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Path Analysis of Psychological Factors Associated with Medication Adherence for Individuals with Chronic Diseases

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PATH ANALYSIS OF PSYCHOLOGICAL FACTORS ASSOCIATED WITH MEDICATION ADHERENCE FOR INDIVIDUALS WITH CHRONIC DISEASES

by

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DEDICATION

This dissertation is dedicated to my family and two constant sources of support- Leila Wilborn and Regina Sansbury.

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ABSTRACT

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The 100 million U.S. residents with hypertension or diabetes generally struggle with medication adherence (MA). On average, 65% refer to themselves as nonadherent in some way, complicating attempts to ascertain the benefits of medical care to reduce morbidity and mortality. It is important, therefore, to ask why patients are not taking effective medications. In answering this question, there is some evidence that individuals dismiss long-term benefits of better nutrition or lifestyle choices due to the asymptomatic or silent nature of chronic diseases (Takiya, Peterson, & Finley, 2004). Nonetheless, there has been limited progress in targeting barriers based on demographic and biomedical factors, because they have not been modifiable predictors of adherence. Clinicians have been looking more to internal phenomena for motivational impetus to meet treatment demands. This community-based observational study evaluated statistical associations of three psychological constructs, time perspective (TP), health beliefs, and health locus of control beliefs on MA for 79 participants using data accessed with permission from the Clinical Trial and Outcomes Branch of the National Institute of Arthritis and Musculoskeletal and Skin Diseases. Path analysis tested the direct effect of TP on MA and the indirect effect of TP through mediators.

Results showed that failure to complete drug regimens is a reality for over 50% of participants. The psychological pathways exhibited some influence in observed medication adherence, but required further manipulation to determine the model of direct and indirect effects between variables. Most notably, analyses did not detect any direct

effect from either future or present-hedonistic time perspective, where older age and greater internal locus of control directly predicted better drug use. Internal locus of control outperformed all other predictors- an increase by a single unit contributed to a 0.77 standard deviation change in the probability of individuals having higher MA. Among indirect effect tests, individuals' internal loci of control also mediated the effect of time perspective on adherence. Both present-hedonistic and future outlooks operated through the mediator to boost prescription drug use. The current study provides the first categorical data model of the strength and direction of simultaneous associations between the described psychological pathways and adherence.

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Introduction

Statement of the Problem

Medication adherence (MA) is the most essential component in managing chronic diseases (Conn et al., 2009; Kripalani, Yao, & Haynes, 2007). It can be more predictive of successful symptom management than unalterable medical factors like disease complexity (Mann, Ponieman, Levanthal, & Halm, 2009). Even still, only 26% of patients comply completely with drug regimens that treat their conditions (Conn et al., 2009). This statistic implies that a majority, or nearly 75% of all patients, contribute to a host of preventable consequences linked to nonadherence in the United States (U.S.) - including $100 billion in medical expenses, 33% of hospital or nursing home visits, and 124,000 deaths each year (Takiya, Peterson, & Finley, 2004).

The 100 million U.S. residents with hypertension or diabetes especially struggle with MA (Broadbent, Donkin, & Stroh, 2011); on average, 65% of those with either chronic disease admit to being nonadherent in some way (Kripalani et al., 2007; Schimittdiel et al., 2008). The high prevalence of nonadherence complicates efforts to ascertain the real benefits of medical care that decreases risk for stroke and other adverse cardiovascular events (Alhalaiqa, Deane, Nawafleh, Clark, & Gray, 2012; Hashmi et al., 2007). Consequently, it is essential for healthcare professionals to explore variables that positively impact chronic disease treatment and mitigate financial costs and preventable medical consequences.

One important task is to evaluate why people do not take medications that effectively manage chronic diseases. In answering this question, contemporary literature

says that people are less adherent to drug regimens to avoid immediate side effects like nausea (Osterberg & Blaschke, 2005; Sluijs et al., 2006); there is also some indication that individuals dismiss long-term benefits of better nutrition or lifestyle choices due to the initially asymptomatic or silent nature of chronic diseases (Takiya et al., 2004). Nonetheless, these revelations have done little to pinpoint why people perform medication-taking behaviors (Takiya et al., 2004). Psychological constructs can be more appropriate mechanisms for understanding what motivates differences in MA (Broadbent et al., 2011; Schimittdiel et al., 2008).

Existing Research on Psychological Factors and Medication Adherence

Time perspective. Healthcare professionals can learn more about a patient's motivation toward health behaviors based on his or her time perspective (TP; Guthrie, Butler, & Ward, 2009; Sansbury, Dasgupta, & Ward, 2012; Wills, Sandy, & Yaeger, 2001). The construct denotes a subconscious, cognitive process for making sense of experiences from the past, prioritizing actions in the present, and setting goals for the future (Zimbardo & Boyd, 1999). Literature indicates that adults with predominantly future outlooks have better exercise habits (Guthrie, Lessl, Ochi, & Ward, 2013; Löckenhoff & Carstensen, 2004), regular condom use, less substance abuse (Henson, Carey, Carey, & Maisto, 2006), better psychological well-being, effective behavioral coping, and higher sense of control (Wills et al., 2001). On the other hand, many individuals with increased present perspectives, particularly those whose decision-making process is motivated by immediate gratification or a strict belief in predetermined fate, report more substance abuse, risky sexual practices (Henson et al., 2006), gambling issues (Hodgins & Engel, 2002), less sense of control, more negative affect, and more use

of angry or maladaptive coping (Wills et al., 2001). Their viewpoints are called present-hedonistic or present-fatalistic time perspectives, respectively. In total, the implication future time perspectives motivates people to invest energies toward anticipated long-term consequences and likely health-promoting behaviors as well, whereas elevated present time perspectives challenges one's willingness to prioritize behaviors according to similar unobservable or delayed goals.

Few studies such as those completed by Sansbury et al. (2012) investigate the relationship between time perspective and MA in chronic disease research. Sansbury et al.'s outcomes substantiate that individuals with dominant future time perspectives typically describe themselves as more adherent to prescribed antihypertensive drugs, compared to others with less future time perspective (Table 1); however, the results do not demonstrate statistically significant contrasts.

Table 1

Mean ± SE for Medication Adherence for All Time Perspective Traits

Variable	Present-hedonistic	Present-fatalistic	Future
Antihypertensive medication			
Completely nonadherent	3.36 ± 0.33	3.00 ± 0.45	3.03 ± 0.27
Slightly adherent	2.40 ± 0.65	2.19 ± 0.61	2.97 ± 0.45
Adherent on average	3.37 ± 0.15	2.95 ± 0.24	3.42 ± 0.20
Mostly adherent	3.12 ± 0.08	2.60 ± 0.13	3.80 ± 0.07
Completely adherent	3.20 ± 0.06	2.60 ± 0.08	3.70 ± 0.05

Given the lack of evidence for a direct effect, it is possible that identified age and education effects contribute to an increase in reported drug use for people with more future outlook. Forthcoming studies must provide better information about how time perspective relates to clinically- and statistically-significant differences in adherence.

Health beliefs. A second psychological construct called health beliefs shows clearer affiliations with medication adherence. For decades, clinical researchers and proponents of the health belief model (Becker, 1974; Brown & Segal, 1996; Harvey & Lawson, 2009) have interpreted patients' motivation to complete prescribed treatment based on their perceived likelihood of experiencing complications related to chronic diseases (susceptibility) and interference with physical or mental functioning (severity). A recent meta-analysis of 27 studies reveals that people who believe diabetes is more threatening are more compliant with drug regimens; but those who do not describe the chronic disease as severe are 22% less likely to be adherent (DiMatteo, Haskard, & Williams, 2007). There are similar implications about perceived susceptibility and medication-taking behaviors (Broadbent et al., 2011; Harvey & Lawson, 2009). Primarily, individuals with elevated perception of disease susceptibility have higher MA, fewer symptoms, and less illness-related stress (Broadbent et al., 2011). Mann et al. (2009) infers that people who struggle with nonadherence often believe that diabetes has few consequences and symptoms. In summary, it is clear that decreased perception of disease severity and susceptibility can systematically inspire poor lifestyle choices and thereby contribute to marginal illness management over time.

Bridging the Gap with Health Locus of Control Beliefs

Considering existing discoveries on perception of disease severity and susceptibility, a question remains if there are other types of health beliefs motivating patients to take prescribed drugs. It is probable that a final construct called health locus of control (HLC) would enable clinical researchers to add new knowledge to what we know about MA. Wallston and Wallston (1981) broadly characterize HLC beliefs as the level of control an individual believes he or she has over personal health. The founders' manuscripts present a multidimensional construct encompassing three additional health beliefs: internal locus of control, powerful others, and chance. These domains represent the perception that treatment outcomes depend on personal actions, external authority figures like medical professionals, or luck (Wallston & Wallston, 1981).

HLC beliefs may further explain differences in medication-taking behaviors previously unattributed to time perspective or health beliefs. Existing chronic disease studies already provide a basis for this assertion (Atkins & Fallowfield, 2006; Barclay et al., 2007; Do, 2011). Among people with human immunodeficiency viruses (HIV), low internal locus of control and high chance beliefs predict poor adherence to anti-retroviral therapy (Barclay et al., 2007; Do, 2011). The two domains can explain 16 to 18% of variance when specifically comparing younger adults' adherence (Barclay et al., 2007); on its own, a one point increase in chance beliefs can produce a 6% decrease in adherence to anti-retroviral therapy (Do, 2011). According to a breast cancer study, women with more powerful others beliefs are less likely to adhere to hormone regimens, particularly if they think medical professionals or family members are more responsible for managing conditions (Atkins & Fallowfield, 2006). Both internal and external loci of

control appear integral to interpreting why patients take drugs. More research into affiliations between HLC beliefs and MA is needed to determine the validity of these inferences for people with hypertension or diabetes.

In summary, nonadherence is linked to avoidable healthcare costs and questions regarding the benefits of medications among individuals with hypertension or diabetes. Clinical researchers and healthcare professionals, more importantly, acknowledge that the patients are more at risk for morbidity and mortality when they do not comply with treatment. Psychological constructs seem to be vital to understanding individual motivators that develop over a lifetime and influence prescription drug use. Contemporary research suggests that future time perspective is better associated with health-promoting behaviors than present time perspectives, yet there is no statistically-significant evidence corroborating similar contrasts in adherence. More conclusive findings show that inconsistent health beliefs systemically inspire poor lifestyle choices and indirectly contribute to marginal chronic disease management. Finally, there is empirical support from prior investigations suggesting that health locus of control beliefs can better explain variance in MA unattributed to the discussed psychological constructs. To advance research on psychological constructs associated with health behaviors, it is essential to determine how HLC beliefs add context to the magnitude and direction of time perspectives' and health beliefs' relationships with adherence, particularly for people with hypertension or diabetes.

