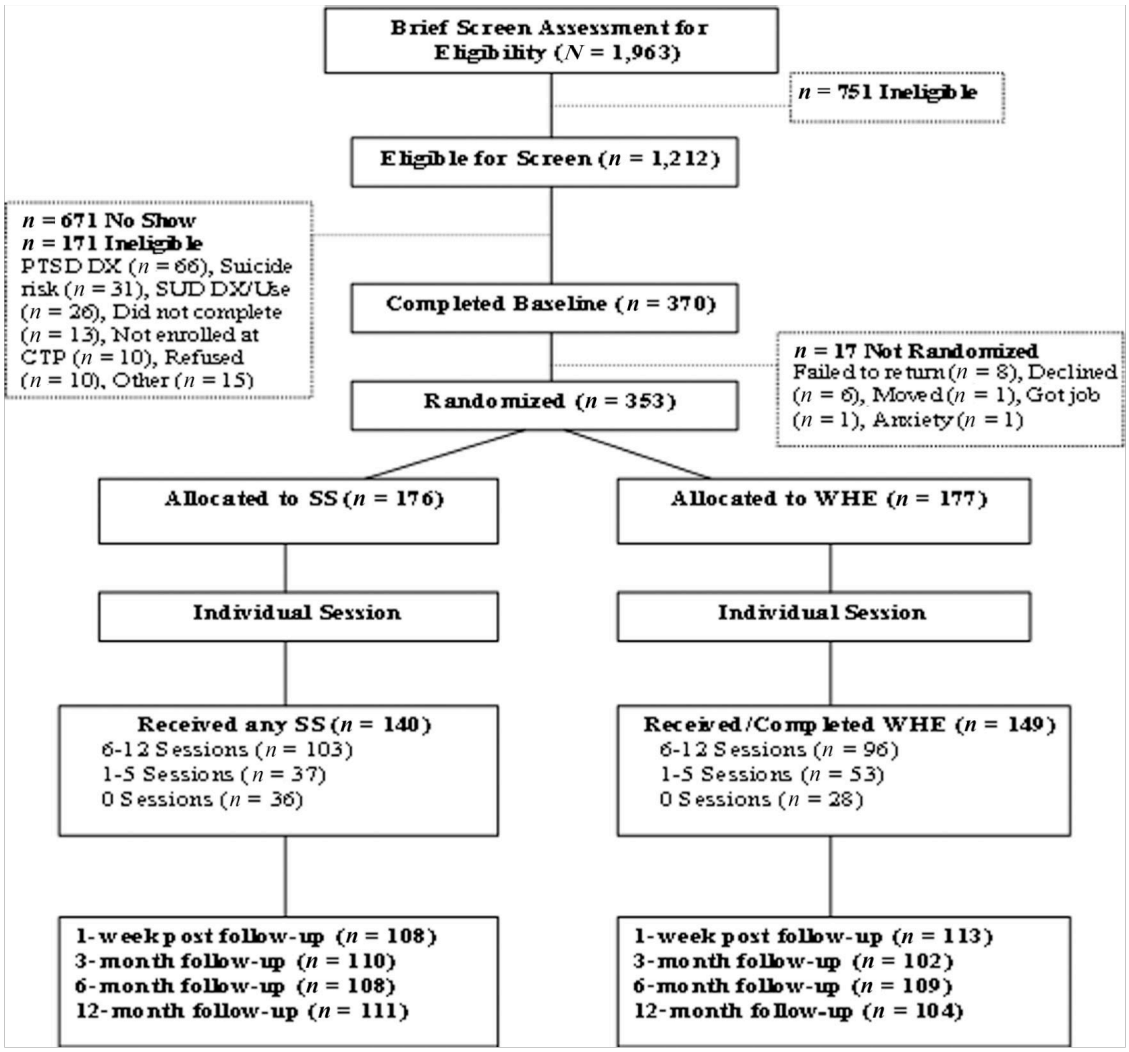

Figure 2. Diagram of participant flow through study.

CTP=community-based substance abuse treatment program; DX=diagnosis; PTSD=posttraumatic stress disorder; SUD=substance abuse disorder; SS=Seeking Safety; WHE=Women's Health Education.

A total of 353 women from outpatient, community-based substance abuse treatment programs (CTPs) met all eligibility criteria and were randomized into the study. To be eligible to participate, women had to report at least one lifetime traumatic event and meet *DSM-IV-TR* criteria for either full or subthreshold PTSD. For subthreshold PTSD, participants must have met *DSM-IV-TR* criteria A (exposure to traumatic stressor), criteria B (re-experiencing symptoms), either criteria C (avoidance and numbing symptoms) or criteria D (hyperarousal symptoms), criteria E (duration of at least one month), and criteria F (significant distress or impairment in functioning). Additional inclusion criteria included: (a) being between the ages of 18 and 65; (b) having a current *DSM-IV-TR diagnosis* of alcohol or drug abuse or dependence and having used alcohol or a drug in the prior 6 months; and (c) being able to provide informed consent. Exclusion criteria consisted of: (a) exhibiting signs of physical deterioration due to an advanced stage medical disease (b) impaired cognition as indicated by a Mini-Mental Status Exam (Folstein, Folstein, & McHugh, 1975) score of less than 21; (c) significant risk of suicidal or homicidal intent, behavior, or history as measured by the Psychiatric Research Interview for Substance and Mental Disorders (Hasin et al., 1996); (d) a history of schizophrenia-spectrum diagnosis; (e) a history of active psychosis (past two months); (f) involvement in PTSD-associated litigation; (g) refusal to be audio- or videotaped; or (h) not fluent in English.

Participants were recruited through advertisements (brochures, flyers, and newspaper) as well as through referrals from CTP staff. If a potential participant was not currently treated at the CTP, she was required to enroll in one of the CTP's outpatient programs in order to be eligible to participate. Recruitment took place throughout a 21-month period between 2004 and 2005. Interested individuals were first briefly screened in person or over the phone to assess the possibility of eligibility, and were then assessed in person to verify eligibility. Participants signed

an informed consent at the beginning of the screening evaluation. Once a participant had completed the baseline evaluation, she was randomized to either SS or WHE.

Table 2 depicts demographic, PTSD-related and psychiatric sample characteristics. The average age of participants was 39.2 (SD=9.3) years. 45% identified as Caucasian, 34% as African-American, 13.3% as multiracial, and 6.6% as Latina. Of participants, 45.6% were either divorced or separated, 36.8% were single, and 17.6% were married; 41.1% of the sample reported living with a partner. The average level of education was completion of high school (12.5 years, SD=2.4). At baseline assessment, more than half of the sample (55.0%) was unemployed. Prior to study enrollment, participants had received on average five previous treatments for alcohol or substance abuse. The most common substance use disorder diagnosed was cocaine dependence (70.5%), followed by alcohol (56.1%), marijuana (27.2%), and opioid dependence (25.6%). A quarter of the sample (25.6%) had been in a controlled environment (jail, medical or psychiatric treatment, alcohol or drug treatment) in the 30 days before enrolling. 80.4% of participants met *DSM-IV* criteria for PTSD and 19.6% met criteria for subthreshold PTSD. The average participant's baseline CAPS score was 62.9 (SD = 19.4), reflecting a severe level of PTSD symptomatology. A majority of the sample reported adult physical abuse (84.8%) or sexual abuse (67.6%). Markedly high childhood abuse rates were also reported (70.1% and 58.7%).

Table 2

Baseline Participant and Diagnostic Characteristics by Treatment Group for the Intention-to-Treat Sample (N = 353)

Variable	Total	Seeking Safety (*N* = 176)[a]	Women's Health Education (*N* = 177)[a]
Age[b]	39.2 (9.3)	39.3 (9.5)	39.0 (9.1)
Race/ethnicity[b]			
African American/Black	34.0	33.0	35.0
Caucasian	45.6	47.16	44.1
Latina	6.5	3.98	9.0
Multiracial	13.3	15.34	11.3
Other	0.6	0.6	0.6
Marital status			
Married	17.6	14.8	20.3
Single	36.8	37.5	36.2
Divorced/separated	45.6	47.7	43.5
Years of education[b]	12.5 (2.4)	12.7 (2.3)	12.4 (2.6)
Employment			
Employed	40.2	40.3	40.1
Unemployed	55.0	54.6	55.4
Student/retired/disabled	4.8	5.1	4.5
Prior alcohol/drug treatment episodes	5.0 (7.9)	5.1 (7.4)	5.0 (8.2)
Controlled environment (past 30 days)	25.6	28.2	23.0
Currently prescribed psychotropic medication[c,d]	44.8	45.5	44.1
Current substance abuse or dependence diagnosis			
Cocaine	70.5	72.7	68.2
Stimulants	7.7	8.5	6.8
Opiates	25.6	25.6	25.6
Marijuana	27.2	27.8	26.6
Alcohol	56.1	59.7	52.5
Current alcohol abuse or dependence diagnosis only[d]	8.8	8.5	9.0
Baseline 7-day abstinent rate	46.2	44.1	46.9
PTSD diagnosis (% full)	80.4	76.7	84.2
CAPS severity, total	62.9 (19.4)	61.6 (19.36)	64.2 (19.4)
Lifetime traumatic experiences			
Child physical abuse	58.7	61.1	56.3
Adult physical abuse	84.8	83.4	86.2
Child sexual abuse	70.1	73.6	66.7
Adult sexual abuse	67.6	65.1	70.1
Transportation accident	72.7	72.2	73.3
Life-threatening illness	39.8	41.5	38.1
Exposed to violent death	19.3	16.5	22.2

Note. Values are either means (with standard deviations) or percentages. PTSD = posttraumatic stress disorder; CAPS = Clinician Administered PTSD Scale.

[a] There were no statistical differences between treatment groups on any variable. [b] The variables were used as covariates in the models. [c] Psychotropic medication was defined as medication prescribed for an emotional, psychological, or psychiatric purpose to include depression, anxiety, psychosis, mood stabilization, or sleep disturbance. [d] Variables included in randomization stratification.

The CTN study was conducted at seven CTPs nationwide. Randomized participants at each CTP varied from 7 to 106. The CTPs ranged from urban settings (n=5) to suburban (n=1) in the Western (n=1), Midwestern (n=1), Northeastern (n=2), and Southeastern (n=3) United States. The CTPs offered a variety of substance abuse treatment components, delivered in varying combinations of outpatient individual and group modalities. The participating CTPs represented a breadth of approaches towards SUD treatment. At the time of randomization, all of the participants were enrolled in one of the CTPs' substance abuse outpatient programs. Women were asked to attend treatment as usual substance abuse services during the 6-week treatment period. If during the treatment phase a woman no longer attended treatment as usual, she was removed from the treatment part of the study, but, as part of the study's intent-to-treat sample, assessed at follow up points.

Eighty two percent of participants attended at least one treatment session. Fifty six percent completed the treatment (attending 6 or more of the 12 sessions). Retention rates were similar at each follow-up period, ranging from 61-63%. No evident bias in attrition from follow-up was found between SS and WHE. At least one follow-up assessment was completed for 82% of participants.

Procedures

Design

The CTN study utilized a randomized, controlled, repeated measures design to evaluate the effectiveness of SS in conjunction with treatment as usual substance abuse services in contrast to an active treatment control group, WHE. The present study utilized a longitudinal, repeated measures design to identify post-treatment patterns of substance use. Following a screening, participant attended a 2.5 to 3 hour baseline evaluation in which information

regarding PTSD diagnoses and symptomatology, substance use diagnosis and past use in 30 days, prior psychiatric and substance abuse treatment characteristics and biographical details were obtained. Eligible participants were then randomized into one of the two treatments. Participants met with a research assistant on a weekly basis for the duration of the treatment and completed a self-report measure of PTSD symptomatology, an inventory of substance use in the past 7 days, and a report of any adverse event. Participants also provided urine and saliva during the weekly meetings for a drug screen and saliva alcohol test. After the treatment, the participant met with a research assistant who conducted assessments at four post-treatment points: 1 week, 3-month, 6-month, and 12-month. Follow-up assessments included measures of the participant's PTSD diagnosis and symptomatology, substance use in past 30 days, and report of any prior or current psychiatric and substance use treatment. All assessments utilized in the current study's secondary analyses are described in the measures section. Assessors blind to treatment assignment administered baseline and post-treatment assessments.

Treatments

SS (Najavits, Weiss, Shaw, & Muenz, 1998) is a manualized, 25-session, cognitive behavioral intervention that addresses trauma and substance abuse and can be delivered in either an individual or group format. Under the developer's supervision, SS was shortened to 12 central modules administered in 6 group sessions as a means of better accommodating to the time frames of community-based outpatient treatment programs. The sessions are similarly structured and provide psychoeducational information regarding PTSD and SUD, coping skills to control PTSD symptoms and prevent substance use, and cognitive restructuring of maladaptive thinking related to substance use and PTSD. Attention is also paid to interpersonal issues and developing effective ways of communicating with an eye towards building a positive support network. Each

session involves a “check in” where women can report any unsafe behaviors or drug use, connecting session topic to the particular experiences in their lives, and “check out” or restatement of their commitment to the session goals.

Empirical support for the efficacy of SS has been documented by various studies in a range of settings and populations. Desai and colleagues (Desai, Harpaz-Rotem, Najavits, & Rosenheck, 2008) undertook a multisite controlled trial comparing SS to treatment as usual for homeless female veterans and reported significantly better outcomes for SS completers in PTSD symptomatology, social support, employment, and psychiatric symptoms. Other studies with challenging populations such as prisoners, at-risk adolescent girls, and low-income clients have reported significant reductions in trauma-related issues, substance and alcohol use and related problems, and improvements in coping skills, and family, social and professional functioning (Najavits, 2002; Najavits, Gallop & Weiss, 2006; Gatz et al., 2007; Hien et al., 2004). In the only previous randomized control trial of SS in comparison to an active control treatment, SS was proven to be as effective as the gold-standard manualized treatment for SUD (relapse prevention) and better than standard community care for a sample of low-income urban women with PTSD and SUD (Hien et al., 2004). Additionally, studies have consistently indicated high retention rates and client satisfaction with SS.

The active control group, WHE (Miller et al., 1998), was modified from a treatment grant in which it was used as an active comparison group in a sample of female partners of intravenous drug users. As a non-specific, manualized treatment, WHE provided women with a psychoeducational curriculum on the female body, sexual and reproductive health, and sexually transmitted diseases, but without any mention of trauma-related issues or substance abuse. As an active comparison condition providing comparable therapist attention, potential benefits, and

issue-oriented sessions without a theoretical focus, WHE controlled for the attribution of efficacy to any of SS's non-specific effects. WHE was similar to SS in all major design components excluding the cognitive behavioral modality. All WHE sessions followed the same format of: (a) topic introduction, (b) group rules and homework assignments, (c) presentation of topic, (d) a topic narration in video, storytelling, and/or reading format, (e) topic exercises and discussions, and (f) affirming goals for the next session.

Treatment as Usual

As a part of the inclusion criteria for participation in the study, participants were required to attend their CTP's usual care services for the 6-week treatment duration. In order to simulate real-world settings, treatment as usual characteristics were allowed to vary. Treatment as usual differed in terms of staffing, and frequency and length of interventions per week; nevertheless, most CTPs offered 3 days per week or more of intensive outpatient services. Addiction treatment orientation was also diverse, but none of the sites offered trauma-informed treatments to the participants for the length of the study. Data on treatment as usual services was collected at all assessments points and classified as either mental health, outpatient medical, inpatient substance abuse treatment, emergency room or hospitalization, and self-help (AA, NA) meeting attendance.