Significance of the Study

In hopes of supporting an alliance with the medical community, the current study illustrates how counselor educators provide unique insight into what motivates patient

behavior. Counseling professionals receive training in clinical techniques and research methodology to provide expertise pertaining to mental health in a variety of healthcare settings. Their competency areas can include human development, assessment, family and group dynamics, clinical supervision, consulting, and teaching (American Counseling Association, 2013).

Counseling practitioners and educators can subsequently apply findings about how psychological factors influence chronic disease management to train other healthcare professionals in effective interventions. Several studies support the use of behavioral interventions to treat medical illness (Duff & Latchford, 2010; Kahana, Drotar, & Frazier, 2008; Riekert, Borrelli, Bilderback, Rand, 2011; Rubak, Sandboek, Lauritzen, & Christensen, 2005). According to Duff and Latchford (2011), behavioral techniques focused on medication adherence can reduce symptoms for people with cystic fibrosis. Motivational interviewing strategies increase adherence to diet and exercise recommendations for those with cancer histories (Bennett, Lyons, Winters-Stone, Nail, & Scherer, 2007; Pinto, Frierson, Rabin, Trunzo, & Marcus, 2005) and asthma (Schmaling, Blume, & Afari, 2001). Counselor educators could train health professionals to administer the psychological interventions in a single visit or as few as 15 minutes (Rubak et al., 2005). They can also tailor the training to complement patients' needs with multifaceted approaches involving physician education about reflective listening, supportive family or group sessions (DiMatteo et al., 2012), behavioral assessment, reminders to refill prescriptions, and rewards that reinforce health behaviors (Haynes, McDonald, & Garg 2002). Finally, it is important to note that teams working with a person with a chronic disease may need some time to identify the optimal approach for

managing drug use on a long-term basis, so they must emphasize patient-centered care and collaborative problem-solving to transition successes from the next appointment to the years ahead (DiMatteo et al., 2012).

Purpose of the Study

The Clinical Trial and Outcomes Branch of the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS) granted access to archival data from its health behavior protocol. The purpose of the current observational study is to test the effects of time perspective, health beliefs, and health locus of control beliefs on medication adherence for individuals with hypertension or diabetes.

Research Questions

The study used meditational path analysis of direct and indirect effects to answer the following research questions.

Direct Effects

1a. *What direct influence does age have on medication adherence among people with hypertension or diabetes*? Contemporary literature indicates that individuals' medication use is significantly and positively associated with age (Barclay et al., 2007; Hashmi et al., 2007). Older patients' adherence rates can be twice as high as those for their younger peers. Individuals between 70- and 80-years-old can have a 92% success rate in taking antihypertensive medication (Hashmi et al., 2007).

Hypothesis 1a: I hypothesized that age would have a direct effect on medication adherence; and I predicted a positive association with the outcome, meaning that older people would report higher adherence than younger people.

1b. *What direct influence does time perspective have on adherence*? Literature signifies that adults with predominantly future outlooks have better exercise habits (Guthrie et al., 2013; Löckenhoff & Carstensen, 2004), regular condom use, less substance abuse (Henson et al., 2006), better psychological well-being, effective behavioral coping, and higher sense of control (Wills et al., 2001). On the other hand, many individuals with increased present perspectives, particularly those whose decision-making process are motivated by immediate gratification or a strict belief in predetermined fate, report more substance abuse, risky sexual practices (Henson et al., 2006), gambling issues (Hodgins & Engel, 2002), less sense of control, more negative affect, and more use of angry or maladaptive coping (Wills et al., 2001). Their viewpoints are called present-hedonistic or present-fatalistic time perspectives, respectively. Based on comparing these findings, the implication is that future perspectives are better affiliated with health-promoting behaviors than present traits, in contrast to associations for unfavorable outcomes linked to present time perspectives.

Hypothesis 1b: I hypothesized that future time perspective would have a direct effect and a positive association with medication adherence, meaning that individuals with more future outlook would report higher adherence than those with more present-hedonistic perspectives. Additionally, I predicted that present-hedonistic time perspective would not yield a direct effect on reported drug use.

Indirect Effects

2a. *How is time perspective indirectly associated with adherence through perception of disease severity*? In a meta-analysis involving several patient groups, DiMatteo et al. (2007) present that individuals who refer to their condition as more

serious demonstrate higher MA, even if clinicians identify them as having poorer health. Those who do not describe the illness as severe may be 22% less likely to be adherent. In essence, the findings show that the subjective rating of the severity of chronic disease is just as valuable as a clinician's rating of health status in predicting medication-taking behavior.

Hypothesis 2a: I hypothesized that perception of disease severity would mediate the effect of time perspective on medication adherence differently. I believed that participants' future and present-hedonistic outlooks could operate through this health belief to influence medication adherence indirectly.

2b. *How is time perspective indirectly associated with adherence through perception of susceptibility to future complications*? Individuals with elevated perception of disease susceptibility have higher MA, fewer symptoms, and less illness-related stress (Broadbent et al., 2011). Mann et al. (2009) infers that people who struggle with nonadherence often believe that diabetes has few consequences and symptoms.

Hypothesis 2b: I hypothesized that perception of susceptibility to future complications would mediate the effect of time perspective on medication adherence differently. I believed that participants' future and present-hedonistic outlooks could operate through this health belief to influence medication adherence indirectly.

3. *How is time perspective indirectly associated with adherence through internal locus of control*? Several diabetes investigations unanimously indicate that HbA1c metabolic control improves among people with more internal locus of control (Macrodimitris & Edner, 2001; O'Hea et al., 2005; Surgenor, Horn, Hudson, Lunt, & Tennent, 2000). Based on Morowatisharifabad and colleagues (2009), this single HLC

belief is the best predictor of successful adherence, even when individuals believe that fate or chance also influence health status at times.

Hypothesis 3: I hypothesized that internal locus of control would mediate the effect of time perspective on medication adherence; and I predicted a positive association between this HLC belief and MA, meaning that time perspective would operate through elevated internal locus of control to increase drug use.

4. *How is time perspective indirectly associated with adherence through external locus of control*? Studies into how health locus of control beliefs influence medication adherence offer that both externality and internality can motivate a person to complete treatment (Atkins & Fallowfield, 2006; Barclay et al., 2007).

Hypothesis 4: I hypothesized that external locus of control would mediate the effect of time perspective on medication adherence differently.

Procedure

The Clinical Trials and Outcomes Branch implemented health behavior protocols from July 2006 to August 2010 in three cities near Washington, D. C. - Silver Spring, Maryland; Hagerstown, Maryland; and Martinsburg, West Virginia. To recruit multicultural community samples, the staff surveyed patrons of beauty shops and barbershops in working-class and more affluent neighborhoods. They then met with community members to explain the study, determine eligibility, and obtain verbal informed consent. The staff had the following inclusion criteria: being 18-years-old or older, being literate in English, and being able to provide informed consent.

The current study pertained to data collected in Martinsburg, because the city cohort contained the most robust information on psychological constructs and health

behaviors. In this city cohort, 98 participants reported ever being diagnosed with high blood pressure or diabetes by a physician. The final group of 79 individuals consisted of those who took prescribed antihypertensive or antidiabetic drugs during the study.

Statistical Analyses

I considered eight variables in the total model: medication adherence as a criterion variable; present-hedonistic and future time perspectives as predictor variables; perceived disease severity, perceived susceptibility to future complications, external locus of control, and internal locus of control as mediators; and age as a covarying predictor variable.

I chose to do path analysis for several reasons. First, it enabled me to examine structural relationships between nonnumeric categories of psychological factors and beliefs (Yu, 2002); moreover, it simultaneously examined direct effects and indirect effects of continuous predictor variables and categorical mediators on categorical outcomes. I also selected path analysis because it enabled me to determine the relevance of psychological constructs on medication adherence by calculating total model fit, which compared the hypothesized total model with a restricted baseline model (Muthén, 1998-2004; Yu, 2002). To accomplish these goals, I ran several tests, including the chi-square statistic and root mean square error of approximation (RMSEA), with estimates below 0.08 and probability above 0.05 as criterion for assessing goodness-of-fit (Muthén & Muthén, 1998-2010). The equation for RMSEA was

$$v((\chi 2/(n*d)) - (1/n))*v(g),$$

where *d* represented degrees of freedom; *n* represented total sample size; χ^2 represented the chi-square statistic; and *g* represented the number of groups (Muthén, 1998-2004).

I also considered two incremental fit indices- comparative fit index (CFI) and Tucker-Lewis Index (TLI) - with 0.95 to 0.99 repeating as additional criteria. Contemporary writers have recognized these conventional cut-offs for preventing Type II error with sample sizes smaller than 100 (Hu & Betler, 1999; Muthén, 1998-2004; Yu, 2002). The equations were

$$TLI = (\chi^2B/df_B - \chi^2_{H0}/df_{H0}) / (\chi^2B/df_B - 1) \text{ and}$$
$$CFI = 1 - \max(\chi^2_{H0} - df_{H0}, 0) / \max(\chi^2_{H0} - df_{H0}, \chi^2B - df_B, 0),$$

where χ^2B represented the chi-square statistic for the baseline model; df_B represented degrees of freedom for the baseline model; χ^2_{H0} represented the chi-square statistic for the hypothesized model; and df_{H0} represented the degrees of freedom for total model (Muthén, 1998-2004).

Definitions

Counselor educator. The advanced counseling professionals receive doctoral-level training in clinical techniques and research methodology to provide expertise pertaining to mental health in a variety of healthcare settings. The competency areas can include human development, assessment, family and group dynamics, clinical supervision, consulting, and teaching.

Diabetes. The condition, clinically referred to as diabetes mellitus, encompasses a set of diseases characterized by elevated sugar levels in blood.

Health beliefs. Health beliefs are a set of values and expectations that motivate health-related behaviors. For instance, perceived severity depicts feelings about the seriousness of developing a chronic disease. This perception also includes evaluations of any consequences to changing health status, like injury or decreasing work responsibilities. Likewise, perceived susceptibility illustrates how vulnerable a person believes he or she is to secondary complications related to chronic diseases. Perception of disease severity and perception of susceptibility to future complications are two predictor variables.

Health locus of control beliefs. Health locus of control beliefs denote people's expectations that their health status is controlled by personal behavior or external influence. The multidimensional construct encompasses three health beliefs: internal locus of control, powerful others, and chance. These domains represent the perception that outcomes depend on personal actions, external authority figures like medical professionals, or luck. The current study divides the health locus of control construct into two mediator variables- internal locus of control and external locus of control.

Hypertension. Hypertension, also called high blood pressure, denotes an inability to maintain systolic blood pressure below 140 mmHg and diastolic blood pressure below 90 mmHg.

Medication adherence. Medication adherence is the extent to which patients' behaviors correspond with instructions by healthcare providers to take prescribed drugs in hopes of treating conditions. Medication adherence is the criterion variable.

Time perspective. Time perspective represents a person's subconscious way of making sense of experiences from the past, prioritizing actions in the present, and setting

goals for the future. To illustrate, individuals with more future time perspectives prioritize behaviors and invest their energies toward anticipated long-term consequences. People with dominant present time perspectives decipher needs and resources to make decisions based on immediate cues from their environments. In particular, their decision-making process can be motivated by being spontaneous and seeking pleasure (hedonistic domain) or a strict belief in predetermined fate (fatalistic domain). The time perspective construct is divided into three predictor variables: future, present-hedonistic, and present-fatalistic outlooks.

CHAPTER 2

Literature Review

Medication adherence (MA) is the extent to which people's behaviors correspond with instructions by healthcare providers to take prescribed drugs in hopes of treating conditions (Atkins & Fallowfield, 2006; Morowatisharifabad, Mazloomy, Baghianimoghadam, & Rouhani Tonekaboni, 2009). It encompasses a range of health behaviors, like taking necessary pill dosages at the appropriate time of day, as opposed to an outcome. To further explain, an individual's adherence to antihypertensive drugs contributes to blood pressure control; but one can still maintain elevated diastolic and systolic pressure levels when consistently taking medications (DiMatteo, Haskard-Zolnierek, & Martin, 2012), especially if he or she does not follow other components of a treatment regimen. Inherently, the construct also represents how nonadherent patients are to drugs (Alhalaiqa et al., 2012). Nonadherence occurs when a person intentionally neglects, unintentionally forgets, or simply fails to complete instructions for medications (i.e. eating food with them). The following literature review references adherence and nonadherence, instead of compliance and noncompliance, because the former terms emphasize a patient's decision-making and collaboration with health professionals (DiMatteo et al., 2012).

The Importance of Medication Adherence

Although the consequences of drug use vary by illness, people who say they have better MA are nearly three times more likely to experience health benefits than individuals with poor adherence. Peers who report nonadherence often stand the best chances of improving health status with more consistent medication use (DiMatteo, 2004;

DiMatteo et al., 2012), particularly if they have conditions that respond well to pharmaceutical therapies. Overall, intricacies related to taking medications for high blood pressure and diabetes represent the difficulties associated other chronic diseases well and thus make befitting representations.

The Disease Burden of Hypertension

Nearly 70 million or 22% of U.S. residents have hypertension (Centers for Disease Control, 2012). Broader estimates indicate that one billion people around the world have the chronic disease (Kearney et al., 2005). Hypertension, also called high blood pressure, denotes their inability to maintain systolic blood pressure below 140 mmHg and diastolic blood pressure below 90 mmHg. It has been identified as the third leading cause of early death or years lost to illness around the world (Kearney et al., 2005). While still alive, an individual is at risk for serious injury due to increased likelihood of having cardiovascular disease or a stroke (Alhalaiqa et al., 2012; Hashmi et al., 2007).

The Disease Burden of Diabetes

Close to 26 million or 8.3% of U.S. residents have diabetes (Centers for Disease Control, 2011). The diagnosis, clinically referred to as diabetes mellitus, pertains to a set of diseases characterized by elevated sugar levels in blood. There are three diagnostic criteria- having A1c hemoglobin levels above 6.5%, having blood sugar levels above 126 milligrams per deciliter before food, or having sugar levels above 200 milligrams per deciliter two hours after eating (Centers for Disease Control, 2011). The potential disease burden for people who meet one of these criteria may increase over time. At least 90% of all new cases occur because individuals' pancreases stop producing insulin after limited

physical activity and poor metabolism (Centers for Disease Control, 2011). Those who acquire diabetes are more acutely at risk for a host of potentially fatal secondary ailments- including kidney failure, blood vessel clotting, amputation of the legs or feet, blindness, cardiovascular disease, and stroke.

Understanding Medication Adherence for Both Diseases

In total, there are roughly 100 million or 30% of U.S. residents with hypertension, diabetes, or both chronic diseases. One Kaiser Permanent study reveals that 81% or nearly 131,000 of 161,697 of Northern California patients with diabetes also have high blood pressure (Schimittdiel et al., 2008). It is clear that these people and others like them have chronic diseases with unique diagnostic criteria; however, medication adherence researchers have recently investigated hypertension and diabetes simultaneously for a few reasons (Broadbent et al., 2011; Mann et al., 2009; Schimittdiel et al., 2008). First, the individuals with single or co-occurring diseases initially experience few symptoms, yet they must take drugs with delayed tangible health benefits. The advantages of adhering on a daily basis accrue over time, in other words. Additionally, contemporary literature indicates that managing the chronic diseases requires similar medication-taking behaviors, given that physicians prescribe an oral medication for the majority of people with hypertension or diabetes (Lau & Nau, 2004; Pladevall et al., 2004). Many individuals with diabetes even take antihypertensive medications to prevent fat depositing in arteries in a condition called atherosclerosis (Mann et al., 2009; Schimittdiel et al., 2008). Lastly, patients typically administer drugs themselves for diabetes and hypertension, barring for the most severe medical crises when hospital staff intravenously

deliver them, so researchers can generally attribute adherence or nonadherence to an individual's own decision-making process (Löckenhoff & Carstensen, 2004).

Adherence decreases disease burden by minimizing symptoms and mitigating risks associated with preventable secondary complications (Alhalaiqa et al., 2012; Conn et al., 2009; Hashmi et al., 2007). A person that decreases his or her systolic blood pressure to below 115 mmHg with antihypertensive medication takes the single most important step to decrease chances of having cardiovascular disease or stoke (Alhalaiqa et al., 2012). Reducing hypertension risk also improves cholesterol and hemoglobin levels for patients taking insulin for diabetes (Schimittdiel et al., 2008). In essence, there are additive benefits to successful adherence.

Equally and in a contrasting way, the disadvantages of poor MA add up for individuals with chronic diseases. Kripalani et al. (2007) offers that 66% of individuals with hypertension do not take prescribed antihypertensive medications as directed, which is akin to the 64% of people with diabetes who struggle with nonadherence (Cramer, 2003; DiMatteo, 2004; Walker et al., 2006). Individuals with lower MA are three times less likely to experience intended health benefits than peers with better adherence (Conn et al., 2009). Prolonged nonadherence can also worsen the disease severity so much so that previously minor diagnoses grow into fatal cases (Conn et al., 2009).

It is imperative, therefore, to ask why patients are not taking the medications that effectively manage high blood pressure or diabetes. Preliminary investigations into this question show that individuals adhere less because they want to avoid immediate side effects (Osterberg & Blaschke, 2005; Sluijs et al., 2006). There is also evidence that patients dismiss the long-term benefits of better nutrition or lifestyle choices due to the

initially asymptomatic or silent nature of chronic diseases (Takiya et al., 2004). Even without absolute confirmation, is clear that nonadherence is more common than adherence.

Existing Knowledge on Medication Adherence

Existing studies point out several predictors and risk factors related to medication-taking behaviors (Barclay et al., 2007; Conn et al., 2009; Hashmi et al., 2007; Kothawala, Badamgarav, Ryu, Miller, & Halbert, 2007; Mann et al., 2009; Nieuwherk & Oort, 2005; Schimittdiel et al., 2008; Takiya et al., 2004). To begin with the findings on predictors, MA is significantly and positively associated with age (Barclay et al., 2007; Hashmi et al., 2007). Older patients' adherence rates can be twice as high as those for younger peers. Individuals between 70- and 80-years-old can have a 92% success rate in taking antihypertensive medication (Hashmi et al., 2007). The amount of time since diagnosis can be a second predictor of lower MA (Kothawala et al., 2007; Takiya et al., 2004). In other words, any failure to take medications only increases without intervention. This assertion is consistent with an earlier finding that the percentage of individuals reporting nonadherence rises from 6 to 66% in the first three years after diagnosis (Levy, 1989).

The list of risk factors exemplifies how realities beyond a person's control can make him or her more susceptible to nonadherence. To illustrate, patients with chronic diseases can spend as much as $8,305.89 over five years for medication (Balkrishnan et al., 2003). Individuals receiving private insurance reimbursements or Medicare services typically report higher MA, whereas people with limited or no coverage say that out-of-pocket costs often prevent them from accessing prescribed drugs (Balkrishnan et al., 2003; Mojtabai & Olfson, 2003). For those who can receive treatment, taking more than

one medication significantly raises risk for nonadherence (Conn et al., 2009; Iskedjian et al., 2002), just as an individual is more likely to struggle with MA if he or she has to take any prescribed pills more than once a day (Takiya et al., 2004). Clinicians refer to these phenomena as dosing frequency effects.

Issues in Medication Adherence Research

Despite what researchers already know about risk factors and predictors for nonadherence, discrepancies in the existing research uncover several questions about how investigators collect data and interpret patient motivation. In particular, a large majority of information comes from White people in single-site pilot programs or research hospital studies (DiMatteo et al., 2007). Such convenient recruitment captures the opinions of patients who can be more inherently motivated and have better resources to improve their health status (Patel & Taylor, 2002). Consequently, community settings can provide better means to gather data from participants whose motivations are more representative of the general patient population.

Mann et al. (2009) offers the only study based in a community setting. The participant group largely consists of Black or Hispanic individuals who are low-income earners, unemployed, and have less than high school educations. Barring this exception, the next limitation is an inability to generalize medication adherence research to multiculturally diverse patient groups, thereby limiting credibility in applying new knowledge to underserved populations with chronic diseases. There are fewer studies evaluating individual motivators among patients who allegedly are at-risk for nonadherence and adverse health. There is potential that including more minorities and

working-class participants could expose intersecting indirect effects from psychological constructs, even if minority status does not directly influence treatment adherence.