Measures

Sociodemographics

Basic demographic information such as age and race/ethnicity, was collected at the screening evaluation. Education, martial status, monthly income, employment pattern (past 3 years), living situation (past 3 years), and previous alcohol and psychiatric treatment episodes were collected at

the baseline evaluation and at all post-treatment follow-up points (1-week, 3-month, 6-month, and 12-month).

Addiction Severity Index, Lite Version (ASI-Lite; McLellan, Cacciola, & Zanis, 1997)

In the current study, the ASI-Lite was used to obtain information about a participant's current and past SUD and evaluate the severity of difficulties in a range of areas. The ASI-Lite is an abbreviated version, administered in 30 minutes or less, of the Addiction Severity Index (ASI; McLellan et al., 1980). Using a semi-structured, face-to-face interview format, the ASI-Lite assesses the severity of problems in seven domains: medical issues, employment and support information, alcohol use, substance use, legal issues, family and social functioning, and legal problems. The measure provides severity indices for each domain and captures both recent (past 30 days) and lifetime overview of problems related to substance use. The difference between the ASI and ASI-Lite is the omission of clinician severity ratings and 22 other questions. Importantly, all of the questions required for the calculation of composite scores remain in the ASI-Lite.

In terms of research applicability, the ASI has been widely utilized for a variety of clinical outcome studies. Over the course of 25 years, the measure's reliability and validity have been demonstrated by numerous studies. In a cluster analysis of 524 male alcoholic veterans, McLellan and colleagues (McLellan et al., 1980) reported high reliability and validity. The researchers found that the ASI was able to classify the sample into 6 distinct subtypes and accurately diagnose their substance abuse problem. The study also documented high interrater reliability coefficients for each of the problem severity ratings (between .85 and .94). High interrater reliability has been reported across multiple settings (Kosten, Rounsaville, & Kleber, 1983; Stöffelmayr, Mavis, & Kasim, 1994; Zanis, McLellan, Canaan, & Randall, 1994). Kosten

et al. (1983) evaluated the concurrent validity of the ASI with 204 opiate addicts and reported that the ASI's composite scores ranged from fair to good concurrent validity with self-report measures. Moreover, the study noted that the ASI accurately identified addicts with co-occurring psychiatric diagnoses, with particular sensitivity for the screening of depression. With a three treatment center sample (58 alcohol abusers and 123 substance abusers), McLellan et al. (1985) reported finding support for the ASI's concurrent and discriminant validity after comparing the measure to a suite of previously validated tests such as the Cornell Medical Index and the Beck Depression Inventory. Importantly, validity findings were consistent across gender, age, ethnicity, type of substance problem, and treatment center.

To date, one study (Cacciola, Alterman, McLellan, Lin & Lynch, 2007) has evaluated the psychometric properties of the ASI-Lite in order to confirm that it possesses similar values as its full-length counterpart. Cacciola et al. (2007) administered the ASI and ASI-Lite to two samples (an intensive outpatient group and a methadone maintenance clinic group) over the course of several days. Administration order was counterbalanced and different interviewers utilized. The study's results suggested a general equivalence between the ASI and the shortened version. The ASI-Lite's summary scales were found to have the same levels of internal reliability than those of the ASI. Notably, the similarity of intraclass correlation values for the measures' summary scales was equivalent to the values found for the test-retest reliability of the full length ASI. In other words, the correlation of the ASI and ASI-Lite was akin to that of two administrations of the ASI, consequently indicating the validity of the ASI-Lite.

Clinician Administered PTSD Scale (CAPS; Blake et al., 1995)

In the current study, the CAPS was used to assess PTSD diagnosis and severity. The CAPS is a structured, clinical interview that assesses frequency and intensity of *DSM-IV-TR*

PTSD symptoms in the past 30 days and has been designed as a standard criterion measure of *DSM-IV-TR* PTSD. The scale is comprised of three symptom cluster subscales: Re-Experiencing, Avoidance/Numbing, and Hyperarousal. The CAPS measures the frequency and intensity separately for each PTSD symptom on a 5 point (0-4) rating scale with a nine-point severity score for individual PTSD symptoms derived by summing frequency and intensity scores. Cluster severity scores, in turn, are calculated by adding the frequency and intensity of scores of all the individual symptoms in the cluster. Lastly, an overall severity score is reached by tallying the subscale scores. In the current study, the standard FI/I2 (frequency = 1 or above, intensity = 2 or above) rule was used to derive PTSD diagnoses from CAPS scores. In addition to the dichotomous (present or absent) diagnostic measure, the CAPS can be utilized as a continuous measure of PTSD symptom severity. Severity scores are classified into 5 categories: asymptomatic/few symptoms (0-19), mild PTSD/subthreshold (20-39), moderate PTSD/threshold (40-59), severe PTSD (60-79), and extreme PTSD (>80) symptomatology. In the present study, significant improvement in PTSD symptom was based on a decrease of 30 points or more on CAPS score. This is a commonly used definition of PTSD improvement (Weathers, Keane, & Davidson, 2001).

The CAPS has been shown to have exceptional psychometric properties across an array of research and clinical settings and various traumatized populations. Interrater reliability for continuous CAPS scores has consistently been found to be over the .90 level (Blake et al., 1990; Hovens et al., 1994; Blanchard, Hickling, Taylor & Loos, 1995). In a sample of 60 veterans who were administered the CAPS twice within an interval of 2-3 days, the test-retest reliability was found to be almost as robust, ranging from .86 to .87 for frequency, .86 to .92 for intensity, and .88 to .91 for severity (Weathers, Keane, & Davidson, 2001). Studies (Blake et al., 1990; Neal,

Busuttil, Herapath, & Strike, 1994; Hyer, Summers, Boyd, Litaker, & Boudewyns, 1996) have also documented high internal consistency for the CAPS, with alphas averaging within the .80 to .90 for each symptom cluster and total PTSD score.

In support of the CAPS validity, studies demonstrating its convergent validity have shown the CAPS to generally correlate at the .70 level with a number of self-report measures such as Mississippi Scale for Combat-Related PTSD, the Keane PTSD Scale of the MMPI, the Impact of Event Scale, the Davidson Trauma Scale, and the PTSD Checklist (Blake et al., 1990; Hovens et al., 1994; Hyer et al., 1996; Zlotnick, Davidson, Shea, & Pearlstein, 1996; Blanchard et al., 1996; Davidson et al., 1997; Weathers et al., 2001). Its diagnostic utility has also been shown to be very strong, with studies reporting kappas above .70 and sensitivities above .80 (Hovens et al., 1994; Neal et al., 1994; Hyer et al. 1996). Importantly, in a review of treatment outcome studies utilizing the CAPS, Weathers et al. (2001) documented 29 studies in which the CAPS was found to be sensitive to clinical changes in the participants. Lastly, an examination of the CAPS internal structure has provided further evidence of the measure's validity. In a confirmatory factor analysis with a sample of 524 male war veterans receiving services at the National Center for PTSD in Boston, King and colleagues (King, Leskin, King, & Weathers, 1998) tested four competing factor models for PTSD symptom clusters. The four-factor structure adopted by the CAPS (re-experiencing, avoidance, effortful avoidance, emotional numbing, and hyperarousal) was found to best fit the data. The CAPS factor structure's consistency with that of the DSM PTSD symptom clusters lends support to the CAPS as a valid measure of PTSD.

Composite International Diagnostic Interview for DSM-IV (CIDI; Robins et al., 1989)

A participant's substance use diagnosis was assessed utilizing the CIDI. The CIDI is a clinician administered, fully structured interview used to determine lifetime and present

substance disorder diagnoses for alcohol, marijuana, stimulants, sedatives, opioids, cocaine, PCP, psychedelics, and inhalants. The CIDI is based on *DSM-IV* and *ICD-11* diagnostic criteria for harmful use, abuse, and dependence of alcohol and drugs. The measure assesses whether SUDs were ever present and whether present in the last year, last 6 months, last month, and last 2 weeks. In addition, the CIDI provides onset, recency, temporal clustering and comorbidity features, e.g. age of first substance use problem, age of recovery, heaviest period of use, current use, and co-occurring psychological disorders.

The CIDI is a product of a unique, international endeavor jointly spearheaded by the World Health Organization and the National Institute of Health to develop sophisticated diagnostic and classification criteria for alcohol, drug, and mental disorders. In the mid 1990's, the WHO/NIH set forth to evaluate the cross-cultural applicability, efficacy, reliability, and validity of the CIDI and two other of its international diagnostic measures. The project enlisted 12 WHO sites in ten countries and published various studies with its total sample of 1825. In addition to the CIDI, researchers administered two other WHO/NIH measures to participants: the Schedules for Clinical Assessment in Neuropsychiatry (SCAN: World Health Organization, 1993) and the Alcohol Use Disorder and Associated Disabilities Interview Scheduled—Alcohol/Drug-Revised (AUDADIS-ADR: World Health Organization, 1992).

With the entire ten-country sample, Utsun et al. (1997) evaluated the item-, criterion-, and diagnostic reliability of each instrument utilizing a test-retest design. The CIDI exhibited good to excellent kappa rates for dependence categories for alcohol (0.75), opiates (0.80), cannabis (0.69), sedatives (0.48), cocaine (0.76), hallucinogens (0.79), and amphetamines (0.76). Cottler et al. (1997) compared the DSM-IV disorders and criteria as measured by the three WHO/NIH instruments in a sub-study involving three countries (Greece, Luxembourg, and the

United States). Reported kappa values indicated an overall high concordance between the three measures for alcohol and opiate dependence, and moderate concordance for cocaine and sedative dependence. Only amphetamine dependence was reported to have a low concordance rate between the three measures. At the level of diagnostic criteria, the agreement among measures was found to vary by substance and instrument. Fair to good agreement was reported for opiate and sedative dependence; fair concordance was found only between the CIDI and SCAN for various alcohol criteria; and lastly, cannabis dependence criteria agreement was notably low across measures. Thus, despite the three instruments making comparable diagnoses, the criteria path to those diagnoses may potentially differ among the measures. Lastly, since one of the measures, the SCAN, is a clinical interview, Cottler et al.'s study can be additionally interpreted as support for the CIDI's "procedural or concurrent validity" (p. 196, 1997).

Substance Use Inventory (SUI; Weiss, Hufford, Najavits, & Shaw, 1995)

In the present study, a participant's recent substance and alcohol use was assessed by the SUI. The SUI is a 36-item scale that asks about an individual's use and route of administration of various substances (alcohol, cocaine, heroin, and marijuana, and in shorter sections, sedatives, PCP, stimulants, and hallucinogens) in the past seven days. The respondent is asked how often in the past seven days was a substance used, with what administration route (smoked, oral, injected), and the maximum dollar amount spent in one day. Desire to use or cravings are assessed with a 5 point scale for each substance; participants are asked to respond regardless of whether the substance was used during the past week. No reliability or validity studies are available for this measure. However, the SUI has been utilized by several research studies (Najavits et al., 1998; Reback, Larkins, & Shoptaw, 2004) to indicate clinical changes in substance use.

Data Analyses

LGMM analyses were utilized to identify a best-fit model of substance use trajectories in the first year following concurrent SUD and trauma treatment. Figure 3 below depicts the hypothesized model of latent and measured variables. The main outcome variable was the percentage of days of use in the past 30 days of the primary problematic substance (either cocaine, alcohol, marijuana, or opioid based on baseline dependence measure).

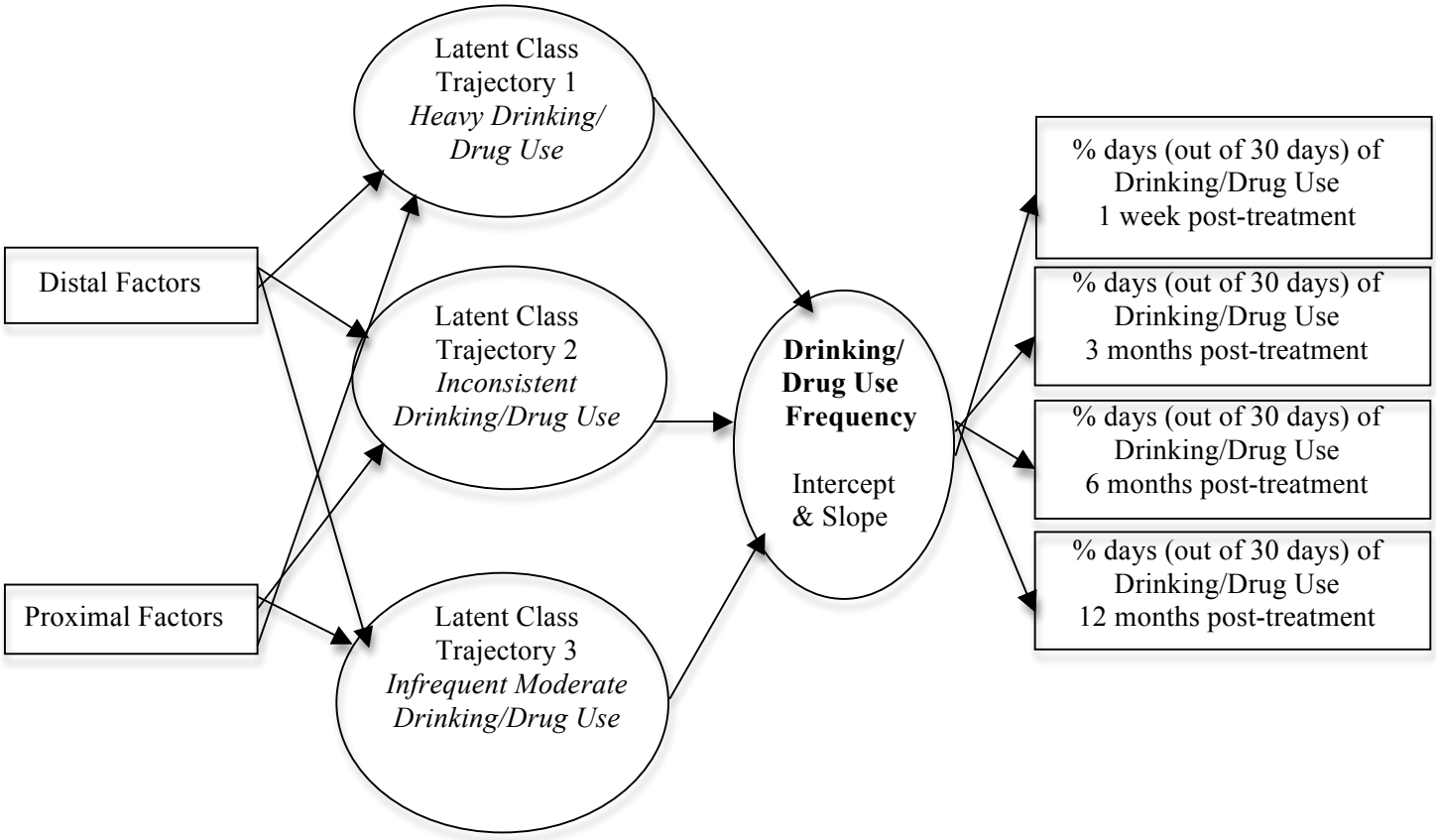

Figure 3. Latent growth mixture model of current study's latent and measured variables.