Another limitation is a discrepancy in data collection tools. There are a number of methods for gathering information- including patient questionnaires and interviews, healthcare provider reports, manual pill counting, electronic pill bottles, and biological assays for drug levels (Atkins & Fallowfield, 2006; Ye, Krupka, & Davidson, 2012); and clinical researchers have issues identifying a single standardized approach for measuring MA. Each method presents challenges like underreporting, time constraints, or high costs. Still, a growing consensus is that there is little difference when comparing medication use between self-reports and more objective measures (Atkins & Fallowfield, 2006; Poweles, Eeles, & Ashley, et al., 1998).

The final limitation, and perhaps the most relevant one, is in converting discoveries on predictors and risk factors into knowledge about individual motivation. Discussed demographic and biomedical variables like age, number of prescribed pills, and dosing frequency are external factors that individuals can neither determine nor modify (Harvey & Lawson, 2009). Therefore, it is more logical to discuss them in terms of epidemiological trends in public health outcomes. It is not valid to refer to these factors as intrinsic motivators.

Psychological Constructs Motivate Medication Adherence

Clinical researchers are already looking at internal phenomena specifically to interpret why patients are more or less adherent to medication regimens (Broadbent et al., 2011; DiMatteo et al., 2007; Mann et al., 2009). Studies employ various psychological models to decipher how health behaviors develop over a lifetime. For instance, the theory

of reasoned action asserts that individuals behave according to information they have about specific health outcomes (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). This model also suggests that people's cognitive schema or expectations about a diagnosis develop in social environments, particularly interactions with family members or medical professionals. Secondly, the theory of planned behavior offers that individuals respond to treatment according to available resources for overcoming perceived barriers (Ajzen, 1985). It especially highlights the importance of locus of control and self-efficacy as motivators. Finally, the health belief model hypothesizes that a set of values and expectations of benefit motivate health-related behaviors (Becker, 1974; Rosenstock, 1974). Compared to the others, clinical researchers use this last conceptual model to interpret use of prescribed drugs (Broadbent et al., 2011; DiMatteo et al., 2007; Mann et al., 2009). The following literature review elaborates on the relationships between psychological constructs and MA. To do so, it will explore findings related to time perspective (TP), health beliefs, and health locus of control (HLC) beliefs.

Time Perspective

Defining Time Perspective

Time perspective (TP) represents a person's subconscious way of making sense of experiences from the past, prioritizing actions in the present, and setting goals for the future (Zimbardo & Boyd, 1999). It is a foundational cognitive structure that develops from repetitive or nonreoccurring life experiences, and it consequently motivates how an individual makes new decisions (Zimbardo & Boyd, 1999). There is a link between time perspective and behavior. In theory, a person who relies on what he or she learned in the past will behave based on insight gained from prior analogous situations in life. The

recall of potential benefits or costs may be nostalgic, traumatic, accurate, or reconstructed memories (Zimbardo & Boyd, 1999). Contrastingly, individuals with more future orientation act according to desired long-term rewards. Their anticipation serves as an intrinsic force driving assessments of how current actions will facilitate goals or alternate outcomes.

The Evolution of Time Perspective Research

The concept of TP has evolved since the late 1990s. Initial assumptions broadly characterized people as having either present or future orientations (Zimbardo & Boyd, 1999). The theorists believed that they consistently favored one outlook over another, so much so that decision-making and actions remained consistent from one situation to the next. Conversely, more recent scholars say that an individual can have more situational or blended perspectives that evolve over time, particularly when new situations or life periods require change (Guthrie et al., 2009; Löckenhoff & Carstensen, 2004). The newer descriptions refer to TP with multidimensional domains called past-positive, past-negative, present-fatalistic, present-hedonistic, and future (Hamilton, Kives, Micevski, & Grace, 2003). The last three perspectives have been especially instrumental in understanding health behaviors in recent years.

Time Perspective and Health Behaviors

Time perspective research makes it increasingly clear that the psychological construct can be a broader mechanism that inspires health behaviors. As an example, literature signifies that adults with predominantly future outlooks have better exercise habits (Guthrie et al., 2013; Löckenhoff & Carstensen, 2004), consistent condom use, less substance abuse (Henson et al., 2006), better psychological well-being, effective

behavioral coping, and higher sense of control (Wills et al., 2001). On the other hand, many individuals with increased present perspectives, particularly those whose decision-making process are motivated by immediate gratification or a strict belief in predetermined fate, report more substance abuse, risky sexual practices (Henson et al., 2006), gambling issues (Hodgins & Engel, 2002), less sense of control, more negative affect, and more use of angry or maladaptive coping (Wills et al., 2001). Their viewpoints are called present-hedonistic or present-fatalistic time perspectives, in order. Based on comparing these findings, the implication is that future outlook is better affiliated with health-promoting behaviors than present outlook, in contrast to associations with unfavorable outcomes linked to present time perspectives.

Only one health behavior study has tested the effect of TP on medication-taking behaviors for participants with hypertension (Sansbury et al., 2012). The results illustrate that individuals with predominantly future orientation follow antihypertensive drug regimens better than peers with present outlooks (Table 1), despite lacking statistically significant correlations between TP and adherence. It is likely that the increase in MA for participants with future perspectives depends on identified age and education effects. Scholars have not published replication studies to explore how TP directly affects individual differences in adherence.

Limitations and Related Research Questions

The relevant limitation in time perspective studies is that there has only been one investigation considering how the psychological construct motivates adherence. Nonetheless, the existing knowledge about TP and other health behaviors points to new questions for consideration. A major finding is that people with more present orientations

navigate health decisions based on concrete, observable realities (Guthrie et al., 2009; Löckenhoff & Carstensen, 2004). Therefore, forthcoming studies must evaluate if those with present-hedonistic outlooks have lower MA because they prioritize immediate gratification and avoiding discomfort. Any nonadherence may be attempts to minimize undesired, but expected, lifestyle changes or side effects. In addition, it is possible that individuals with elevated present-fatalistic orientations, denoted by strict belief in predetermined fate, have little faith in efforts to improve symptoms with better health behaviors. Published studies on time perspective indicate that the present perspectives are inversely correlated with future ones (Guthrie et al., 2009; Guthrie et al., 2013). If people with predominantly future orientations prioritize behaviors and invest their energies based on anticipated long-term consequences, it is more likely that their decision-making process promotes medication-taking behaviors. Investigators need to evaluate associations between TP and MA to verify the validity of these inferences.

Health Beliefs

Defining Health Beliefs

Health beliefs are a set of subjective values and expectations that motivate health-related behaviors like complying with treatment demands (Becker, 1974; Rosenstock, 1974). The psychological construct includes six distinct dimensions: (1) perceived severity or interference with physical and mental functioning, (2) perceived potential threat from a medical condition, (3) perceived barriers, (4) perceived benefits, (5) behavioral cues, and (6) modifying factors (Brown & Segal, 1996). Theorists and clinical researchers reference the first four perceptions the most (Brown & Segal, 1996; Janz & Becker, 1984), so they will only be discussed for the sake of brevity. The perceived

severity dimension depicts feelings about the seriousness of developing a chronic condition. This perception also involves evaluations of any consequences for changes in health status, such as injury or decreasing work responsibilities. Next, the perceived susceptibility domain depicts how vulnerable a person believes he or she is to secondary complications or new illnesses. Perceived benefits describe the degree to which an individual believes specific treatments will be successful for curing or managing a condition. Finally, the perceived barriers domain represents the awareness of any challenges that impede individuals from taking necessary actions to improve their health (Brown & Segal, 1996).

The Evolution of the Health Belief Model

In the mid-20th century, a group of social psychologists introduced the idea of health beliefs to explain why patients did not participate in preventative care or screening tests at the U.S. Public Health Service (Becker, 1974; Janz & Becker, 1984; Rosenstock, 1974). The multidimensional model gained popularity from 1966 to 1987 when clinical researchers published as many as 16 studies relating patient behavior to health beliefs (Harrison, 1992). Since the turn of the 21st century, proponents of the model (Broadbent et al., 2011; Harvey & Lawson, 2009; Mann et al., 2009) concentrate on medication-taking behaviors in particular; they have published over 100 publications on MA (DiMatteeo et al., 2007).

Today, there is a broad understanding that "the decision to comply with medical regimens ultimately lies with the patient within the context of [her or his] beliefs and values" (Brown & Segal, 1996, p. 903). Individuals that have chronic diseases, like hypertension and diabetes, can make a series of trade-offs after receiving new medical

information (Harvey & Lawson, 2009; Löckenhoff & Carstensen, 2004). These trade-offs, especially weighing short-term discomforts against health over time, can determine how well they manage symptoms and even complications brought on by treatment (Löckenhoff & Carstensen, 2004). It is understood that people take inventory of external resources like finances to do so (Barclay et al., 2007); furthermore, the following contemporary health belief findings largely support the premise that internal phenomena can also influence decision-making.

General Findings on Health Beliefs and Medication Adherence

Several contemporary studies have applied the health belief model to understand medication adherence among individuals with chronic diseases (Barclay et al., 2007; Barnes et al., 2004; DiMatteo et al., 2007; Mann et al., 2009). In a meta-analysis involving several patient groups, DiMatteo et al. (2007) say that individuals who refer to their condition as more serious demonstrate higher MA, even if clinicians identify them as having poorer health. Those who do not describe the illness as severe may be 22% less likely to be adherent. In essence, the findings show that the subjective rating of the severity of chronic disease is just as valuable as a clinician's rating of health status in predicting medication-taking behavior.

In addition to the meta-analysis, there are a host of publications employing the health belief model as a framework for interpreting MA to diabetes drugs (Aikens & Piette, 2009; Barnes, Moss-Morris, & Kaufusi, 2004; Harvey & Lawson, 2009; Mann et al., 2009; Weiland, Nguyen, & Jelinek, 2012). Fewer studies concentrate on hypertension alone (Hashmi et al., 2007; Sansbury et al., 2012); and the smallest number of

investigations focus on co-occurring hypertension and diabetes cases (Mann et al., 2009; Schimittdiel et al., 2008).

Discoveries from diabetes-only studies emphasize the significance of health beliefs when comparing participants' medication-taking behaviors. Mann et al. (2009) proposes that people who are less adherent may believe their illnesses come and go with symptoms. The results reveal that those who only take prescribed drugs when blood sugar is high, undoubtedly lowering the effectiveness of the treatment regimen to prevent crises over time, are over 35% more likely to report nonadherence. Based on a similar study of African-American adults with limited health literacy, Aikens and Piette (2009) suggest that unrealistic concerns about medication discourage MA. The researchers elaborate that many nonadherent people have unsubstantiated fears about experiencing adverse side effects or addiction to drugs. There are similar implications about perceived susceptibility and prescription drugs (Broadbent et al., 2011; Harvey & Lawson, 2009). Most notably, individuals with elevated perception of disease susceptibility have higher MA, fewer symptoms, and less illness-related stress (Broadbent et al., 2011). Mann et al. (2009) infers that people who struggle with nonadherence generally believe that diabetes has few consequences and symptoms.

The two hypertension studies have mixed results on health beliefs (Hashmi et al., 2007; Sansbury et al., 2012). Like some people with diabetes, evidence supports that nonadherent groups believe the high blood pressure comes and goes with symptoms (Hashmi et al., 2007). The implication is that patients who think each antihypertensive pill contributes to overall health have better adherence, and they experience lower diastolic and systolic blood pressures. The investigation by Sansbury and colleagues

(2012) does not go as far in recognizing individual differences in MA according to health beliefs; the findings verify that nonadherence is associated with conflicting health beliefs, particularly if individuals with hypertension understand the current seriousness of the illness but fail to interpret susceptibility to future consequences. Nonetheless, the analysis fails to identify any statistically-significant effects from perception of hypertension severity or perception of susceptibility on reported drug use (Figure 1).

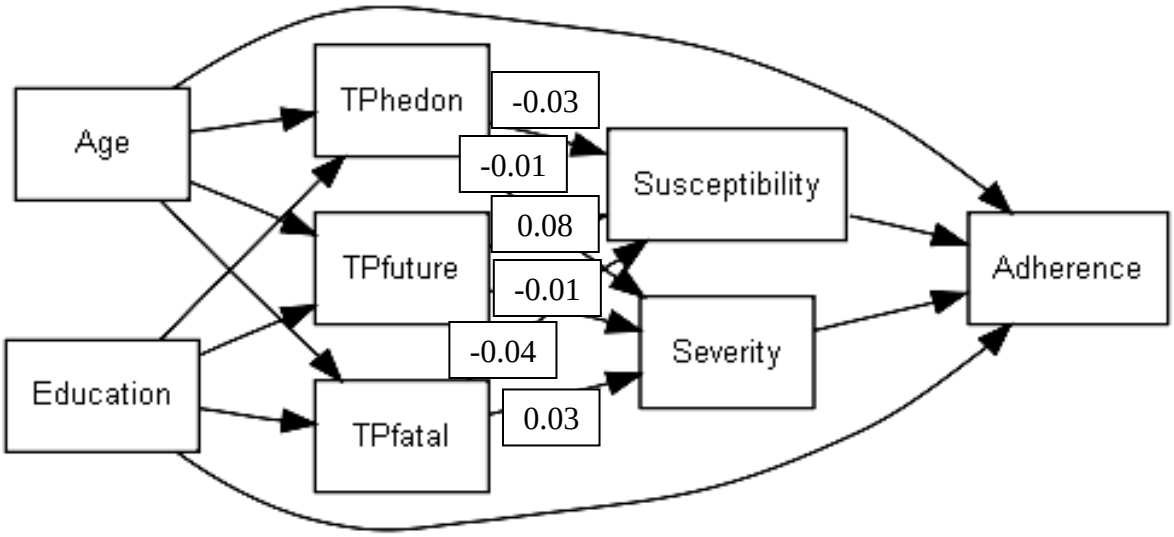

Figure 1. Mediator path diagram of total model for medication adherence. * p <.05. **p <.001.

The investigations for individuals with the two chronic diseases may provide the most descriptive illustrations of what deters medication-taking behaviors. In particular, Mann et al. (2009) cites one research participant who says, "you only have diabetes when your blood sugar is high, [and] the consequences of diabetes are minimal" (p. 280). The results corroborate that people with lower MA frequently have concerns that medical

treatment will interfere with their social lives or lead to addiction to prescribed pills. According to a related investigation, Schittdiel et al. (2008) suggests that improving health beliefs and intensifying treatment with a psychoeducation seminar on medications can significantly lower an individual's risk for cardiovascular events. The outcomes also imply that those who do not receive these solution-focused interventions will maintain nonadherence over time. In all, there is substantial support from observational and intervention studies that improving health beliefs can enhance medication-taking behaviors.

Health Locus of Control Beliefs

Defining Health Locus of Control Beliefs

A final psychological construct, health locus of control (HLC), denotes people's expectations that personal behavior or outside forces influence control health status. Proponents broadly separate HLC beliefs into two components- internal locus of control and external locus of control (Wallston & Wallston, 1981; Wallston et al., 1978). According to theory, a person with elevated internal locus of control attributes changes in a medical condition to his or her own actions. The people with more external loci defer to the authority of others for influencing health outcomes.

The Evolution of the Multidimensional Health Locus of Control Model

The idea of HLC beliefs dates back to a larger discussion about locus of control from the mid-20th century. Rotter (1966) anchors the older concept in social learning theory, defining HLC beliefs by stating:

> When a reinforcement is perceived by the subject as following some action of his own but not being entirely contingent upon his action, then, in our culture, it is typically perceived as the result of luck, chance, fate, as under the control of powerful others, or as unpredictable because of the great complexity of the forces

> surrounding him. When the event is interpreted in this way by an individual, we have labeled this a belief in external control. If the person perceives that the event is contingent upon his own behavior or his own relatively permanent characteristics, we have termed this a belief in internal control. (p. 1)

According to Rotter's description, people behave or respond based on an anticipated outcome. The self-reinforcing relationship between past experiences and existing expectations serves as an intrinsic stimulus to motivate them to perform new actions.

The biomedical community readily embraced the locus of control construct and published more than 600 publications in the first 10 years after its early descriptions (Rotter, 1975). Today, clinical researchers know that locus of control affects satisfaction among patients with tuberculosis (Seeman & Evans, 1962), health literacy related to diabetes (DuCette, 1974; Lowery & Ducette, 1976), and success with weight loss plans (Salzer, 1978). Contemporary researchers apply terms like health-externals and health-internals to describe patients receiving diabetes care (Wallston, Wallston, Kaplan, & Maides, 1976; Wallston & Wallston, 1981). The people called health-externals score above average on HLC surveys, indicating the belief that they have little control over symptoms; instead, they surmise that chance, luck, fate, and powerful others are more influential in determining if they are sick or healthy. On the other hand, health-internals receive HLC scores that are below the mean and report that personal behavior determines symptoms and chronic disease status.

Today, many clinical researchers follow the Rotter model in separating HLC beliefs into internality and externality (Kuwahara et al., 2004; Ruffin, Ironson, Fletcher, Balbin, Schneiderman, 2011; Wang et al., 2002). Others further divide the psychological construct into internal locus of control, chance externality, and powerful others

externality domains (Egan et al., 2009; Evans, Ferrando, Rabkin, & Fishman, 2000; Morowatisharifabad et al., 2009). Both models contribute relevant knowledge about general health behaviors and MA.

Existing Knowledge on Health Locus of Control

Social determinants. Observational studies highlight several social determinants as predictors of HLC beliefs. For instance, investigators associate higher internal locus of control with being younger (Egan et al., 2009) and having more formal education (Morowatisharifabad et al., 2009); whereas, they connect increased external locus of control, or a higher combination of chance and powerful others externality, to women and people with less education (Kuwahara et al., 2004). People with more chance beliefs typically have less education (Egan et al., 2009; Morowatisharifabad et al., 2009). Older adults generally endorse elevated powerful others externality (Egan et al., 2009).

The findings on external locus of control and age are not as conclusive. In an investigation with Iranian patients (Morowatisharifabad et al., 2009), there is support that younger people tend to defer to the authority of others for accomplishing health goals. A second study points to a similar age contrast in externality among generally healthy individuals in Japan (Kuwahara et al., 2004). However, a study of Hispanic American women receiving obstetric and gynecological care does not corroborate that younger patients defer to others to improve health status (Roncancio, Ward, & Berenson, 2011), likely because the group included fewer middle-aged or older adults.

General health behaviors. Studies comparing the role of HLC beliefs on general health behaviors offer varied results. In regard to adverse outcomes, clinical researchers write that externality is positively associated with higher body fat levels (Egan et al.,

2009), cigarette smoking, excessive alcohol consumption (Kuwahara et al., 2004), depression, life stress (Evans et al., 2000), and helplessness (Rabkin, Williams, Neugebauer, Remien, & Goetz, 1990). They also correlate increased internality with health benefits- namely less helplessness (Rabkin et al., 1990) and increased likelihood of surviving a lung transplant (Burker, Evon, Galanko, & Egan, 2005). It appears that the comparative advantages of internal locus of control supersede those of external locus of control by these findings.

However, there is also compelling information that externality contributes to positive outcomes. Results show that people with greater chance beliefs can experience less depression, anxiety, and hostility about HIV status (Jenkins & Patterson, 1998); an individual who ascribes to an external locus of control may have fewer depression symptoms (Wang et al., 2002); and a person with more confidence in healthcare providers can improve his or her likelihood of living longer with AIDS. These discoveries on the benefits of externality, alongside internality, support assertions by a few theorists. How does external locus influence health-promoting behaviors? Based on one theory (Seeman & Evans, 1962), patients profit from relying on doctors when they acquire meaningful feedback and information on the advantages of adhering to treatment, and others benefit when they depend on trustworthy family members and peers for care. Overall, having social support enables them to share responsibility in working toward better nutrition or lifestyle changes (Schlenk, 1984).

Medication adherence. Investigations into how HLC beliefs impact adherence also point to the advantages of both externality and internality. To start, there is some evidence that the benefits function differently based on gender. Higher MA is associated

with internal locus of control for males with kidney failure, where it is associated with lower internal of control for females (Takaki & Yano, 2006). A second observation, and likely the more important one, is that externality and internality domains can operate independently to improve adherence. For example, literature indicates that decreased powerful others and internal locus of control beliefs among women inspire better adherence to hormone regimens for breast cancer care (Atkins & Fallowfield, 2006). There is also evidence that elevated chance beliefs and decreased internal locus of control beliefs function simultaneously to encourage compliance to antiretroviral therapy for younger adult males with HIV (Barclay et al., 2007).

In regard to the specific chronic diseases considered by the proposed study, contemporary research focuses more on patients with diabetes than hypertension to compare HLC beliefs and MA. Diabetes investigations largely analyze sugar levels in hemoglobin as a biological measure of adherence (Macrodimitris & Edner, 2001; O'Hea et al., 2005; Surgenor et al., 2000). The findings unanimously indicate that HbA1c metabolic control improves among people with more internal locus of control. According to Morowatisharifabad et al. (2009), this single HLC belief is the best predictor of successful adherence, even when individuals believe that fate or chance also influence health status. Internal locus of control and chance beliefs together can explain over 9% of variance in biological measures of MA (Morowatisharifabad et al., 2009). It is unclear whether or not this support for internality would be replicated with self-reported drug use.