Mplus

Mplus version 6.5 (Múthen & Múthen, 2009) was utilized to conduct the LGMM analyses. Mplus employs maximum likelihood estimation (MLE) with an accelerated expectation maximization algorithm to enable the estimation of models for continuous outcome variables with missing values. To account for the challenges in identifying global maximum rather than local optima in mixture models, Mplus supplies automatically generated starting values with random perturbations. Following Hipp and Bauer's (2006) recommendations, multiple sets of starting values (for this study, 100 random sets with 50 full optimizations) were employed to increase the estimation power of the mixture models.

Model Construction

A series of unconditional growth mixture models for the substance use outcome (percentage of days used in past 30 days) was first created with one model for each class calculation. Models were built by the systematic increase of the number of classes (i.e. one through five-class models) and associated growth factors (i.e. linear and quadratic terms). Because a large number of women were not using at any one follow up point (61% abstinent at 1-week following treatment, 56% abstinent at 3-months, 46% abstinent at 6-months, and 47% abstinent at 12-months posttreatment) but only a small number of participants (6.6%) reported abstinence at all four follow up points in the post-treatment year, the current study utilized a two-part (u- and y-part) parallel modeling strategy. The u-part consisted of a latent class growth analysis of the probability of being categorized a user or non-user. The y-part involved a growth mixture analysis of the use trajectories of those who were categorized users in the u-part. With this two-part model, logistic growth model estimations of binary indicators were measured alongside growth models for the continuous outcomes of those using at the time of measurement.

Model Estimation

To estimate the model with the optimal amount of classes, the relative fit of models with differing amounts of classes was conducted by comparison of the Bayesian information criterion (BIC; Schwarz, 1978) and the adjusted likelihood ratio test (aLRT: Lo, Mendell, & Rubin, 2001). The BIC measures a model's relative fit on the basis of a function of its log-likehood value; the log-likelihood value takes into account both the model's fit to the observed data as well as the model's complexity (the number of parameters in the model). The aLRT tests a model (*k)* against a model with one less class (*k-1)*; a significant *p* value shows that a model is a better fit relative to a model with one less class. Lastly, classification precision was evaluated by the entropy statistic (Ramaswamy, DeSarbo, Reibstein, & Robinson,1993) which estimates the probability of an individual's class membership. Entropy values range from 0 to 1.0 with numbers closer to 1.0 indicating more classification accuracy. In sum, the best relative fit model would have the lowest BIC, a significant LMR *p* value and the highest entropy statistic value.

The study utilized Mplus's missing at random (MAR) estimation procedure to account for missing data.

After arriving at the unconditional growth two-part mixture model with the best fit, conditional two-part growth mixture modeling was employed in order to 1.) reduce model misspecification and 2.) identify variables significantly associated with membership in each trajectory class. The conditional two-part models consisted of the re-estimation of the unconditional models with the incorporation of specific covariates within latent growth mixture modeling's multinomial logistic regressions. Covariate selection began by the collection of theoretically and empirically relevant variables (see Chapter 2). Selected variables were then analyzed for potential significant associations with particular class membership utilizing an

MPlus procedure: the Wald test of equality of means across latent trajectory classes was run using posterior probability based on multiple imputations. Lastly, the conditional model included the covariates into the best-fitting unconditional growth mixture models as covariates of the probability of class membership and growth factors. Controlling for these covariates on growth factors and class memberships thus permitted the further specification of class membership estimates. Twenty two cases were excluded from the conditional model due to missing covariate data.

CHAPTER 4: RESULTS

The current study utilized Mplus to construct one to four class two-part models of the post-trial substance use trajectories of participants.

In line with previous researchers (Witkiewitz & Masyn, 2008; Witkiewitz et al, 2007; Muthen, 2001) the u-part and y-part of the two-part models were assessed separately for class and growth functions as a means of increasing the accuracy of fit estimation. Table 3 provides the model fit statistics for the unconditional and conditional mixture models assessed in this study.

Table 3

Model Fit for Unconditional and Conditional Growth Mixture Models

Model	BIC	Entropy	aLRT	*p*
Unconditional u-part				
1-class	1005.618			
2-class	1010.697	0.737	190.784	0.0000
Unconditional y-part				
1-class	280.177			
2-class	224.351	0.725	73.321	0.0177
3-class	197.399	0.737	45.760	0.0097
4-class	187.915	0.716	29.086	0.3142
Unconditional two-part				
1-class	1479.227			
2-class	1303.283	0.743	203.921	0.000
3-class	1270.392	0.769	70.458	0.0011
Conditional two-part 3-class	1265.486	0.839	65.069	0.05

Note. BIC = Bayesian information criterion; aLRT = adjusted Lo-Mendell-Rubin likelihood ratio.

The best log likelihood was not replicated for 3-class unconditional U-part and 4-class unconditional two-part models. The results of these two models were not shown due to the generalizability of the model.

Unconditional Growth Mixture Models

The 2-class model (with the slope, slope-variance, and intercept constrained to zero) afforded the best fit for the unconditional u-part models in a comparison of BIC, significant aLRT, and entropy statistics. Figure 4 illustrates the estimated trajectories of a 2-class model for likelihood of primary substance use in the year following treatment. The two latent classes were identified as 1.) high probability of use and 2.) low probability of use. Class proportions were 55.1% and 44.9% respectively.

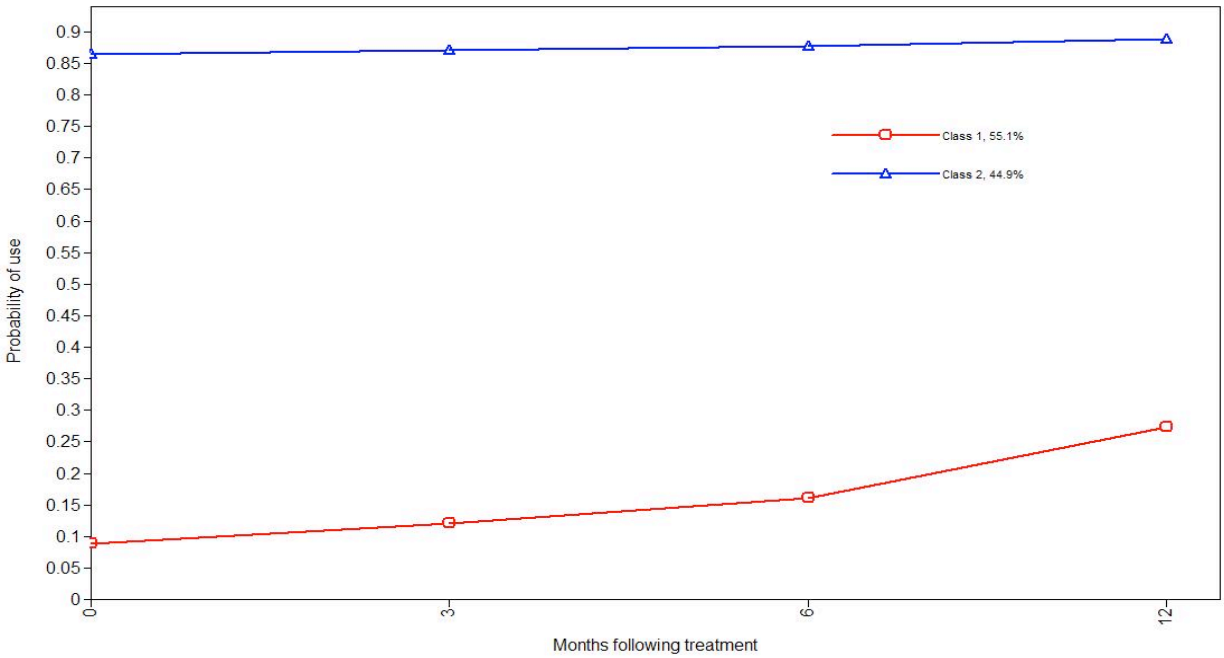

Figure 4. Estimated trajectories of 2-class model for probability of use in the 12 months following treatment (unconditional u-part).

For the unconditional y-part modeling, the 3-class estimate provided the best fit due to the 3-class model's BIC (197.399), adjusted Lo-Mendell-Rubin ratio test (aLRT = 45.760, p = .0097), and entropy (.737). The best-fitting model for the y-part was the 3-class model (slope,

quadratic terms, and the variance of the intercept at random and invariant across latent classes; slope-variances and quadratic terms constrained at zero). Figure 5 illustrates the distinct trajectories of the 3-class model for use patterns over the course of the year following treatment.

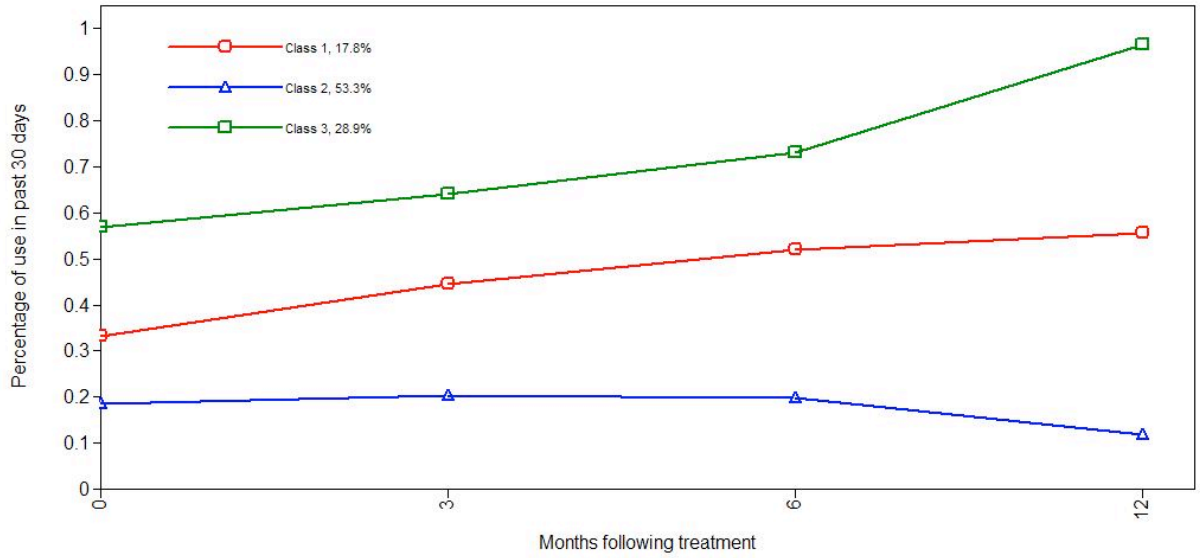

Figure 5. Estimate trajectories of 3-class model for 30-day frequency of substance use in the 12 months following treatment (unconditional y-part).

The two-part modeling was comprised of a u-part model of likelihood of use (with no variances in intercept and slope) and a y-part model (with class-equal variances in intercept and no variances in slope and quadratic terms) of use during the post-treatment year. On the basis of its BIC, significant aLRT, and entropy, the 3-class model provided a better fit than the 1- or 2-class models to the observed data in the analysis of unconditional two-part model estimations. As shown in Figure 6, the estimated trajectories of the best fit model depicts three distinct use patterns in the year following treatment: 1.) a “light use” group 2.) a “lapsing” group and 3.) a “relapsing” group. Class proportions were as follows: the “light use” group comprised 54.5% of the sample, the “lapsing” group 23.6%, and the “relapsing” group 21.9%.

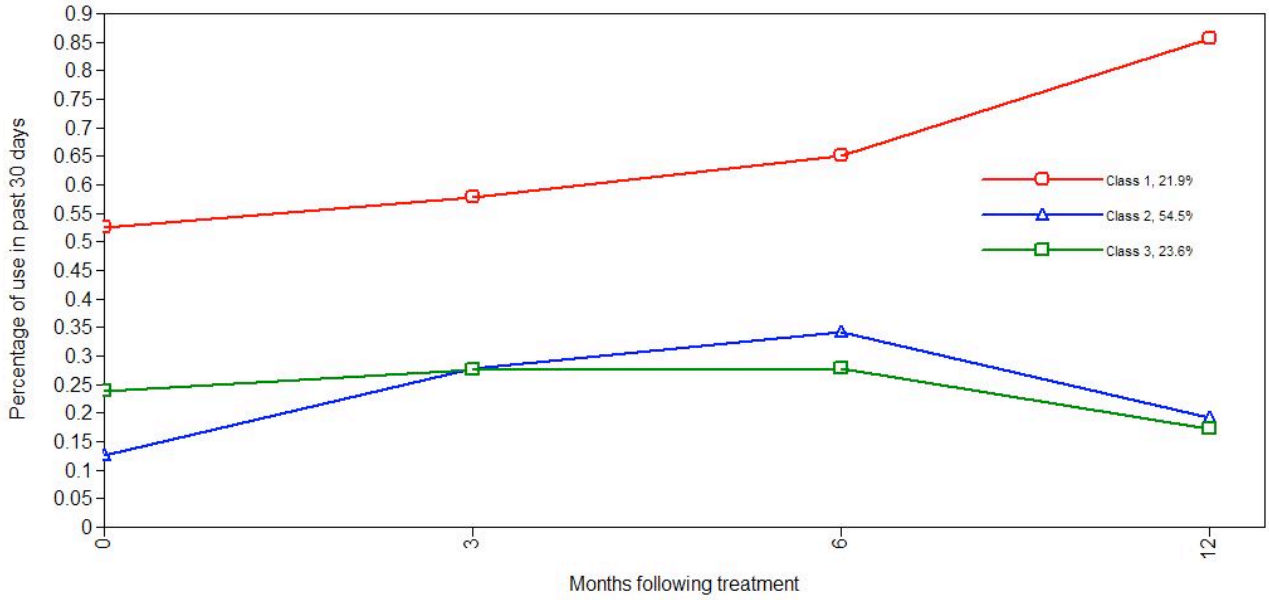

Figure 6. Estimated trajectories for the two-part, 3-class growth mixture model for 30-day frequency of substance use in the 12 months following treatment.

The results from this unconditional two-part analysis support the hypothesis of recovery as a heterogeneous phenomenon, better understood as consisting of distinct subgroups rather than a binary--abstinent or relapse--categorization. This study's 3-class model indicated that more than half of the sample was comprised of a "light use" class, characterized by both a low likelihood of use post-treatment and when using, doing so at a low frequency (estimated 10 days per month). The second class in this model depicts the trajectory of a lapsing group: women with a high likelihood for use in the post-treatment year but light to moderate use following lapses. The third estimated group consisted of women who similar to the "lapsing" group were very likely to resume using their primary substance but unlike the second class, when they did so, used frequently. Because of the presence of both a high risk and high frequency of use following treatment, this third subgroup of the sample can be labeled a "relapsing" class.