There is little research exploring if and how externality contributes to self-reported MA, yet the available information appears generally indicative of a potential advantage for people with hypertension. Results demonstrate that a person who attributes

his or her health status to nonmodifiable factors like a higher power or bad luck can comply better with antihypertensive drug regimens (Patel & Taylor, 2002); and some people with predominant externality beliefs show better adherence and less co-occuring depression over a year (Wang et al., 2002). It is possible that others neglect to take antihypertensives due to favoring alternative treatments against a doctor's orders (i.e. simply losing weight, stopping smoking, or minimizing salt intake). In total, another implication is that external locus of control serves as a protective factor against psychological distress by allowing patients to look outside themselves for optimism about chronic diseases (Wang et al., 2002). Therefore, any resulting reduction in helplessness or hopelessness could indirectly boost morale and encourage health-promoting behaviors like MA.

Limitations and Future Directions

The limitations in existing studies introduce several questions about HLC beliefs and adherence. Even with recent assertions that "different diabetic patients have different attributional styles" (Morowatisharifabad et al., 2009, p. 42), there are not enough investigations comparing internality and externality as predictors for prescription drug use. Contemporary research discusses the role of HLC beliefs in treatment for other chronic diseases (Atkins & Fallowfield, 2006; Barclay et al., 2007), but studies have not yet considered if externality and internality operate independently as motivators for individuals with diabetes or hypertension. Moreover, it is important to consider if there is an indirect effect from broader psychological constructs like time perspective through HLC beliefs to adherence. Future studies can incorporate stepwise logistic regression and path analyses to answer these new questions.

As noted earlier in the chapter, a second glaring limitation relates to inconsistencies in data collection methods. Many chronic disease studies on HLC beliefs employ biological tests to measure drug levels (Macrodimitris & Edner, 2001; O'Hea et al., 2005; Surgenor et al., 2000), but there have also been a few investigations using self-reports (Patel & Taylor, 2002; Wang et al., 2002). Both methods can be effective means for collecting data (Atkins & Fallowfield, 2006; Poweles et al., 1998). Some clinical researchers believe that pill counts and drug levels provide better quantifiable, reliable precision for making empirically-based contrasts (Atkins & Fallowfield, 2006; Ye et al., 2012). On the other hand, others assert that objective methods are less than ideal to complement research designs centered on psychological constructs. Self-report questionnaires appear uniquely suited to capture small clinically-relevant contrasts in patient perception for MA research (Patel & Taylor, 2002; Wang et al., 2002). They typically make research designs less vulnerable to nonresponse by participants, and they are simpler and less expensive to complete (Wang et al., 2002). Most importantly, self-reports can provide better anonymity so that individuals may honestly describe adherence or nonadherence behaviors (Guthrie et al., 2009; Guthrie et al., 2013), in comparison to objective measures that they fear could be reviewed by clinicians or other medical staff.

Conclusions

The 100 million U.S. residents with hypertension or diabetes often struggle with medication adherence (MA). On average, 65% refer to themselves as nonadherent in some way, complicating attempts to ascertain the real benefits of medical care to reduce morbidity and mortality associated with higher risk for stroke and other adverse cardiovascular events. It is important, therefore, to ask why patients are not taking the

medications that can effectively manage high blood pressure or diabetes. In answering this question, there is some evidence that individuals refuse to take medication to avoid immediate side effects. Others may broadly dismiss the long-term benefits of better nutrition or lifestyle choices due to the asymptomatic or silent nature of chronic diseases. Unfortunately, there has been little progress in targeting these barriers based on demographic and biomedical factors, because they have not been modifiable or even consistent predictors of medication-taking behaviors.

Clinicians and health service professionals look more to internal phenomenon as motivators to meet treatment demands. In general, contemporary literature shows that future time perspectives are better affiliated with health-promoting behaviors than present ones, yet there is no statistically significant evidence corroborating similar contrasts in adherence based on time perspective. More conclusive findings show that inconsistent health beliefs systemically inspire poor lifestyle choices and indirectly contribute to marginal chronic disease management. The studies into how HLC beliefs influences MA offer that both externality and internality can motivate patients to complete treatment, but there remains a need to clarify the comparative benefits using a self-report measure. The current study implemented a mediational path analysis to determine the degree to which HLC beliefs add to the identified relationships between psychological constructs and medication adherence, particularly for people with hypertension or diabetes.

CHAPTER 3

Methodology

The study investigated the effects of time perspective (TP), health beliefs, and health locus of control (HLC) beliefs on medication adherence (MA) for participants with hypertension or diabetes.

Research Questions

The study used meditational path analysis of direct and indirect effects to answer the following research questions.

Direct Effects

1a. *What direct influence does age have on medication adherence among people with hypertension or diabetes?* Contemporary literature suggests that individuals' drug use is significantly and positively associated with age (Barclay et al., 2007; Hashmi et al., 2007). Older patients' adherence rates can be twice as high as those for younger peers. Individuals between 70- and 80-years-old can have a 92% success rate in taking antihypertensive medication (Hashmi et al., 2007).

Hypothesis 1a: I hypothesized that age would have a direct effect on medication adherence; and I predicted a positive association with the outcome, meaning that older people would report higher adherence than younger people.

1b. What direct influence does time perspective have on adherence? Literature signifies that adults with predominantly future outlooks have better exercise habits (Guthrie et al., 2013; Löckenhoff & Carstensen, 2004), consistent condom use, less substance abuse (Henson et al., 2006), better psychological well-being, effective behavioral coping, and higher sense of control (Wills et al., 2001). On the other hand,

many individuals with increased present perspectives, particularly those whose decision-making process is motivated by immediate gratification or a strict belief in predetermined fate, report more substance abuse, risky sexual practices (Henson et al., 2006), gambling issues (Hodgins & Engel, 2002), less sense of control, more negative affect, and more use of angry or maladaptive coping (Wills et al., 2001). Their viewpoints are called present-hedonistic or present-fatalistic time perspectives, respectively. Based on comparing these findings, the implication is that future perspectives are better affiliated with health-promoting behaviors than present traits, in contrast to associations for unfavorable outcomes linked to present time perspectives.

Hypothesis 1b: I hypothesized that future time perspective would have a direct effect and a positive association with medication adherence, meaning that individuals with more future outlook would report higher adherence than those with more present-hedonistic perspectives. Additionally, I predicted that present-hedonistic time perspective would not yield a direct effect on reported drug use.

Indirect Effects

2a. How is time perspective indirectly associated with adherence through perception of disease severity? In a meta-analysis involving several patient groups, DiMatteo et al. (2007) present that individuals who refer to their condition as more serious demonstrate higher MA, even if clinicians identify them as having poorer health. Those who do not describe the illness as severe may be 22% less likely to be adherent. In essence, the findings show that the subjective rating of the severity of chronic disease is just as valuable as a clinician's rating of health status in predicting medication-taking behavior.

Hypothesis 2a: I hypothesized that perception of disease severity would mediate the effect of time perspective on medication adherence differently. I believed that participants' future and present-hedonistic outlooks could operate through this health belief to influence medication adherence indirectly.

2b. How is time perspective indirectly associated with adherence through perception of susceptibility to future complications? Individuals with elevated perception of disease susceptibility have higher MA, fewer symptoms, and less illness-related stress (Broadbent et al., 2011). Mann et al. (2009) infers that people who struggle with nonadherence often believe that diabetes has few consequences and symptoms.

Hypothesis 2b: I hypothesized that perception of susceptibility to future complications would mediate the effect of time perspective on medication adherence differently. I believed that participants' future and present-hedonistic outlooks could operate through this health belief to influence medication adherence indirectly.

3. How is time perspective indirectly associated with adherence through internal locus of control? Several diabetes investigations unanimously indicate that HbA1c metabolic control improves among people with more internal locus of control (Macrodimitris & Edner, 2001; O'Hea et al., 2005; Surgenor et al., 2000). According to Morowatisharifabad et al. (2009), this single HLC belief is the best predictor of successful adherence, even when individuals believe that fate or chance also influences health status.

Hypothesis 3: I hypothesized that internal locus of control would mediate the effect of time perspective on medication adherence; and I predicted a positive association

between this HLC belief and MA, meaning that time perspective would operate through elevated internal locus of control to increase drug use.

4. How is time perspective indirectly associated with adherence through external locus of control? Studies into how health locus of control beliefs influence medication adherence offer that both externality and internality can motivate a person to complete treatment (Atkins & Fallowfield, 2006; Barclay et al., 2007).

Hypothesis 4: I hypothesized that external locus of control would mediate the effect of time perspective on medication adherence differently.

Ethical Compliance

Recruitment

I did not recruit new participants for health behavior protocols.

Selection

I did not select new participants for the study.

Compensation or Incentives

Clinical Trial and Outcomes Branch provided four to five stamps as a minor incentive when individuals agreed to participate in the health behavior protocol. The current study did not involve any incentive or compensation, because it no longer required data collection from research participants.

Potential Risks

There were no foreseeable physical, psychological, social, legal or other risks associated with using the archival data for statistical reporting. A research nurse ensured that all hard-copy materials for the study remained in cabinets in a locked office at the National Institutes of Health. Additionally, the NIAMS Clinical Trial and Outcomes

Branch maintained electronic versions of the research data on a password-encrypted database to prevent the harmful use of individuals' information.

Potential Benefits

The principal benefit was a contribution to health behavior theory related to individuals with chronic diseases. The study illustrated that counselor educators could provide unique insight into what motivated patients to be more or less adherent to medical treatment regimens.

Confidentiality

The Clinical Trial and Outcomes Branch safely kept all archival data from health behavior protocols on an electronic database that was only available to the principal investigator and research staff. As a research fellow, I maintained professional and ethical standards of confidentiality in order to preserve the privacy of each participant within the limits allowed by law.

Measures

Each participant completed a 6-page questionnaire comprised of the Morisky Medication Adherence Scale (MMAS; Morisky et al., 1986), three subscales of the Zimbardo Time Perspective Inventory (ZTPI; Zimbardo & Boyd, 1999), two health belief items, the Multidimensional Health Locus of Control Scale (MHLC; Wallston, Wallston, & DeVellis, 1978), and demographic items (Appendix).

Medication Adherence

The MMAS has four items assessing the degree of medication adherence. The questions ask, “Do you ever forget to take your medicine? Are you careless at times about taking your medicine? When you feel better do you sometimes stop taking your

medicine? Sometimes if you feel worse when you take the medicine, do you stop taking it?" People circle a 1 or 0 for yes or no responses, providing a total score up to 4. Then, responses are reverse coded to produce five categorical levels (0 = *completely nonadherent*, 1 = *slightly adherent*, 2 = *adherent on average*, 3 = *mostly adherent*, 4 = *completely adherent*). The MMAS has marginal internal consistency with a Cronbach's alpha rating of .61 (Morisky et al., 1986). However, the self-report survey is mainstay in clinical research noting its predictive validity and clinical importance, because of its sensitivity to discriminate hypertension control (Morisky et al., 1986) from hypertensive crises (Ross, Walker, & MacLeod, 2004; Shea, Misra, Erhlrich, Field, & Francis, 1992).

Time Perspective

The three ZPTI subscales include 37 items that assess an individual's orientation to present-hedonistic, present-fatalistic, and future time perspectives. The present-hedonistic subscale has 15 items that assess being spontaneous, taking risks, and seeking pleasure (i.e. "Taking risks keeps my life from becoming boring"). The present-fatalistic subscale has 9 items evaluating the sense that one does not control his or her fate (i.e. "Often luck pays off better than hard work"). Finally, the future subscale has 13 items that assess the importance of planning and considering consequences in a participant's life (i.e. "I keep working at difficult uninteresting tasks if they will help me get ahead"). People endorse 5-point Likert-type responses ranging from *very untrue* to *very true*. Answers are averaged and reverse coded when necessary so that higher scores up to 5 indicate more of the construct. Cronbach's alpha ratings show acceptable internal consistency reliability (present-hedonistic = .79, present-fatalistic = .74, future = .77; Zimbardo & Boyd, 1999). Additionally, the ZTPI demonstrates construct validity by its

relationships with risk-taking behaviors and other psychological factors (Apostolidis, Fieulaine, & Soulė, 2006 Zimbardo & Boyd, 1999; Zimbardo, Keough, & Boyd, 1997). As previously done in contemporary investigations (Guthrie et al, 2009; Guthrie et al., 2013; Löckenhoff & Carstensen, 2004; Sansbury et al., 2012), the Clinical Trials and Outcomes Branch narrowed the ZPTI to three subscales to minimize response burden.

Health Beliefs

The Clinical Trial and Outcomes Branch used items on disease severity and susceptibility from prior hypertension research exploring expectations that motivate health-related behaviors (Brown & Segal, 1996). The disease severity item asks, "Which of the following statements best describes your view of high blood pressure?" People answer using four categorical levels (1 = *a serious problem*, 2 = *a minor concern*, 3 = *a somewhat important problem*, 4 = *the least of my worries*). The susceptibility item is "High blood pressure can increase a person's risk of having stroke, heart trouble, or kidney failure in the future. Which of the following statements best describes how you think about your high blood pressure?" Individuals responded by endorsing one or four items (1 = *hardly ever think about health and hypertension*, 2 = *sometimes think about health and hypertension but do not worry*, 3 = *often think about how hypertension affected health and sometimes worry*, 4 = *worry a lot about how high blood pressure might affect future health*). We reworded the item stems to evaluate perception of severity and susceptibility related to diabetes in identical ways. Both sets of responses, including the reverse coded items, served as categorical variables.

Health Locus of Control

The MHLC consists of 18 items that rate people's expectations that personal behavior or external influences control their health status. It captures how well individuals identify with the internal locus of control, chance, and powerful others subscales. The internal locus of items evaluate how much a person attribute changes in a medical condition to his or her own actions (i.e. "If I get sick, it is my own behavior which determines how soon I get well again). The chance items represent the perception that medical outcomes are determined chance or fate (i.e. "No matter what I do, if I am going to get sick, I will get sick). Lastly, the powerful others subscale assesses how much individuals believe external authority figures are more influential in determining if they are sick or healthy (i.e. "Health professionals control my health"). Individuals endorse Likert-type responses ranging from 1 to 6 for *strongly disagree* to *strongly agree*. Answers are averaged so that higher ratings up to 6 illustrate more of the construct.

Procedure

Participants completed the 6-page questionnaire and provided information on demographic characteristics like age, ethnicity, marital status, years of formal education, gender, and employment. The Clinical Trials and Outcomes Branch entered data from Fall 2006 to Summer 2010. Research assistants stored the files in password-protected databases that could only be viewed by them and the director of the Clinical Trials and Outcomes Branch. In June 2012, I proposed the current study under the supervision of the same director.

Statistical Analyses

Preliminary Analyses

My preliminary analyses tested reliability estimates, common factors, sample size and power estimates, statistical assumptions, trends in demographic information, and the percentage of missing data.

Reliability estimation. I used Statistical Analysis System Version 9.3 programs to estimate reliability for continuous scales (SAS Institute, Inc., Cary, NC). I verified internal consistency among Multidimensional Health Locus of Control Scale (MHLC) items for internal locus of control ($\alpha = 0.67$), powerful others beliefs ($\alpha = 0.67$), and chance beliefs ($\alpha = 0.63$; Wallston et al., 1978). I eliminated the third internal locus of control item, which poorly correlated with remaining ones, to raise the subscale's alpha rating from 0.67 to 0.71. Then, I generated an external locus of control variable by averaging powerful others and chance items, thereby producing a new scale with higher internal consistency ($\alpha = 0.76$). Health behavior researchers have applied a similar method for measuring externality beliefs with the MHLC in the past (Egan, 2009; Wallston & Wallston, 1981).

Common factors. I explored conceptual and statistical relationships between external locus of control and time perspectives, given specific concerns about dependence with the present-fatalistic scale. Several of the present-fatalistic items- namely "It does not make sense to worry about the future, since there is nothing that I can do about it anyway" and "Often luck pays off better than hard work"- appeared very similar to externality items like "No matter what I do, I'm likely to get sick." Early theorists and recent investigators alike have noted the conceptual link between external locus of

control and present-fatalistic time perspective. The two psychological constructs mutually motivate the prediction of failures or successes, negativity related to the potential of personal action altering life events (Haghighatgoo, Ali Besharat, & Zebardast, 2011), expectations (Haghighatgoo et al., 2011; Lewin, 1951), and competency and contingency beliefs (Shell & Husman, 2001).

Through subsequent analysis, I discovered statistical evidence that externality beliefs and present-fatalistic outlook measured some underlying psychological factor. My common factor analysis estimated the total final communality to be 0.75, so I determined that the two variables possessed an extremely high degree of shared variance across their 21 items. Additionally, linear regression verified that participants' external loci of control significantly varied based on time perspective ($F = 8.43$, $p < .0001$); present-fatalistic outlook predicted differences in this health HLC belief ($t = 3.64$, $p < 0.001$), where present-hedonistic outlook ($t = -0.16$; $p = 0.87$) and future outlook ($t = -0.50$, $p = 0.62$) did not. Given conceptual and statistical support, I elected to drop the present-fatalistic time perspective items in favor of external locus of control ones. I believed that the remaining variable could encompass individuals' attitudes toward influencing health outcomes and overall life experiences.

Sample size and power estimates. Statistical power analyses were conducted to determine appropriate sample sizes for identifying significant results, should they exist, and for avoiding misleading associations (Balkin & Sheperis, 2011). An a priori test using G*Power 3.1 software (Faul, Erdfelder, Lang, & Buchner, 2007) determined that I needed a minimum of 55 participants to detect a total model effect at a power of .80, if such statistically significant result existed and given an alpha of .05. Furthermore,

contemporary studies often follow a 1:10 ratio of sample size to the number of parameters in structural equation modeling (Kline, 2005). Given that 79 individuals provided information on eight parameters, I considered that ratio acceptable for conducting the current investigation. A post hoc analysis further indicated that mediation path analysis would achieve statistical power at the .88 significance level. Overall, these preliminary findings demonstrated that the primary analyses could afford me acceptable and high statistical power, given that contemporary standards require at least an 0.80 significance level for a large effect (Cohen, 1988), to make accurate observations regarding psychological factors associated with medication adherence.

Statistical assumptions. I judged that it was inappropriate to evaluate many assumptions associated with continuous scales for the categorical variables. However, I used SAS programs to confirm the normal distribution of responses to continuous scales and to test multicollinearity between all items (SAS Institute, Inc., Cary, NC). I was especially concerned that certain predictor variables, time perspectives and health locus of control beliefs, were somewhat similar in theory. I calculated variance inflation factors (VIF; Table 2). The results indicated that VIF ranged between 1.53 and 5.28 for most variables; however, powerful others items highly correlated with the chance and external locus of control items.

Table 2

Evaluation of Variance Inflation Factors (VIF) for Predictor Variables

Variable	VIF
Present-hedonistic	2.03
Present-fatalistic	2.95
Future	1.91
Internal locus of control	1.53
External locus of control	4.25
Chance	5.28
Powerful others	*

*locpower = 2 (locext - locchance)

In the next step, I used a stepwise regression for generalized linear models, with 0.25 as the variable selection criterion and 0.15 as the staying criterion, to generate a final set of predictor variables. The outcomes demonstrated that likelihood ratio test would perform well if I divided HLC beliefs into internal locus of control and external locus of control, so I elected to exclude chance and powerful others effects from the total model.

Participant characteristics. The final group of 79 individuals consisted of 66 with a single diagnosis and 13 with co-occurring hypertension and diabetes. The participants were generally older minorities with some college education (Table 3). The group included slightly more males (54.43%) than females (45.47%). In comparison, the City of Martinsburg has reported that 63.30% of its 17,227 residents were 18- to 64-years-old; 22.50% of its residents were racial or ethnic minorities; 48.80% were male and 51.20% were female (U.S. Census Bureau, 2010). The demographic information illustrated that the participants represented a more multicultural sample than residents living in Martinsburg.