Conditional Growth Mixture Models

Although the data from the above modeling estimation supports the study hypothesis of recovery as multimodal and heterogeneous, the unconditional models are not equipped to provide details regarding the differences between each post-treatment trajectory. A conditional two-part modeling estimation was performed to evaluate the role of specific covariates in predicting membership to each of the three estimated classes as well provide more correct model specifications and estimations. The differences between conditional class specific means of 11 potential covariates were first assessed through a Wald test of the three-class two-part unconditional model. The distribution of covariate means and equality of means across classes are shown in Table 4.

Table 4

Distribution of covariate means and equality tests of means across latent trajectory classes of primary substance use using posterior probability-based multiple imputations in 3-class LGMM (N=288)

Covariates	**Trajectory classes**							
	Light N=145		**Lapsers N=77**		**Relapsers N=66**		**Wald Test of Mean Equality**	
	Mean	**SE**	**Mean**	**SE**	**Mean**	**SE**	**X^2**	***p*-value**
Age	37.15	0.78	41.89	1.15	38.64	1.28	10.670	0.005
PTSD severity, baseline	60.741	1.79	61.98	2.42	65.84	2.53	2.429	0.297
Prior psychiatric treatment episodes	2.72	0.35	3.43	1.04	3.23	0.88	0.711	0.701
Percentage of using days in 30 days prior to study	16.20	2.50	35.90	4.60	46.30	5.60	37.975	0.000
Total lifetime years of alcohol/drug use	10.43	0.67	13.04	1.07	12.14	1.22	5.325	0.070
Prior alcohol/drug treatment episodes	4.69	0.62	4.66	0.55	4.97	0.72	0.104	0.949
Treatment Type (SS vs. WHE)	0.53	0.04	0.49	0.06	0.47	0.07	0.702	0.704
Treatment Attendance	7.38	0.37	6.65	0.52	6.51	0.54	2.581	0.275
Change in PTSD severity from baseline to 1-week follow up	-31.95	1.83	-24.56	2.32	-25.41	2.76	8.890	0.012
Psychiatric treatments during 1 year follow up period	0.74	0.28	0.54	0.19	0.19	0.06	4.269	0.118
Alcohol/drug treatment episodes during 1 year follow up period	1.00	0.07	0.70	0.09	0.73	0.10	9.171	0.010

Four variables were found to be significantly different among the three classes: age, alcohol/drug use at baseline, PTSD improvement, and treatment post-study. The four noted variables were then included in a re-estimation of the latent growth mixture models of the three-class two-part model. In order to test study hypotheses, also included in the re-estimation were treatment type (SS vs. WHE), attendance of assigned treatment, and history of substance abuse treatment. The effect of these 7covariates on the growth parameters and trajectories were then assessed. Table 5 depicts the prevalence of the 7 covariates in each of the 3 classes.

Table 5

Covariates of Trajectories of Alcohol/Substance Use in the 3-Class Conditional LGMM Model (N=266[a])

Covariates	**Light vs. Lapsers AOR (CI 95%)**	**Relapsers vs. Lapsers AOR (CI 95%)**	**Relapsers vs. Light AOR (CI 95%)**
Treatment Type (SS vs. WHE)	1.76 (0.74-4.21)	1.36 (0.43-4.29)†	0.77 (0.32-1.84)
Age	0.91 (0.87-0.95)**	0.89 (0.84-0.95)**	0.99 (0.93-1.04)
Previous substance abuse treatment	1.00 (0.97-1.04)	0.99 (0.93-1.05)	0.99 (0.93-1.04)
Percentage of using days in 30 days prior to study	0.07 (0.02-0.21)**	1.44 (0.42-4.98)	20.88 (5.51-79.19)**
SS/WHE attendance	1.04 (0.94-1.15)	0.99 (0.89-1.10	0.59 (0.54-0.65)
Change in PTSD severity from baseline to 1-week follow up	0.97 (0.95-0.99)**	0.99 (0.97-1.02)	1.02 (1.00-1.05)†
Alcohol/drug treatment episodes during 1 year follow up period	1.86 (1.12-3.10)*	1.02 (0.49-2.14)	0.55 (0.29-1.02)†

[a]Excludes 22 cases with missing data

†$p<0.10$

*$p<0.05$

**$p<0.01$

Of note, several covariates hypothesized to be related to distinguishing between the three recovery trajectories were found to not be predictive of membership. In particular, the trauma-related covariates of severity of PTSD symptoms at baseline and duration of PTSD symptoms did not vary between classes. Moreover, class membership was not correlated on the basis of whether a woman participated in the trauma-informed treatment, Seeking Safety, or was randomized to the psychoeducation-focused active control of Women's Health Education.

Membership in the "light use" class was predicted by the covariates of baseline use amount of primary substance use, change in CAPS score from baseline to first assessment point (one week following treatment) and substance abuse treatment post-treatment. Women with little to no use at the beginning of the study as well as women who continued in substance abuse treatment programs following the end of the active study period were more likely to follow a trajectory of less lapses and decreased use in the year following treatment. In support of the relationship between PTSD and substance abuse treatment effectiveness, women who demonstrated improvement in their PTSD symptoms during the active study period were more likely to have a "light use" trajectory rather than a "lapsing" or "relapsing" pattern.

Women in both the "lapsing" and "relapsing" class were observed to be using more frequently at baseline than those in the "light" category. The "lapsing" and "relapsing" were also differentiated by the frequency of use at baseline with the "relapsing" class exhibiting the highest frequency of use at the start of treatment. Also in comparison to the "light" use women, "lapsing" and "relapsing" women were found to have less positive change with regard to PTSD symptoms. However, when compared to one another, no difference was found in the level of PTSD improvement between "lapsing" and "relapsing" trajectories. Data indicated that age is a distinguishing factor between membership in the "lapsing" or "relapsing" classes. "Lapsing"

women tended to be older than those in the “relapse” category. Lastly, the amount of previous substance abuse episodes also distinguished the “relapse” and “lapse” trajectories, with “lapsing” women reporting more of a history of substance use treatment.

CHAPTER 5: DISCUSSION

Summary of Main Findings

The current study marks the first attempt to apply a trajectory-centered approach to the investigation of substance use recovery for women dually diagnosed with PTSD and substance use disorders. Specifically, the present study aimed to empirically identify multiple substance use trajectories in the year following SUD treatment utilizing latent growth mixture modeling (LGMM), a statistical analysis that allows for the distinguishing of qualitatively distinct subgroups within a population. Addiction research has traditionally employed variable-centered, population average-focused statistical methods (Dierker, Rose, Tan, & Li, 2010) to examine the recovery process. This study was undertaken in the context of an evolving body of research emphasizing the value of pattern-centered methodology in addressing the vexing amount of heterogeneity (often evidenced in lackluster outcome findings) of post-treatment substance use behavior. Moreover, the employment of LGMM allowed for the investigation of the modeling of change in substance use behavior as nonlinear, dynamic phenomena. Rather than assessing addiction treatment outcomes on the basis of a binary code of "abstinent" or "relapsed," the current study re-examined the post-treatment data of 353 women in light of a growing consensus of recovery as a highly complex and likely nonlinear process.

Multiple Trajectories in Recovery

It was hypothesized that three distinct trajectories of use would be found during the first year following addiction treatment: one group of women with similarly heavy drug use; a second group of women whose use can be categorized as "bouncing" or inconsistent; and a third class in which women are observed to be infrequent, "light users." The present study's findings strongly

supported its primary hypothesis that a 3-class trajectory model best captured the use patterns of dually diagnosed women with PTSD and SUD.

The detection of three distinct subgroups in post-treatment use echoes findings from previous research that have modeled alcohol and substance use with LGMM techniques (Chung, Maisto, Cornelius, Martin, & Jackson, 2005; Witkiewitz & Masyn, 2008, Jackson, Sher, & Schulenberg, 2008) and provides further confirmation of the presence of clinically significant subgroups in the recovery process. These findings extend prior research and point to the applicability of a trajectory-based modeling approach for a high-risk population in recovery: women with comorbid PTSD. In line with its stated hypotheses, results from the current study identified a group of heavy post-treatment users ("relapsers") and a group of low, infrequent users ("light users"). The presence of these two subclasses within the sample dovetails with prior studies utilizing LGMM to theorize substance use behavior (Jackson & Sher, 2005; Jacob, Bucholz, Sartor, Howell, & Wood, 2005) and reiterates the ubiquity of heterogeneous use and multiple recovery trajectories following substance abuse treatment.

Results from the current study found that more than half of participants (55%) were "light users" after undergoing substance use treatment; it was observed that this group had a low likelihood of use and when they did use, did so in low levels over the course of the twelve month follow up period. In the present study, the "relapsers" group comprised 22% of the sample; in stark comparison to the "light users," these women were characterized by not only a high probability of post-treatment use but heavy use that by the end of twelve months was documented to be close to daily.

As stated above, the present study confirmed its primary hypothesis and found that a 3-class model best fit the heterogeneity of post-treatment use. Additionally, two of the classes

observed supported the study hypothesis and were consistent with previous investigations of post-treatment substance use. Importantly, results from the current study's analysis revealed a third subgroup which did not resemble the hypothesized "bouncing" class, but instead described a novel recovery path. For 24% of participating women, their pattern of use after treatment was characterized by a high probability of use—resembling that of the "relapsing" class—and a low frequency of use—akin to that of the "light" users class. These women represented a group in which use after treatment was practically a given; however their use never exceeded more than 10 days per month.

In previous studies where an increasing and/or decreasing use class was not observed, growth-centered investigations typically encountered a "bouncing" or "inconsistent" substance use subgroup in which its members' behavior tended towards the unpredictable (Witkiewitz et al, 2007; Gueorguieva et al, 2010). It has been hypothesized that this "bouncing" class represents a particular, "unstable" state within the recovery process (Witkiewitz et al, 2007); in contrast, frequent and infrequent use are framed as "stable" states. If recovery is understood as a discontinuous change process involving a pull towards a state of equilibrium (be it consistent use or no use), the unstable state of inconsistent use may represent the oscillation of an individual between relapse and abstinence. The lack of support for this "inconsistent" class in the current study and the quantitative stability found in the study's third class—use throughout the year was relatively stable in its low frequency—suggests the presence of a discontinuous, yet distinct process. Rather than symbolizing the cyclical chaos of relapse-abstinence-relapse, the "lapsing" class represent a group of women undergoing the incremental gains of *recovery*.

Risk and Resilience between Subgroups in Recovery

The study's second set of hypotheses aimed to heighten the interpretive power of a trajectory-based approach by addressing specific variables in the lives of participants that may

predict membership in one of the three distinct growth classes. By identifying unique correlates of each trajectory, the present study attempted to gain a sense of what distinguished each pattern of recovery from the other, in addition to their substance use. It was hypothesized that a series of addiction and treatment career traits as well as PTSD severity and symptomatology would be associated with membership in the different recovery pathways for substance use in the twelve months following treatment. The covariates tested would incorporate distal ones—static, historical variables—as well as proximal factors—variables currently at play during the follow up period. It was hypothesized that individuals classified by their heavy use after SUD treatment would report higher levels of both distal and proximal factors associated with negative treatment outcomes.

Findings from the current analyses indicated that members of the "light," "lapsing," and "relapsing" differed from one another across several important distal and proximal variables. Women who were characterized by a low likelihood of use and low frequency of use ("light" group) were distinguishable from the sample's two other subgroups by their baseline level of use (lower than both other classes), further SUD treatment following the active treatment (more than the other two groups), and PTSD symptom change during the active study (more improvement in PTSD symptoms than the other two classes). Results demonstrated that the "lapsing" and "relapsing" women were distinguishable from one another by the amount of use at baseline ("relapsers" using more than "lapsers"), age ("lapsers" being older than "relapsers"), and number of previous treatments ("lapsers" having more previous treatments than "relapsers").

Support for Developmental Paradigms in SUD Research

The results from the covariate analyses confirmed both previous empirical findings (Shuckit, 1992; McKay, Rutherford, Alterman, Cacciola, & Kaplan, 1995; McKay, Merikle,

Mlvaney, Weiss & Koppenhaver, 2001) and clinical intuition regarding the relationship of severity of use at baseline and treatment outcome: women who are initially use less are likely to continue on the trajectory of lower use whereas heavy use at baseline is strongly associated with negative treatment outcomes.

In addition to supporting the benefit of nuanced treatment matching, the current study promotes the understanding of substance use disorders from a chronic disorder perspective (McLellan, 2002) in several of its covariate analyses findings. Naturally, when considered as a potentially chronic condition, the impact of after- and continuing-care efforts for improvement of symptoms and maintenance of gains are understood as critical (McLellan et al, 2005). The findings from the current analysis lend support to the applicability of after-care / maintenance treatment for this population: "light" users reported more contact with substance abuse programs following the active treatment than "lapsers" or "relapsers." It is important to note that the higher rates of post-study treatment sought out by the "light" group may have reflected an increased amount of motivation and commitment to recovery rather than the effects of additional treatment. However, studies have demonstrated that both formal and informal after care efforts can bolster the efficacy of SUD treatments (Laudet, 2008; Scott & Dennis, 2009), acting as "booster shots" and reinforcers of the original treatment. It is likely that the observed relationship between light use in recovery and continued care represents not only the relevance of a chronic disorder perspective but the step-wise, multi-determined pattern of recovery. That one of the defining traits of the "light" women in recovery is continued SUD treatment underscores the dynamic nature of recovery trajectories where gains, growth, and development are interactive, self-perpetuating movements (more motivation leads to more treatment which leads to more gains and more motivation).

Along similar lines, findings from the covariate analyses highlight the benefit of not only after-care efforts but also multiple treatments *prior* to the given intervention. As such, results underscore the relevance of a career-focused perspective when investigating recovery patterns and the usefulness of adopting a broader, "long-range" lens that acknowledges the impact of previous exposure to treatment. In the present study, the SUD treatment careers (Hser et al, 1997) of women played a significant role in which recovery trajectory they would ultimately follow. Specifically, the amount of prior treatment episodes predicted whether a woman would be a member of either the "lapse" or "relapse" class wherein women who had more treatment experience were more likely to be "lapsers" than "relapsers." Given these findings, the cliché descriptive of "having been around the block" may prove to be more of a positive indicator for change and recovery than perhaps originally intended. The results of the current study thus emphasize that for addictive disorders, intervention efforts are best understood as links in a chain rather than independent of one another—as potentially interactive, incremental, and cumulative events.

The results concerning extra-treatment interventions—be they prior or after the given treatment—may also be interpreted utilizing the transtheoretical model of change (Prochaska and DiClemente, 1983; Prochaska, DiClemente, & Norcross, 1992; Prochaska & Velicer, 1997). Adding specificity to a generic longitudinal perspective that envisions change as inherently occurring in stages, Prochaska and Di Clemente propose that the process of behavioral change consists of particular, developmental phases—*pre-contemplation*, *contemplation*, *preparation, action, maintenance,* and *relapse*—each with their own set of processes, motivations, and concerns. Women who are members of the "light" and "lapsing" subgroups may reflect a group of individuals who have already "passed through" the first three stages of *pre-contemplation*,

contemplation, and *preparation*; their pursuit of further treatment may signal their status in either the *action* or *maintenance* stage of recovery. In contrast to the traditional abstinent-or-relapsed construct, within Prochaska and DiClemente's model, lapses may occur at any time within the three latter stages; it is the motivations and skills employed by the individual after a lapse that delineates one stage from another. In the current study, the very presence of a "light" and "lapse" group of women suggests that lapses can be addressed differently by different types of women, depending on her location within the stages of change model.

Significance of Trauma in Trajectory Modeling of Use

When examining the significance of PTSD to the trajectories of substance use following treatment, results from the current study embody the complexity of the association between addictive disorders and PTSD. Firstly, the results strongly highlight the importance of PTSD symptom amelioration for women in recovery. It was demonstrated through their membership in the "light" recovery class, that women who reduced their PTSD symptoms during the active study phase were better able to manage their substance use in the year following treatment. This finding provides further evidence of an active, influential relationship between PTSD and SUD during the recovery process. The predictive importance of reduction of PTSD symptomatology in growth trajectories reinforces a body of literature that has sought to justify the concurrent treatment of PTSD and SUD (Foa, Keane & Friedman, 2000; Jacobsen, Southwick & Kosten, 2001; Hien et al., 2004, 2009). This finding may also point to the relevance of the self-medication hypothesis in describing the functional relationship between PTSD and SUD symptoms. For women in the "light" use class, the reduction of PTSD symptoms may have potentially lessened the urge to self-medicate through substances for the year following treatment. The link between PTSD and SUD symptom change may also be influenced by the

phenomenological similarities of both disorders (Najavits, Runkel, Neuner et al, 2003). Both PTSD and SUD are understood as "triggering" disorders wherein environmental cues prompt a memory of the trauma or substance that in turn provokes a physiological and psychological arousal. In addition to potentially facing less problematic arousal due to PTSD symptom reduction, women who have decreased their PTSD symptoms during the active study period may find themselves more equipped to manage triggers and arousal associated with substance use. Gains in symptom management (through acquisition of specific skills, exposure to stimuli and effective management of arousal) may be translated from PTSD to SUD.

It is equally to important to note that in contrast to the power of PTSD symptom change to predict class membership—distinguishing "light" users in recovery from the two other subgroups—neither the severity (total CAPS score) nor the chronicity of women's PTSD symptoms (months present) at the outset of treatment were able to assist classification in any of the three trajectories of substance use. This finding may be interpreted as demarcating the boundary between the two disorders within a model that emphasizes the effects of their overlap. The limited power of PTSD's diagnostic traits alone to estimate future substance use highlights the notion that despite a strong association within comorbidity, PTSD and SUD must also be conceptualized as separate and distinct disorders. The extent to which PTSD and SUD reinforce and mitigate one another appears to vary widely and is subject to a multitude of contextual variables.

Along similar lines, whether a woman was randomized to the trauma-informed adjunct treatment, *Seeking Safety,* or the active control, *Women's Health Education*, did not predict membership to one of the three patterns of recovery. These results echo research that emphasizes the importance of interactional effects when evaluating the relationship of PTSD to SUD

symptoms. While attempting to map the association between PTSD symptom change and SUD symptom change, studies indicate that the severity of SUD at baseline, degree of PTSD symptom change, and treatment type appear to be key factors in substance use outcome. A series of re-analyses of the data utilized for the current study have demonstrated the extent to which mediating and moderating effects are at play within the association of PTSD change and SUD change. Hien (Hien et al, 2010) found that *Seeking Safety* was significantly more effective than *Women's Health Education* in decreasing SUD symptoms but only for a specific subgroup: women with heavy baseline use who had achieved significant PTSD reductions. Other factors that have been demonstrated to impact the treatment effects of *Seeking Safety* upon substance use outcome involve attendance patterns during the active treatment phase (Hien et al, 2012) as well as after care efforts, specifically participation in self-help groups such as AA and NA (Morgan-Lopez et al, under review). Nonetheless, further exploration of the mechanisms of change that link PTSD symptom change to substance use reductions lie beyond the scope of the current study.

Clinical Implications

The study's key clinical implications are derived from its finding of multiple and distinct trajectories of substance use within the heterogeneity of use in the year following treatment. The empirical establishment of multiple recovery courses carries with it implications for how clinicians may elect to begin, engage, and conclude substance use treatments for women dually diagnosed with PTSD and SUD.

Firstly, the study results directly challenge the persistent and widely held belief that equates substance use following SUD treatment with treatment failure. Instead, LGMM analyses showed that more than one recovery path was available to women who used after being treated for SUD. The women in the present study were observed to behave in a style much more

consonant with the possibilities outlined in Marlatt and Gordon's (1985) relapse prevention model. Findings indicated that women were either at a high or low likelihood of use post-treatment. Despite their risk level of risk, if they were to use, relapse was not a given. Instead, most women in the study were likely to use infrequently after what Marlatt and Gordon term a "lapse." Only for a minority of women did use following treatment result in frequent, routine use.

For women dually diagnosed with PTSD and SUD, the current study established the presence of several varied clinical presentations linked to substance use following treatment, each with potentially different needs, vulnerabilities, and strengths. Results provide support for—and encourage further investigation of—nuanced treatment matching. The present study serves to highlight opportunities for tailoring interventions to the specific clinical presentation and the potential impact of these choices on a woman's trajectory of recovery. By the same token, analyses demonstrate that a "one-size-fits-all" approach may be of limited value for this population. Rather, the current study suggests that when considering treatment type, intensity, and frequency, attention to factors such as a woman's severity of use at the onset of treatment, previous exposure to treatment, and PTSD symptomatology will likely mean the difference between membership in a positively-oriented or negatively-oriented course of recovery.

Findings point to the utility of considering SUD recovery as a chronic disorder wherein multiple treatment exposures are the norm and are best understood in the context of a larger change pattern, rather than as independent, stand-alone interventions. Furthermore, the current study endorses the theory of "stages of change" (Prochaska and DiClemente,1983) which emphasizes the risk of presuming that all individuals at the onset of treatment are situated or poised to enter the *action* stage of change.

When translated into clinical terms, these results encourage clinicians to begin treatment with a detailed assessment of prior treatment episodes, acknowledging prior gains made, and consequently tailoring current treatment goals based on this information. Additionally, clinicians should be attentive to the presence of any shame associated with a return to treatment. As a means of mitigating such stigma, the present study findings could be provided as psychoeducation to patients; multiple treatments are common, expectable events in recovery and more importantly, can be associated with positive outcomes. In short, women who return for further treatment should be strongly validated for doing so, their stigma whenever possible normalized, and their effort to seek more treatment emphatically framed as a strength and predictor of success.

The present findings are equally relevant at the conclusion of a SUD treatment and can be utilized to promote both informal and formal after care supports, such as AA/NA participation and periodic check-in / "booster" sessions with the current provider. Here, too, the clinician may need to effectively educate the patient towards adopting a stance that considers the conclusion of the current treatment as something other than a definite end and/or "cure." Instead, pursuing community or clinical support should be encouraged, de-stigmatized when necessary, and in discussion with the patient, explicitly linked to better outcomes.

This study joins a body of literature that implores clinicians to "meet the patient where she's at" and moreover, actively intervene in both the discovery and creation of meaning around instances of substance use (Tartarsky, 2007). To prematurely assign a specific meaning or—at worst, judgment—to substance use is to potentially foreclose therapeutic opportunities as well as risk the dissolution of the therapeutic alliance with the patient. Specific therapeutic styles, such as Motivational Interviewing (Miller & Rollnick, 1991), which aim to cultivate an atmosphere of

collaboration and non-confrontation may help clinicians effectively explore with patients their use and consequently, their ambivalence about change. Such discussions also function as a means of eliciting the patient's own reasons for change and have been shown to increase treatment retention and effectiveness (Miller & Rose, 2009).

With regard to the role of trauma and substance use, this study provides further justification for integrated treatments that target both PTSD symptoms and substance use concurrently. For clinicians, this may translate into further assurance that the discussion of PTSD symptoms and specific interventions for PTSD will not negatively impact SUD treatment, but may very well reduce the need of patients to use substances for self-medicating purposes. Nevertheless, treatment planning considerations should include the temporal relationship of the two disorders, severity of both disorders, and psychoeducation of the disorders' reciprocal association.

Results from the current study invariably contain policy implications. Findings repeatedly underscore the positive value of adopting a chronic disorder model for SUD in both achieving and prolonging recovery. In support of such a framework for addiction, the present study highlights the need for policy to promote the design, development and access to centers that can effectively provide comprehensive, recovery-management oriented care (McLellan et al, 2000). The current substance abuse treatment system bears the signs of a system beleaguered by a profound conflict between its stated role and actual function. The pejorative "revolving door" description of treatment and the collective sense of failure felt by patients and clinicians as individuals move in and out of treatment programs speak to the necessity of formalizing into the system's design what it has been valiantly attempting to do for decades under the guise of something else: treat a set of disorders that are chronic in nature and in need of continued care.

The present study contributes to the body of literature that emphasizes the centrality of trauma in the lives of women seeking SUD treatment. Policy aimed at the integration of trauma and addiction treatment for women remains in its nascent stages (Najavits, 2009). The current findings further promote the effectiveness of concurrent treatment and provide support for further funding and establishment of women-centered treatment facilities that can holistically address the challenges faced by this dually diagnosed population.

Limitations and Future Directions

The discussion of limitations in this study is organized into two parts: the methodological limitations stemming from the use of extant data are first addressed and are then followed by technical and theoretical concerns regarding the statistical and interpretive use of LGMM.

Beyond the Confines of Extant Data: Present Limitations and Next Steps in Research

The use of secondary data is likely this study's greatest limitation. As with all secondary analyses, the research questions posed were amended to suit the specific constraints of the extant data. The outcome variable selected for the current study reflects such a limitation. Paradoxically, as the present investigation argues for researchers to look beyond a binary evaluations—abstinent or relapsed—to treatment it remains constrained to the relative and imprecise meaning of its outcome variable, "percentage of days of use." The current study accounted only for the number of use days in the past month and did not assess change in the quantity of use (for example, number of standard drinks or dollar amount of cocaine). The rationale for the present study's variable selection stemmed from the study's effort to evaluate the suitability of LGMM analyses to an as of yet unexamined population, women with co-occurring PTSD and SUD. Since its results demonstrated a general replication of findings with this methodology, it stands now that a next wave of studies should expand the testing of LGMM

analyses to other outcome variables. Akin to the innovations in statistical procedures, the re-evaluation of traditional outcome variables (number of days, quantity of use) is an integral part of the field of addiction research's necessary evolution and quest to more effectively describe and assess substance use disorders and its treatments. It is recommended that future investigations adopt a critical view of the utility of quantity-only variables (be they days or dollar amounts) and explore alternate variables. For example, alongside behavioral variables, future research may wish to incorporate the analysis of shifts in cognitive and emotional appraisals around substance use.

Future investigations of trajectories of substance use following treatment would also benefit from a more rigorously controlled set of substance abuse treatments. In order to fulfill the mission of evaluating "real-life" treatment scenarios, the original CTN study (Hien et al, 2009) designed the addiction treatment component as "treatment as usual" and thus included an intentionally heterogeneous group of substance abuse programs that varied in their orientations and philosophies towards addiction treatment. A next step in the direction of modeling courses of recovery would involve testing the fit of the 3-class growth model with specific substance use interventions delivered in a manualized and controlled fashion. For instance, would the current study's model be similarly reproduced in an abstinence-based, relapse prevention, or harm reduction context? What differences might be detected in recovery courses when examined across a variety of intervention types? Furthermore, current findings were based on the relatively small length of the participating CTN's substance abuse treatments (6 weeks). Would varying trajectories be noted if the active time in treatment were extended? Further control of the treatment type and dosage may very well impact the patterns of use observed following treatment.

The sole reliance on a retrospective self-report measure for the study's main outcome measure represents another potential limitation. As part of their Addiction Severity Index-Lite assessment, women in the study were asked to provide the specific amount of days in the past 30 days in which they had used their primary SUD substance. In conjunction with simple recall errors, the bias inherent in self-report measures has been well documented (May & Foxcroft, 1995). Future research should consider incorporating both corroborating objective measures of use (e.g. breathalyzer and urine samples) as well as innovations in real-time assessment such as ecological momentary assessment methods (Ferguson & Shiffman, 2011) to enhance the accuracy and reliability of substance use measures.

The constraints of its design did not permit the present study to address the implicit issue of affect regulation in the treatment of occurring PTSD and SUD. Functional impairments in affect regulation are hallmarks of both disorders; the ability to measure dynamic affective phenomenon such as shifts in affect control stands as a central area of investigation for this population. The present study hypothesized and confirmed the presence of distinct subgroups post-treatment; real-time assessments (such as handheld computers, electronic diaries, phone hot-lines) would allow future studies to collect data on affect functioning and elucidate the role affect regulation plays in determining membership in positive and negative recovery trajectories.

Recovery trajectories were modeled on the basis of women's use of their primary problematic substance and as such, incorporated a variety of substance types (e.g. cocaine, alcohol, marijuana, opioids, and sedatives). The present study elected to examine substance types in aggregate in order to account for the relatively small total sample size as well as the limited prevalence of use of some of the substance types. Despite research indicating the salience of similar recovery trajectories across substances (Chung et al, 2004), it is critical that future

researchers systematically investigate the number and quality of fit of trajectory models by drug class and type to test the generalizability of a 3-class model. The substitution of one substance for another while in recovery is a commonly observed phenomenon (Sumnall, Tyler, Wagstaff, & Cole, 2004; Petry, 2001) and should be taken into account in the design of future trajectory-centered studies. Moreover, particularly relevant to the comorbidity of PTSD and SUD is evidence from prior research that points to the use of specific substances to medicate specific PTSD symptoms (Ouimette, Read, Wade, & Tirone, 2010). Future studies could utilize a trajectory-based approach to answer questions such as how might the amelioration of PTSD symptoms impact membership in substance-specific recovery courses.

The sample size of 353 women also represents a study limitation by virtue of being potentially underpowered to detect relevant clinical phenomena. Although LGMM research has been conducted with smaller sample sizes (Chung, Maisto, Cornelius, Martin, & Jackson, 2005; Gueorguieva et al, 2010) the size of the current sample may have potentially restricted the ability to identify growth patterns; with a larger *N*, the detection a fourth pattern, as documented in a number of LGMM substance studies (e.g. Jacob et al., 2005; Schulenberg, Wadsworth, O'Malley, Bachman, & Johnston, 1996; Weisner, Weichold, & Silbereisen, 2007) may have been possible. Moreover, a larger sample would have increased the power to distinguish between-group differences with regard to covariates.

Alongside the study's quantitative recommendation for a larger sample, its results point to the importance of qualitative research on this population. The present study focused on the presence of distinct trajectories during recovery for women with PTSD and SUD; qualitative investigations would permit for an up-close look at their daily lives and potentially generate hypotheses about differences in their recoveries. Secondary analyses of CTN-15 data could begin

the bridge between quantitative and qualitative knowledge about dually diagnosed women: ASI data provides a host of interpersonal, systemic variables can help researchers begin to contextualize these subgroups within their interpersonal matrices.

Limits of LGMM and Need of Integrative Analytic Approaches

In line with relatively recent developments in addiction research, the present study aimed to classify SUD patients on the basis of their trajectories—or pathways—of recovery, rather than the traditionally employed variable-focused categorizations. Often labeled trajectory-based (or group-centered or pattern-centered), these approaches for modeling change in SUD symptoms have grown substantially in popularity in the past two decades as an alternative to linear-based models. LGMM stands as one of the main statistical tools employed in trajectory-based studies; as its use increases across research contexts, criticism concerning its utility, suitability, and ultimately, meaning have arisen.

Perhaps one of the most important limitations noted in the use of LGMM is the inability of this statistical technique to empirically conclude the "true" number of classes within a sample—and whether such a correct number exists in the first place (Sher, Jackson, & Steinley, 2011). LGMM, instead, allows only for the specification and comparison of classes based on fit statistics. It remains the responsibility of the investigator to select the number of classes and discern on the basis of relative comparison across models which model most accurately represents the data. Under certain conditions LGMM may erroneously reject the one-class model. The employment of LGMM presupposes the existence of latent subgroups within a population, qualitatively distinct subgroups within a larger, heterogeneous group. Bauer and Curran (2003) remind us that alternatively, another possibility should be considered for the latent

class trajectories modeled by LGMM: the presence of "a complex but unitary population of individual trajectories" (p. 339).

That is to say, researchers must always face a dilemma when employing LGMM analyses: do its trajectory models reflect population heterogeneity or a homogeneous group with a multifaceted distribution? Nonnormality in a population distribution curve of a population is a likely sign of its heterogeneity, but this must not be automatically assumed (Sher et al, 2011). Nonnormality can be present as well within a homogeneous group (caused, for instance, by erroneous scaling of measurements). If LGMM is utilized without a proper rationale or evaluation of this alternative assumption, Bauer and Curran caution that there is the likelihood of a statistical "overextraction" of classes, the spurious generation of subgroups in instances where a one-class model would have more accurately reproduced the data (e.g. when a population resembles a more unitary group than not). Such overextraction, the researchers noted, has far-reaching consequences. In effort to highlight the possibility and implication of such phenomena, Bauer and Curran (2003) themselves designed and tested an instance of overextraction of classes and found that in addition to promoting the detection of false classes with false relationships to covariates, the overextraction masked important predictive relationships which did indeed exist when study population was examined in aggregate form. In the current study, the single-class model exhibited enough variance in its growth parameters to merit re-analysis within a latent growth mixture model. Nevertheless, the future research directions herein discussed should provide statistical justification and rationale for the use of LGMM.

Similarly, many have warned against the pull towards reification of trajectory groups derived from statistical analyses (Sher et al, 2011; Bauer & Curran, 2003; Rindskopf, 2003). It is important to remember that statistically derived groups such as those identified in this study must

not be understood as fixed traits of the participants. Jackson and Sher (2005, 2006, & 2008) argue analyses such as LGMM do not inherently possess any assurance that the modeled trajectories correspond with actual groups. Instead, they recommend the modeling of trajectories on theory rather than solely on empirical findings; however, a purely theory-based model is vulnerable to an over-reliance on chance or a substantial amount of participants who simply do not fit into any of the theorized subgroups (Sher et al, 2011). It is clear that future investigations of trajectories of substance use must skillfully incorporate both empirical and theoretical findings—such as the current study—when hypothesizing trajectories and take heed of both the limitations and benefits of these innovative methodologies.

Conclusion

In terms of research advancement, the current study demonstrated how LGMM extends our understanding of traumatized women in recovery. From the vantage point of clinical value, the current study had the aim of answering a deceptively simple question, *what really happens in recovery*? Taken as a whole, the present findings underscore the clinically varied significance of substance use and the numerous challenges—as well as opportunities—faced by clinicians working with traumatized, substance abusing women. It behooves researchers and clinicians alike to continue to deeply explore who these women are, what particular vulnerabilities they carry forward, what present day liabilities they are confronted with, and what life during recovery is and can be.

BIBLIOGRAPHY

Amaro, H., & Hardy-Fanta, C. (1995). Gender relations in addiction and recovery. *Journal of Psychoactive Drugs, 27*, 325-337.

Anglin, M. D., Hser, Y. I., & McGlothlin, W. H. (1987). Sex differences in addict careers. 2. Becoming addicted. *American Journal of Drug and Alcohol Abuse, 13*, 59–71.

Anglin, M. D., Hser, Y. I., Grella, C. (1997). Drug addiction and treatment careers among clients in the drug abuse treatment outcome study (DATOS). *Psychology of Addictive Behaviors, 11,* 308-323.

Bauer, D. J., Curran, P. J. (2003). Distributional assumptions of growth mixture models: implications for overextraction of latent trajectory classes. *Psychological Methods, 8*, 338-363.

Becker, M. A., Noether, C. D., Larson, M. J., Gatz, M., Brown, V., Heckman, J. P., & Giard, J. (2005). Characteristics of women engaged in treatment for trauma and co-occurring disorders: Findings from a national multisite study. *Journal of Community Psychology, 33,* 429-443.

Betty Ford Institute Consensus Panel. (2007). What is recovery? A working definition from the Betty Ford Institute. *Journal of Substance Abuse Treatment, 33,* 221-228.

Blake, D.D, Weathers, F. W., Nagy, L.M., Kaloupek, D.G., Klauminzer, G., Charney, D.S., Keane, T.M. (1990). A clinician rating scale for assessing current and lifetime PTSD: the CAPS-1. *The Behavior Therapist, 13,* 187–188.

Blake, D. B., Weathers, F. W., Nagy, L. M., Kaloupek, D. G., Gusman, F. D., Charney, D. S., … Keane, T. M. (1995). The development of a Clinician-Administered PTSD Scale. *Journal of Traumatic Stress, 8,* 75–90.

Blanchard, E.B., Hickling, E.J., Taylor, A.E., & Loos, W.R. (1995). Psychiatric morbidity associated with motor vehicle accidents. *Journal of Nervous and Mental Disease,* 183, 495–504.

Blanchard, E.B., Hickling, E.J., Buckley, T.C., Taylor, A.E., Vollmer, A., Loos, W.R. (1996). Psychophysiology of posttraumatic stress disorder related to motor vehicle accidents: Replication and extension. *Journal Consulting and Clinical Psychology, 64,* 742–751.

Brady, K.T., Dansky, B.S., Sonne, S.C., & Saladin, M.E. (1998). Posttraumatic stress disorder and cocaine dependence: Order of onset. *American Journal on Addictions, 7*, 128–135.

Brady, K. T., Grice, D. E., Dustan, L., Randall, C. (1993). Gender difference in substance use disorders. *American Journal of Psychiatry, 150,* 1707-1711.

Brady, K. T., Killeen, T., Saladin, M. E., Dansky, B., & Becker, S. (1994). Comorbid substance abuse and posttraumatic stress disorder: Characteristics of women in treatment. *American Journal on Addictions, 3,* 160-164.

Brady, K. T., & Randall, C. L. (1999). Gender differences in substance use disorders. *Addictive Disorders, 22,* 241-252.

Breslau, N. (2009). The epidemiology of trauma, PTSD, and the posttrauma disorders. *Trauma, Violence, & Abuse, 10,* 198-210.

Breslau, N., Davis, G. C., Andreski, P., & Peterson, E. (1991). Traumatic events and posttraumatic stress disorder in an urban population of young adults. *Archives of General Psychiatry, 48,* 216-222.

Brown, G. R., & Anderson, B. (1991). Psychiatric morbidity in adult inpatients with childhood histories of sexual and physical abuse. *American Journal of Psychiatry, 148,* 55-61.

Brown, P. J., Recupero, P. R., & Stout, R. (1995). PTSD substance abuse comorbidity and treatment utilization. *Addictive Behaviors, 20,* 251-254.

Brown, V. B. & Melchior, L. A. (2008). Women with co-occurring disorders (COD): Treatment settings and service needs. *Journal of Psychoactive Drugs, SARC Supplement 5, Nov 2008*, 365-376.

Brownell, K. D., Marlatt, G. A., Lichtenstein, E., & Wilson, G. T. (1986). Understanding and preventing relapse. *American Psychologist, 41*, 765–782.

Cacciola, J.S., Alterman, A.I., McLellan, A.T., Lin, Y., & Lynch, K.G. (2007). Initial evidence for the reliability and validity of a "Lite" version of the Addiction Severity Index. *Drug and Alcohol Dependence, 87,* 297-302.

Chaney, E. R., O'Leary, M. R., & Marlatt, G. A. (1978). Skill training with alcoholics. *Journal of Consulting and Clinical Psychology, 46,* 1092–1104.

Chatham, L. R., Hiller, M. L., Rowan-Szal, G. A., Joe, G. W., & Simpson, D. (1999). Gender differences at admission and follow-up in a sample of methadone maintenance clients. *Substance Use and Misuse, 34,* 1137–1165.

Chilcoat, H. D. & Breslau, N. (1998). Investigations of causal pathways between drug use disorders. *Addictive Behaviors, 23,* 827-840.

Chung, T., Maisto, S. A., Cornelius, J. R., & Martin, C. S. (2004). Adolescents' alcohol and drug use trajectories in the year following treatment. *Journal Of Studies On Alcohol*, *65*, 105-114.

Chung, T., Maisto, S. A., Cornelius, J. R., Martin, C. S., Jackson, K. M. (2005). Joint trajectory analysis of treated adolescents' alcohol use and symptoms over 1 year. *Addictive Behaviors, 30*, 1690-1701.

Coffey, S. F., Saladin, M. E., Drobes, D. J., Brady, K. T., Dansky, B. S., & Kilpatrick, D. G. (2002). Trauma and substance cue reactivity in individuals with comorbid posttraumatic stress disorder and cocaine or alcohol dependence. *Drug and Alcohol Dependence, 65,* 115-127.

Colder, C., Menta, P., Balanda, K., Campbell, R. & Mayhew, K. (2001). Identifying trajectories of adolescent smoking: an application of latent growth mixture modeling. *Health Psychology,* 20, 127-35.

Copeland, J. (1997). A qualitative study of barriers to formal treatment among women who self-managed change in addictive behaviours. *Journal of Substance Abuse Treatment, 14*, 183-190.

Cottler, L.B., Grant, B.F., Blaine, J., Mavreas, V., Pull, C., Hasin, D., … Mager, D. (1997). Concordance of DSM-IV alcohol and drug use criteria and diagnoses as measured by AUDADIS-ADR, CIDI and SCAN. *Drug and Alcohol Dependence, 47,* 185-205.

Covington, S. S. (2002). Helping women recover: Creating gender-responsive treatment. In S.L.A. Straussner & S. Brown (Eds.). *The Handbook of Addiction and Treatment for Women: Theory and Practice.* San Francisco, CA: Jossey-Bass Publishers.

Davidson, J.R.T., Book, S.W., Colket, J.T., Tupler, L.A., Roth, S.H., David, D., … Feldman, M.E. (1997). Assessment of a new self-rating scale for posttraumatic stress disorder. *Psychological Medicine, 27*, 153–160.

Dansky, B. S., Saladin, M. E., Brady, K. T., Kilpatrick, D. G., & Resnick, H. S. (1995). Prevalence of victimization and posttraumatic stress disorder among women with substance use disorders: Comparison of telephone and in-person assessment samples. *The International Journal of the Addictions, 30*, 1079-1099.

Dawson, D. A. (1996). Gender differences in the probability of alcohol treatment. *Journal of Substance Abuse and Treatment, 8*, 211–225.

Dawson, D. A., Goldstein, R. B., & Grant, B. F. (2007). Rates and correlates of relapse amongst individuals in remission from DSM-IV alcohol dependence: A 3-year follow-up. *Alcoholism: Clinical and Experimental Research, 31,* 2036-2045.

Desai, R. A., Harpaz-Rotem, I., Najavits, L. M., & Rosenheck, R. A. (2008). Impact of the Seeking Safety Program on clinical outcomes among homeless female veterans with psychiatric disorders. *Psychiatric Services, 59,* 996–1003.

Deykin, E. Y. & Buka, S. L. (1997). Prevalence and risk factors for posttraumatic stress disorder among chemically dependent adolescents. *American Journal of Psychiatry,* 154, 752-757.

Dierker, L., Rose, J., Tan, X., & Li, R. (2010). Uncovering multiple pathways to substance use: A comparison of methods for identifying population subgroups. *The Journal Of Primary Prevention*, *31*, 333-348.

Donovan, D. M. (1996). Assessment issues and domains in the prediction of relapse. *Addiction, 91,* S29-S36.

El-Bassel, N., & Schilling, R.F. (1994). Social support and sexual risk taking among women on methadone. *AIDS Education and Prevention, 6,* 506–513.

Ferguson, S. G., & Shiffman, S. (2011). Using the methods of ecological momentary assessment in substance dependence research—Smoking cessation as a case study. *Substance Use & Misuse*, *46*, 87-95.

Fillmore, K. M., Golding, J. M. Leino, E. V, Motoyoshi, M., Shoemaker, C., Terry, H., Ager, C. R., & Ferrer, H. P. (1997). Patterns and trends in women's and men's drinking. In R.W. Wilsnack & S.C. Wilsnack, S.C., (Eds.) *Gender and Alcohol: Individual and Social Perspectives (*pp. 21–48). New Brunswick, NJ: Rutgers Center of Alcohol Studies, 1997.

Foa, E.B., Keane, T.M., & Friedman, M.J. (2000). Guidelines for treatment of PTSD. *Journal of Traumatic Stress, 13,* 539-588.

Folstein, M., Folstein, S., & McHugh, P. (1975). "Mini-Mental State": A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12,* 196–198.

Food and Drug Administration, U.S. Department of Health and Human Services, 1993. Guidelines for the Study and Evaluation of Gender Differences in the Clinical Evaluation of Drugs. Federal Register, 58, 39406–39416.

Food and Drug Administration, U.S. Department of Health and Human Services, 1994. NIH Guidelines on the inclusion of women and minorities as subjects in clinical research. NIH Guide, 23.

Gatz, M., Brown, V., Hennigan, K., Rechberger, E., O'Keefe, M., Rose, T. & Bjelac, P. (2007). Effectiveness of an integrated, trauma-informed approach to treating women with co-occurring disorders and histories of trauma: The Los Angeles site experience. *Journal of Community Psychology,* 35, 7, 863-878.

Gomberg , E. S. L. (1988). Alcoholic women in treatment: The question of stigma and age. *Alcoholism, 23,* 507-514.

Green, C. A. (2006). Gender and use of substance abuse treatment services. *Alcohol Research and Health, 29,* 55-62.

Green, C. A., Polen, M. R., Dickinson, D. M., Lynch, F. L., & Bennett, M. A. (2002). Gender differences in predictors of initiation, retention, and completion in an HMO-based substance abuse treatment program. *Journal of Substance Abuse Treatment, 23*, 285-295.

Greenfield, S. F., Brooks, A. J., Gordon, S. M., Green, C. A., Kropp, F., McHugh, K., … Miele, G. M. (2007). Substance abuse treatment entry, retention, and outcome in women: A review of the literature. *Drug and Alcohol Dependence, 86*, 1-21.

Greenfield, S. F., Manwani, S. G., & Nargiso, J. E. (2003). Epidemiology of substance use disorders in women. *Obstetrics & Gynecology Clinics of North America, 30*, 413–446.

Grella, C. (2008). From generic to gender-responsive treatment: Changes in social policies, treatment services, and outcomes of women in substance abuse treatment. *Journal of Psychoactive Drugs, SARC Supplement 5,* 327-343.

Grella, C., & Joshi, V. (1999). Gender differences in drug treatment careers among clients in the National Drug Abuse Treatment Outcome Study. *American Journal of Drug and Alcohol Abuse, 25,* 385-406.

Grella, C. E., Hser, Y. I., & Hsieh, S. (2003). Predictors of drug treatment re-entry following relapse to cocaine use in DATOS. *Journal of Substance Abuse Treatment, 25,* 145-54.

Grella, C. E., Scott, C. K., Foss, M. A., Dennis, M. L. (2008). Gender similarities and differences in the treatment, relapse, and recovery cycle. *Evaluation Review, 32,* 113-137.

Grella, C. E., Scott, C. K., Foss, M. A., Joshi, V., & Hser, Y. I. (2003). Gender differences in drug treatment outcomes among participants in the Chicago Target Cities Study. *Evaluation and Program Planning, 26,* 297-310.

Grice, D. E., Brady, K. T., Dustan, L. R., Malcolm, R., & Kilpatrick, D. G. (1995). Sexual and physical assault history and posttraumatic stress disorder in substance-dependent individuals. *American Journal on Addictions, 4*, 297 – 305.

Griffin, M. L., Weiss, R. D., Mirin, S. M., & Lange, U. (1989). A comparison of male and female cocaine abusers. *Archives of General Psychiatry, 46,* 122– 6.

Gueorguieva, R., Wu, R., Donovan, D., Rounsaville, B. J., Couper, D., Krystal, J. H., & O'Malley, S. S. (2010). Naltrexone and combined behavioral intervention effects on trajectories of drinking in the COMBINE study. *Drug And Alcohol Dependence*, *107*, 221-229.

Haas, A., & Peters R. (2000). Development of substance abuse problems among drug-involved offenders. Evidence for the telescoping effect. *Journal of Substance Abuse, 12,* 241– 53.

Hasin, D.S., Trautman, K.D., Miele, G.M., Samet, S., Smith, M. and Endicott, J. (1996). Psychiatric Research Interview for Substance and Mental Disorders (PRISM): Reliability for substance abusers. *American Journal of Psychiatry, 153*, 1195-1201.

Hernandez-Avila, C. A., Rounsaville, B. J., & Kranzler, H. R. (2004). Opioid-, cannabis- and alcohol-dependent women show more rapid progression to substance abuse treatment. *Drug and Alcohol Dependence, 74*, 265–272.

Hien, D.A. (2009). Trauma, posttraumatic stress disorder, and addiction among women. Eds. Brady, K. T., Back, S. E., Greenfield, S. *Women and Addiction: A comprehensive handbook*. New York: Guilford Press.

Hien, D.A., Cohen, L. R., & Campbell, A. (2005). Is traumatic stress a vulnerability for women with substance use disorders? *Clinical Psychology Review, 25,* 813-823.

Hien, D.A., Jiang, H., Campbell, A.N., Hu, M.C., Miele, G.M., Cohen, L.R., … Nunes, E.V. (2010). Do treatment improvements in PTSD severity affect substance use disorders? A secondary analysis from a randomized clinical trial in NIDA's Clinical Trials Network. *American Journal of Psychiatry, 167,* 95-101.

Hien, D.A., Litt, L. C., Cohen, L. R., Miele, G. M., Campbell, A. (2008). *Trauma services for women in substance abuse treatment: An integrated approach.* Washington, DC: American Psychological Association.

Hien, D.A., Litt, L., Miele, G.M., Cohen, L.R., & Capstick, C. (2004). Promising treatments for women with comorbid PTSD and substance use disorders. *American Journal of Psychiatry, 161*, 1426-1432.

Hien, D.A., Morgan-Lopez, A. A., Campbell, A. N., Saavedra, L. M., Wu, E., Cohen, L., Ruglass, L., & Nunes, E. V. (2012). Attendance and substance use outcomes for the Seeking Safety program: Sometimes less is more. *Journal of Consulting and Clinical Psychology, 80*, 29-42.

Hien, D.A., Wells, E.A., Jiang, H., Suarez-Morales, L., Campbell, A.N., Cohen, L.R., … Nunes, E.V. (2009). Multisite randomized trial of behavioral interventions for women with co-occurring PTSD and substance use disorders. *Journal of Consulting and Clinical Psychology, 77,* 607-619.

Hill, K. G., White, H. R., Chung, I. J., Hawkins, J. D., & Catalano, R. F. (2000). Early adult outcomes of adolescent binge drinking: Person and variable-centered analyses of binge drinking trajectories. *Alcoholism: Clinical and Experimental Research, 24,* 892–901.

Hipp, J. R. & Bauer, D. J. (2006). Local solutions in the estimation of growth mixture models. *Psychological Methods, 11,* 36-53.

Hodgins, D. C., el-Guebaly, N. & Addington, J. (1997). Treatment of substance abusers: Single or mixed gender programs. *Addiction* (Abingdon, England), 92, 805-812.

Hovens, J.E.J.M, Van der Ploeg, H.M, Bramsen, I., Klaarenbeek, M.A., Schreuder, B.J.N., & Rivero, V.V. (1994). The development of the Self-Rating Inventory for Posttraumatic Stress Disorder. *Acta Psychiatrica Scandinavica, 90,* 172–183.

Hser, Y. I., Anglin, M. D., Grella, C., Longshore, D., & Prendergast, M. L. (1997). Drug treatment careers: A conceptual framework and existing research findings. *Journal of Substance Abuse Treatment, 14,* 543-558.

Hser, Y. I., Huang, D., Teruya, C., Anglin, M. D. (2003). Gender comparisons of drug abuse treatment outcomes and predictors. *Drug and Alcohol Dependence, 72,* 255-264.

Hser, Y. I., Grella, C., Chou, C., Anglin, M. D. (1998). Relationships between drug treatment careers and outcomes: Findings from the National Drug Abuse Treatment Outcome Study. *Evaluation Review, 22,* 496-519.

Hser, Y. I., Longshore, D., & Anglin, M. D. (2007). The life course perspective on drug use: A conceptual framework for understanding drug use trajectories. *Evaluation Review, 31,* 515-547.

Hubbard, R. L., Flynn, P. M., Craddock, S. G., & Fletcher, B. W. (2001). Relapse after drug abuse treatment. In F. M. Tims, C. G. Leukefeld, J. J. Platt (Eds.), *Relapse and recovery in addictions* (pp. 109-121). New Haven, CT: Yale University Press.

Hyer, L.A., Summers, M.N., Boyd, S., Litaker, M., & Boudewyns, P.A. (1996). Assessment of older combat veterans with the Clinician- Administered PTSD Scale. *Journal of Traumatic Stress, 9*, 587–593.

Jackson, K. M. & Sher, K. J. (2005). Similarities and differences of longitudinal phenotypes across alternate indices of alcohol involvement: A methodologic comparison of trajectory approaches. *Psychology of Addictive Behaviors, 20*, 373-384.

Jackson, K. M., & Sher, K. J. (2006). Comparison of longitudinal pheno-types based on number and timing of assessments: A systematic comparison of trajectory approaches II. *Psychology of Addictive Behaviors, 20,* 373–384.

Jackson, K. M., Sher, K. J., & Schulenberg, J. E. (2008). Conjoint developmental trajectories of young adult substance use. *Alcoholism: Clinical and Experimental Research, 32*, 723-737.

Jacob, T., Bucholz, K. K., Sartor, C. E., Howell, D. N., & Wood, P. K. (2005). Drinking trajectories from adolescence to the mid-forties among alcohol dependent males. *Journal of Studies on Alcohol, 66*, 745-755.

Jacobsen, L.K., Southwick, S.M. & Kosten, T.R. (2001). Substance use disorders in patients with posttraumatic stress disorder: A review of the literature. *American Journal of Psychiatry, 158,* 1184-1190.

Jacobson, R. (1986). The contributions of sex and drinking history to the CT brain scan changes in alcoholics. *Psychological Medicine, 16,* 547–559.

Joe, G. W., Simpson, D. D., & Broome, K. M. (1999). Retention and patient engagement models for different treatment modalities in DATOS. *Drug and Alcohol Dependence, 57,* 113-125.

Johnson, P. B., Richter, L., Kleber, H. D., McLellan, A.T., & Carise, D. (2005). Telescoping of drinking-related behaviors: gender, racial/ethnic, and age comparisons. *Substance Use and Misuse, 40*, 1139–1151.

Kelly, P., Blacksin, B., & Mason, E. (2001). Factors affecting substance abuse treatment completion for women. *Issues in Mental Health Nursing, 22,* 284-304.

Kessler, R. C., McGonagle, K. A., Zhao, S., Nelson, C. B., Hughes, M., Eshleman, S., Wittchen, H. U., & Kendliner, K. S. (1994). Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States: results from the National Comorbidity Study. *Archives of General Psychiatry, 51,* 8–19.

Kessler, R. C., Crum, R. M, Warner, L. A., Nelson, C. B., Schulenberg, J., & Anthony, J. C. (1997). Lifetime co-occurrence of DSM-III-R alcohol abuse and dependence with other psychiatric disorders in the National Comorbidity Study. *Arch Gen Psychiatry, 54*, 313-321.

Kessler, R., Sonnega, A., Bromet, E., Hughes, M., & Nelson, C. (1995). Posttraumatic stress disorder in the national comorbidity study. *Archives of General Psychiatry, 4,* 231-244.

Kilpatrick, D. G., Acierno, R., Resnick, H. S., Saunders, B. E., & Best, C. L. (1997). A 2-year longitudinal analysis of the relationships between violent assault and substance use in women. *Journal of Consulting and Clinical Psychology, 65*, 834-847.

Kilpatrick, D. G., Resnick, H. S., Saunders, B. E., & Best, C. L. (1998). Victimization, posttraumatic stress disorder, and substance use and abuse among women. In C. L. Wetherington & A. B. Roman (Eds.), *Drug addiction research and the health of women* (pp. 285-307, NIH Publication No. 98-4290). Rockville, MD: National Institute on Drug Abuse.

King, D. W., Leskin, G. A., King, L. A. & Weathers, F. W. (1998). Confirmatory factor analysis of the Clinician -Administered PTSD Scale: Evidence for the dimensionality of posttraumatic stress disorder. *Psychological Assessment,* 10, 90-96.

Kosten, T. R., Rounsaville, B. J. & Kleber, H. D. (1983). Concurrent validity of the addiction severity index. *Journal of Nervous & Mental Disease,* 171, 606-610.

Laudet, A. B. (2008). The Road to Recovery: Where Are We Going and How Do We Get There? Empirically Driven Conclusions and Future Directions for Service Development and Research. *Substance Use & Misuse, 43(12/13)*, 2001-2020.

Lex, B. W. (1991). Some gender differences in alcohol and polysubstance users. *Health Psychology, 10,* 121-132.

Litt, M. D., Kadden, R. M., Cooney, N. E., & Kabela, E. (2003). Coping skills and treatment outcomes in cognitive-behavioral and interactional group therapy for alcoholism. *Journal of Consulting and Clinical Psychology, 71,* 118-126.

Lo, Y., Mendell, N. R., & Rubin, D. B. (2001). Testing the number of components in a normal mixture. *Biometrika, 88,* 767-778.

Longshore, D., Hsieh, S., & Anglin, M. D. (1993). Ethnic and gender differences in drug users' perceived need for treatment. *International Journal of Addiction, 28,* 539–558.

Marlatt, G. A. (1978). Craving for alcohol, loss of control, and relapse: A cognitive behavioral analysis. In P. E. Nathan, G. A. Marlatt, & T. Loberg (Eds.)*, New directions in behavioral research and treatment* (pp.271–314). New Brunswick, NJ: Rutgers Center of Alcohol Studies.

Marlatt, G. A., & Gordon, J. R. (Eds.). (1985). *Relapse prevention: Maintenance strategies in the treatment of addictive behaviors*. New York: Guilford Press.

Marsh, J. C., Cao, D., & D'Aunno, T. (2004). Gender differences in the impact of comprehensive services in substance abuse treatment. *Journal of Substance Abuse Treatment, 27,* 289-300.

May, C., & Foxcroft, D. (1995). Minimizing bias in self-reports of health beliefs and behaviours. *Health Education Research*, *10*, 107-112.

McCance-Katz, E., Carroll, K., Rounsaville, B. (1999). Gender differences in treatment-seeking cocaine abusers—implications for treatment and prognosis. *American Journal of Addiction, 8*, 300– 311.

McKay, J.R., & McLellan, A. T. (1998). Deciding where to start: Working with polyproblem individuals. In W.R. Miller & N. Heather (Eds.), *Treating addictive behaviors* (pp. 173-186). New York, NY: Plenum Press.

McKay, J. R., Merikle, E., Mulvaney, F. D., Weiss, R. V., & Koppenhaver, J. M. (2001). Factors accounting for cocaine use two years following initiation of continuing care. *Addiction, 96*, 213–225.

McKay, J. R., Rutherford, M. J., Alterman, A. I., Cacciola, J. S., & Kaplan, M. R. (1995). An examination of the cocaine relapse process. *Drug and Alcohol Dependence, 38*, 35–43.

McKay, J. R., Rutherford, M. J., Cacciola, J. S., Kabasakalian-McKay, R., & Alterman, A. I (1996). Gender differences in the relapse experiences of cocaine patients. *The Journal of Nervous and Mental Disease, 184,* 616-622.

McLellan, A. T. (2002). Have we evaluated addiction treatment correctly? Implications from a chronic care perspective. *Addiction, 97*, 249-252.

McLellan, A.T., Cacciola, J.S., & Zanis, D. (1997). *The Addiction Severity Index-"Lite" (ASI-"Lite")*. Center for the Studies of Addiction, University of Pennsylvania/Philadelphia VA Medical Center.

McLellan, A. T., Lewis, D. C., O'Brien, C. P., & Kleber, H. D. (2000). Drug dependence, a chronic medical illness: Implications for treatment, insurance, and outcomes evaluation. *Journal of the American Medical Association, 284,* 1689-1695.

McLellan, A. T., Luborsky, L., Cacciola, J., Griffith, J. E., Evans, F., Barr, H. L., & O'Brien, C. P. (1985). New data from the Addiction Severity Index: Reliability and validity in three centers. *Journal of Nervous and Mental Disorders*, *173*, 412–423.

McLellan, A. T, Luborsky, L., Woody, G. E., & O'Brien, C. P. (1980). An improved diagnostic evaluation instrument for substance abuse patients: The Addiction Severity Index. *Journal of Nervous and Mental Disease, 168,* 26-33.

McLellan, A. T., McKay, J. R., Forman, R., Cacciola, J., & Kemp, J. (2005). Reconsidering the evaluation of addiction treatment: From retrospective follow-up to concurrent recovery monitoring. *Addiction, 100,* 447-458.

Messina, N., Wish, E., Nemes, S. (2000). Predictors of treatment outcomes in men and women admitted to a therapeutic community. *American Journal of Drug and Alcohol Abuse, 26,* 207-227.

Miller, B.A., Downs, W.R., Gondoli, D.M. & Keil, A. (1987). Role of childhood sexual abuse in the development of alcoholism in women. *Violence and Victims*, *2*, 57-172.

Miller, S., Pagan, D., & Tross, S. (1998). *Women's Health Education.* In *Peer activism for female partners of injection drug users.* Unpublished treatment manual, Columbia University.

Miller, W. R., & Rollnick, S. (1991). *Motivational interviewing: Preparing people to change addictive behavior.* New York: Guilford Press.

Miller, W. R., & Rose, G. S. (2009). Toward a theory of motivational interviewing. *American Psychologist, 64*, 527-537.

Morgan-Lopez, A.A., Saavedra, L.M., Hien, D.A. Campbell, A.N., Wu, E. & Ruglass, L. (under review) Synergistic effects between Seeking Safety and Twelve-Step Affiliation on women with comorbid PTSD and SUDs.

Muthén, B., & Muthén, L. (2000). Integrating person-centered and variable-centered analysis: Growth mixture modeling with latent trajectory classes. *Alcoholism: Clinical and Experimental Research, 24,* 882–891.

Muthén, L. & Muthén, B. (2009). *Mplus user's guide.* Sixth edition. Los Angeles: Muthén & Muthén.

Muthén, B., & Shedden, K. (1999). Finite mixture modeling with mixture outcomes using the EM algorithm. *Biometrics, 55,* 463–469.

National Institute on Alcohol Abuse and Alcoholism (NIAAA), (1999). Are women more vulnerable to alcohol's effects? *Alcohol Alert 46.*

Najavits, L. M. (2002) Seeking safety: Therapy for trauma and substance abuse. *Corrections Today, 64,* 136-139.

Najavits, L. M. (2009). Psychotherapies for trauma and substance abuse in women: Review and policy implications. *Trauma, Violence, & Abuse*, *10*, 290-298.

Najavits, L. M., Gallop, R. J. & Weiss, R. D. (2006). Seeking Safety therapy for adolescent girls with PTSD and substance use disorder: A randomized controlled trial. *Journal of Behavioral Health Services and Research, 33*, 453-463.

Najavits, L. M., Runkel, R., Neuner, C., Frank, A. F., Thase, M. E., Crits-Christoph, P., & Elaine, J. (2003). Rates and Symptoms of PTSD among Cocaine-Dependent Patients. *Journal Of Studies On Alcohol*, *64*, 601-606.

Najavits, L. M., Weiss, R. D., & Shaw, S. R. (1997). The link between substance abuse and posttraumatic stress disorder in women: A research review. *The American Journal on Addictions, 6*, 237-283.

Najavits, L.M., Weiss, R.D., Shaw, S.R., & Muenz, L. (1998). "Seeking safety": Outcome of anew cognitive-behavioral psychotherapy for women with posttraumatic stress disorder and substance dependence. *Journal of Trauma and Stress,11*, 437-456.

Neal, L. A., Busuttil, W., Herapath, R., & Strike, P. W. (1994). Development and validation of the computerized Clinician Administered Posttraumatic Stress Disorder Scale-1-Revised. *Psychological Medicine,* 24, 701-706.

Norris, F. H., & Slone, L .B. (2007). The epidemiology of trauma and PTSD. In M.J. Friedman, T.M. Keane, P.A. Resnick (Eds.), *Handbook of PTSD: Science and practice* (pp. 78-98). New York: Guilford Press.

Nunes, E. V., Quitkin, F. M., Donovan, S. J., Deliyannides, D., Ocepek-Welikson, K. & Koenig, T. (1998). Imipramine treatment of opiate-dependent patients with depressive disorders: A placebo-controlled trial. *Archives of General Psychiatry,* 55, 153-160.

Orford, J. & Keddie, A. (1985). Gender differences in the functions and effects of moderate and excessive drinking. *British Journal of Clinical Psychology,* 24, 265-279.

Ouimette, P. C., Ahrens, C., Moos, R. H., & Finney, J. W. (1997). Posttraumatic stress disorder in substance abuse patients: Relationships to 1-year posttreatment outcomes. *Psychology of Addictive Behaviors, 11,* 34–47.

Ouimette, P., Read, J. P., Wade, M., & Tirone, V. (2010). Modeling associations between posttraumatic stress symptoms and substance use. *Addictive Behaviors*, *35*, 64-67.

Petry, N. (2001). A behavioral economic analysis of polydrug abuse in alcoholics: a symmetrical substitution of alcohol and cocaine. *Drug and Alcohol Dependence*, *62*, 31-39.

Piazza, N. J., Vrbka, J. L., & Yeager, R. D. (1989). Telescoping of alcoholism in women alcoholics. *International Journal of Addiction, 24*, 19–28.

Prochaska, J. O. & DiClemente, C. C. (1982). Transtheoretical therapy: Toward a more integrative model of change. *Psychotherapy: Theory, Research and Practice, 19*, 276-288.

Prochaska, J. O., DiClemente, C. C., & Norcross, J. C. (1992). In search of how people change: Applications to addictive behavior. *American Psychologist, 47*, 1102-1114.

Prochaska, J. O., & Velicer, W.F. (1997). The Transtheoretical Model of health behavior change. *American Journal of Health Promotion, 12,* 38-48.

Ramaswamy, V., DeSarbo, W., Reibstein, D., & Robinson, W. (1993). Empirical pooling approach to marketing mix elasticities with PIMS data. *Marketing Science, 12,* 103–124.

Randall, C. L., Roberts, J. S., Del Boca, F. K., Carroll, K. M., Connors, G. J., & Mattson, M. E. (1999). Telescoping of landmark events associated with drinking: A gender comparison. *Journal on Studies of Alcohol, 60*, 472–479.

Read, J. P., Brown, P., & Kahler, C. W. (2004). Substance abuse and posttraumatic stress disorders: Symptom interplay and effects on outcome. *Addictive Behaviors, 29,* 1665−1672.

Reback, C.J., Larkins, S., & Shoptaw, S. (2004). Changes in the meaning of sexual risk behaviors among gay and bisexual male methamphetamine abusers before and after drug treatment. *AIDS and Behavior*, *8*, 87-98.

Rindskopf, D. (2003). Mixture or homogeneous? Comment on Bauer and Curran (2003). *Psychological Methods, 8,* 364–368.

Robins, L.N., Wing, J., Wittchen, H.-U., Helzer, J.E., Babor, T.F., Burke, J., … Towle, L.H. (1989). The Composite International Diagnostic Interview: An epidemiologic instrument suitable for use in conjunction with different diagnostic systems and in different cultures. *Archives of General Psychiatry, 45,* 1069-1077.

Saunders, J. B, Davis, M., & Williams, R. (1981). Do women develop alcoholic liver disease more readily than men? *British Medical Journal (Clinical Research Edition), 282*, 1140–1143.

Schmidt, L., & Weisner, C. (1995). The emergence of problem-drinking women as a special population in need of treatment. In M. Galanter (Eds) *Recent Developments in Alcoholism, Vol. 12: Alcoholism and Women*. New York: Plenum Press, pp. 309–334.

Schober, R., & Annis, H. M. (1996). Barriers to help-seeking for change in drinking: a gender-focused review of the literature. *Addictive Behaviors, 21,* 81-92.

Schore, A. N. (2001). The effects of early relational trauma on right brain development, affect regulation, and infant mental health. *Infant Mental Health Journal,* 22, 1-2, 201-269

Schuckit, M. A. (1992). Advances in understanding the vulnerability to alcoholism. In C. P. O'Brien & J. H. Jaffe (Eds.). *Addictive States*. New York, NY: Raven Press, pp. 93-108.

Schuckit, M. A., Anthenelli, R. M., Bucholz, K. K., Hesselbrock, V. M., &Tipp, J. (1995). The time course of development of alcohol-related problems in men and women. *Journal of Studies on Alcohol, 56*, 218–225.

Schuckit, M., Daeppen, J. B., Tipp, J., Hesselbrock, M., Bucholz, K. (1998). The clinical course of alcohol-related problems in alcohol dependent and nonalcohol dependent drinking women and men. *Journal of Studies on Alcohol, 59*, 581– 590.

Schulenberg, J., Wadsworth, K. N., O'Malley, P. M., Bachman, J. G., & Johnston, L. D. (1996). Adolescent risk factors for binge drinking during the trtansition to young adulthood: Variable- and pattern-centered approaches to change. *Developmental Psychology, 32*, 659-974.

Schwarz, G. (1978). Estimating the dimension of a model. *The Annals of Statistics, 6,* 461-464.

Scott, C. K., Foss, M. A., Dennis, M. L. (2005). Pathways in the relapse—treatment—recovery cycle over 3 years. *Journal of Substance Abuse Treatment, 28,* S63-S72.

Scott, C. K., & Dennis, M. L. (2009). Results from two randomized clinical trials evaluating the impact of quarterly recovery management checkups with adult chronic substance users. *Addiction, 104,* 959-971.

Sharkansky, E. J., Brief, D. J., Peirce, J. M., Meehan, J. C., & Mannix, L. M. (1999). Substance abuse patients with posttraumatic stress disorder (PTSD): Identifying specific triggers of substance use and their associations with PTSD symptoms. *Psychology of Addictive Behaviors, 13,* 89-97.

Sher, K. J., Jackson, K. M., & Steinley, D. (2011). Alcohol use trajectories and the ubiquitous cat's cradle: Cause for concern?. *Journal Of Abnormal Psychology*, *120*, 322-335.

Shiffman, S. (1989). Conceptual issues in the study of relapse. In M. Gossop (Ed.), *Relapse and addictive behavior* (pp. 149-179). New York: Tavistock.

Simpson, D. D., Joe, G. W., Fletcher, B. W., Hubbard, R. L., & Anglin, M. D. (1999). A national evaluation of treatment outcomes for cocaine dependence. *Archives of General Psychiatry, 56,* 507-514.

Smith, E. M., Cloninger, C. R., Bradford , S. (1983). Predictors of mortality in alcoholic women: a prospective follow-up study. *Alcohol: Clinical and Experimental Research, 7,* 237-243.

Sonne, S. C., Back, S. E., Zuniga, D. C., Randall, C. L., & Brady, K. T. (2003). Gender differences individuals with comorbid alcohol dependence and post-traumatic stress disorder. *American Journal on Addictions, 12,* 412-423.

Stöffelmayr, B. E., Mavis, B. E. & Kasim, R. M. (1994). The longitudinal stability of the Addiction Severity Index. *Journal of Substance Abuse Treatment, 11*, 373–378.

Substance Abuse and Mental Health Services Administration. (2009). *Results from the 2008 National Survey on Drug Use and Health: National Findings.* Rockville, MD.

Sumnall, H., Tyler, E., Wagstaff, G., Cole, J. (2004). A behavioural economic analysis of alcohol, amphetamine, cocaine, and ecstasy purchases by polysubstance misusers. *Drug and Alcohol Dependence*, *76*, 93-99.

Tartarsky, A. (2007). *Harm Reduction*. New York: Jason Aronson.

Timko, C., Finney, J. W., & Moos, R. H. (2005). The 8-year course of alcohol abuse: Gender differences in social context and coping. *Alcoholism: Clinical and Experimental Research, 29*, 612–621.

Tuyns, A. J. & Pequignot, G. (1984). Greater risk of ascitic cirrhosis in females in relation to alcohol consumption. *International Journal of Epidemiology, 13,* 53-57.

Ustun, B., Compton, W., Mager, D., Babor, T., Baiyewu, O., Chatterji, S., … Sartorius, N. (1997). WHO study on the reliability and validity of the alcohol and drug use disorder instruments: Overview of methods and results. *Drug & Alcohol Dependence,* 47, 161-169.

van der Kolk, B. A. (2001). The psychobiology and psychopharmacology of PTSD. *Human Psychopharmacology: Clinical and Experimental. Special Issue: New understanding and management strategies in the field of depressive disorders, 16,* S49-S64.

van Olphen, J., & Freudenberg, N. (2004). Harlem service providers' perceptions of the impact of municipal policies on their clients with substance use problems. *Journal of Urban Health, 81*, 222-231.

Waldrop, A., Back, S. E., Verduin, M. L., & Brady, K. T. (2007). Triggers for cocaine and alcohol use in the presence and absence of posttraumatic stress disorder. *Addictive Behaviors, 32,* 634-639.

Walitzer, K.S. & Dearing, R.L. (2006). Gender differences in alcohol and substance use relapse. *Clinical Psychology Review, 26,* 128-148.

Wallen, J. (1992.) A comparison of male and female clients in substance abuse treatment. *Journal of Substance Abuse and Treatment, 9*, 243–248.

Weathers, F. W., Keane, T. M., & Davidson, J. R. (2001). Clinician-Administered PTSD Scale: A review of the first ten years of research. *Depression and Anxiety, 13,* 132–156.

Wechsberg, W. M., Craddock, S. G., & Hubbard, R. L. (1998). How are women who enter substance abuse treatment different than men? A gender comparison from the Drug Abuse Treatment Outcome Study (DATOS). *Drugs & Society, 13*, 97-115.

Weisner, C. (1993). Toward an alcohol treatment entry model: A comparison of problem drinkers in the general population and in treatment. *Alcoholism: Clinical and Experimental Research, 17,* 746-752.

Weisner, C., & Schmidt, L. (1992). Gender disparities in treatment for alcohol problems. *Journal of the American Medical Association, 268,* 1872-1876.

Weisner, M., Weichold, K., & Silbereisen, R. K. (2007). Trajectories of alcohol use among adolescent boys and girls: identification, validation, and sociodemographic characteristics. *Psychology of Addictive Behaviors, 21*, 62-75.

Weiss, R.D., Hufford, C., Najavits, L.M., & Shaw, S.R. (1995). *Weekly Substance Use Inventory*. Unpublished measure, Harvard Medical School.

Witkiewitz, K., & Marlatt, G. A. (2004). Modeling the complexity of post-treatment drinking: It's a rocky road to relapse. *Clinical Psychology Review, 27,* 724-738.

Witkiewitz, K., & Masyn, K. E. (2008). Drinking trajectories following an initial lapse. *Psychology of Addictive Behaviors, 22*, 157-167.

Witkiewitz, K., van der Maas, H. L. J., Hufford, M. R., Marlatt, G. A. (2007). Nonnormality and divergence in post-treatment alcohol use: Reexamining the Project MATCH data "another way". *Journal of Abnormal Psychology, 116,* 378-394.

World Health Organization, 1992. Alcohol Use Disorder and Associated Disabilities Interview Schedule-Alcohol/Drug-Revised. World Health Organization, Geneva, Switzerland.

World Health Organization, 1993. Schedules for Clinical Assessment in Neuropsychiatry. American Psychiatric Press, Washington, D.C.

Wu, J. & Witkiewitz, K. (2008). Network support for drinking: An application for multiple groups growth mixture modeling to examine client-treatment matching. *Journal of Studies on Alcohol and Drugs, 69,* 21-29.

Yehuda, R. (2001). Biology of posttraumatic stress disorder. *Journal of Clinical Psychiatry, 62*, 41-46.

Zanis, D. A., McLellan, A. T., Canaan R., & Randall, M. (1994). Reliability and validity of the ASI in a homeless sample. *Journal of Substance Abuse Treatment*, *11*, 541–548.

Zlotnick, C., Davidson, J.R.T., Shea, M.T., & Pearlstein, T. (1996). Validation of the Davidson Trauma Scale in a sample of survivors of childhood sexual abuse. *Journal of Nervous and Mental Disease, 184*, 255–257.