Table 3

Means, Standard Errors, and Prevalence Percentages for Participant Characteristics

Variable	Mean ± SE/ Prevalence (%)
Age (years)	58.84 ± 1.57
Years of formal education	12.83 ± 0.27
Time perspective	
Present-hedonistic	3.17 ± 0.06
Present-fatalistic	2.71 ± 0.10
Future	3.66 ± 0.07
Internal locus of control	4.57 ± 0.09
External locus of control	3.27 ± 0.09
Gender	
Women	45.57%
Men	54.43%
Racial/ethnic background	
White (non-Hispanic origin)	40.51%
Black	37.97%
Asian or Pacific Islander	1.27%
Hispanic	3.80%
Other	16.46%

Missing data. People answered every item on medication adherence, time perspective, and health locus of control beliefs. Some in the final group failed to answer questions about health beliefs, however. Twenty-four people did not provide 12 or 15.19% of responses for perception of disease severity and 12 or 15.19% of responses for perception of susceptibility to future complications. I recoded the 24 missing values in the dataset from "." to -999, because Muthén and Muthén (1998-2010) have recommended this step for completing path analysis in Mplus. Ensuing tests corrected for

recoded data to maximize use of all available data by determining maximum likelihood in latent response variables (Muthén, Jo, & Brown, 2003).

Primary Analysis

I used primary analyses to conduct descriptive statistics, path analysis and total model fit, and structural modeling. I considered eight variables in the total model: medication adherence as a criterion variable; present-hedonistic and future time perspectives as predictor variables; perceived disease severity, perceived susceptibility to future complications, external locus of control, and internal locus of control as mediators; and age as a covarying predictor variable.

Descriptive statistics. I employed central tendency and correlation procedures to gather descriptive statistics on participants' information. For example, I calculated group means for time perspective and health locus of control beliefs, because they were continuous variables, whereas I found group mode for health beliefs and medication adherence, because they were categorical ones. Correlation analyses allowed me to determine statistical relationships between all the variables.

Path analysis and total model fit. I chose to do path analysis for several reasons. First, it enabled me to examine structural relationships between nonnumeric categories of psychological factors and beliefs (Yu, 2002); moreover, it simultaneously examined direct effects and indirect effects of continuous predictor variables and categorical mediators on categorical outcomes. I also selected path analysis because it enabled me to determine the relevance of psychological constructs on medication adherence by calculating total model fit, which compared the hypothesized total model with a restricted baseline model (Muthén, 1998-2004; Yu, 2002). To assess goodness-of-fit, I ran several

tests, including the chi-square statistic and root mean square error of approximation (RMSEA) estimate, with an estimates below 0.08 and probability above 0.05 as criteria for assessing goodness-of-fit between the hypothesized model and null model. The equation for RMSEA was

$$v((\chi 2/(n*d)) - (1/n))*v(g),$$

where *d* represented degrees of freedom; *n* represented total sample size; χ^2 represented the chi-square statistic; and *g* represented the number of groups (Muthén, 1998-2004).

I also considered two incremental fit indices- comparative fit index (CFI) and Tucker-Lewis Index (TLI) - with 0.95 to 0.99 repeating as additional criteria. Contemporary writers have recognized these conventional cut-offs for preventing Type II error with sample sizes smaller than 100 (Hu & Betler, 1999; Muthén, 1998-2004; Yu, 2002). The equations were

$$TLI = (\chi^2B/df_B - \chi^2_{H0}/df_{H0}) / (\chi^2B/df_B - 1) \text{ and}$$
$$CFI = 1 - \max(\chi^2_{H0} - df_{H0},0)/ \max(\chi^2_{H0} - df_{H0}, \chi^2B - df_B, 0),$$

where χ^2B represented the chi-square statistic for the baseline model; df_B represented degrees of freedom for the baseline model; χ^2_{H0} represented the chi-square statistic for the hypothesized model; and df_{H0} represented the degrees of freedom for total model (Muthén, 1998-2004).

Structural modeling. I generated mediation models with several procedures divided into ANALYSIS, and MODEL commands (Muthén & Muthén, 1998-2010).

ANALYSIS command. Four ANALYSIS procedures established the technical guidelines for the path analysis:

```
ANALYSIS:
ESTIMATOR = WLSMV;
PARAMETERIZATION = THETA;
!ITERATIONS = 5000;
!BOOTSTRAP = 1000;
```

To start, I calculated a diagonal weighted matrix with standard errors and chi-square statistics adjusted for means and variance in order to determine weighted least square parameter estimates (WLSMV) with the DIFFTEST command. This procedure allowed me to find probit regression coefficients or probability for likelihood of categorical outcomes (Muthén & Muthén, 1998-2010), in essence. In the next step, I selected Theta parameterization to set variance and residual variance between parameters at one for the main pathways (Muthén & Muthén, 1998-2010). My iterations procedure specified 5000 as the maximum number of draws to Quasi-Newton algorithms for model estimates. Finally, I chose the bootstrap procedure, in combination with the confidence interval option in the OUTPUT command, in order to formulate bootstrap standard errors and to adjust confidence intervals for potential bias; and I used it with the model indirect option to correct for any potential bias in mediator parameters (Muthén & Muthén, 1998-2010).

MODEL command. The procedures for the MODEL command defined the predicted relationships for direct effects and indirect effects:

```
MODEL:
adherence_htndom ON age tphedon tpfuture locint locext susc_htndom sev_htndom;
locint locext ON tphedon tpfuture age;
susc_htndom sev_htndom ON tphedon tpfuture age;
tphedon tpfuture ON age;
tphedon WITH tpfuture;
locint WITH locext;
sev_htndom WITH susc_htndom;
```

MODEL indirect:
adherence_htndom IND tphedon;
adherence_htndom IND tpfuture;

Specifically, I used the ON or WITH statements to determine how well parameters regressed on or correlated to one another, respectively; and I employed the IND option to identify estimated indirect effects (Muthén & Muthén, 1998-2010).

OUTPUT command. I described which procedures I wanted to interpret path analysis with the following OUTPUT command:

OUTPUT:
SAMPSTAT;
PATTERNS;
RES;
MOD (3.84);
TECH1;
TECH5;
!TECH8;
!CINTERVAL (bcboot);

Most notably, I requested the SAMPSTAT option to acquire sample thresholds, sample probit regression coefficients, and probit residual correlations, given that the model had ordered categorical variables and covariates (Muthén & Muthén, 1998-2010). I also selected the PATTERNS option to verify where participants omitted answers on the health behavior protocols; the summary of missing data confirmed that several people did not complete items on health beliefs. Next, I chose the TECH1 procedure to request arrays with starting values and parameter specifications. Lastly, I chose the CINTERVAL option, in combination with the bootstrap option in the ANALYSIS command, in order to formulate bootstrap standard errors and to adjust confidence intervals for potential bias.

CHAPTER 4

Results

In this fourth chapter, I comprehensively state the results of mediational path analyses to answer six research questions. I initially describe how participant characteristics cluster in regard to demographics, psychological constructs, and medication adherence. In the remaining sections, I explain pathways from identified predictors to reported categories of prescribed drug use, ranging from *completely nonadherent* to *completely adherent*; and I delineate findings from direct and indirect effect tests on the associations between psychological constructs and the ordinal categorical outcome.

Participant Characteristics

In terms of demographics, the 79 participants consisted of 66 with a single diagnosis and 13 with co-occurring hypertension and diabetes. Their ages varied from 19- to 86-years-old (M = 58.84 ± 1.57, Table 3). Individuals reported having formal education from middle school up to advanced graduate degrees (M = 12.83 ± 0.27). On average, the group included slightly more men (n = 43, 54%) than women (n = 36, 45%). People represented diverse racial and ethnic backgrounds- including non-Hispanic White origin (n = 32, 41%), Black or African American origin (n = 31, 40%), Hispanic origin (n = 3, 4%), and Asian or Pacific Islander origin (n = 1, 1%), in order of prevalence. The remaining participants who selected *other* presumably identified with multiple racial or ethnic backgrounds (n = 12, 17%). To summarize, the majority of individuals were older minority men with high school diplomas or general education development certification and some college education.

People provided an array of responses pertaining to psychological constructs and reported drug use. According to analysis of continuous variables for group trends, they reported moderate future time perspectives ($M = 3.66 \pm 0.07$) and slightly less present-hedonistic time perspective ($M = 3.17 \pm 0.06$) on ZPTI subscales scores ranging from 0 to 5. They also described themselves as having more internal locus of control ($M = 4.57 \pm 0.09$) than external locus of control ($M = 3.27 \pm 0.09$) on MHLC subscales scores ranging from 0 to 6.

Individuals showed clear patterns on categorical scales related to health beliefs and medication adherences (Table 4). As many as 58% believed that hypertension was a serious problem; 77%, an even larger percentage, believed that diabetes was a serious problem in their lives. Smaller groups, 13% and 39%, expressed a great deal of worry about future complications. The majority of participants, 29% or 48% respectively, said they were *mostly adherent* or *completely adherent* to antihypertensive regimens. However, 23% referred to themselves as *adherent on average* or less often. People reported similar use of antidiabetic medications- 30% and 39%, in order, said they were *mostly adherent* or *completely adherent* to regimens. Overall, all responses pertaining to antihypertensive and antidiabetic drug use shared a covariance of 0.77, so I determined that the outcomes could be collapsed onto the single main pathway for interpreting results.

Correlation analyses further demonstrated statistically significant relationships between medication adherence and health beliefs in the main pathways (Table 5). Two Spearman regression coefficients, 0.44 and 0.40, indicated that reported drug use

Table 4

Percentages for Psychological Constructs and Medication Adherence

Variable	Prevalence (%)
Perception of hypertension severity	
Least of worries	2.99%
A minor concern	8.96%
A somewhat important problem	29.85%
A serious problem	58.21%
Perception of susceptibility to hypertension complications	
Hardly ever thought about	17.91%
Sometimes thought about with no worry	29.85%
Often thought about with worry	32.84%
Worried about a lot	19.40%
Antihypertensive medication adherence	
Completely nonadherent	9.62%
Slightly adherent	1.92%
Adherent on average	11.54%
Mostly adherent	28.85%
Completely adherent	48.08%
Perception of diabetes severity	
Least of worries	3.23%
A minor concern	3.23%
A somewhat important problem	16.13%
A serious problem	77.42%
Perception of susceptibility to diabetes complications	
Hardly ever thought about	6.45%
Sometimes thought about with no worry	22.58%
Often thought about with worry	32.26%
Worried about a lot	38.71%
Antidiabetic medication adherence	
Completely nonadherent	13.04%
Slightly adherent	4.35%
Adherent on average	13.04%
Mostly adherent	30.43%
Completely adherent	39.13%

increased with perceived disease severity and susceptibility to future complications. Correlations did not identify how adherence regressed on other psychological constructs.

Table 5

Spearman Correlation Coefficients Between Predictors and Medication Adherence

Variable	Age	Present-hedonistic	Future	Disease severity	Susceptibility	Internal control	External control
Age							
Present-hedonistic	0.22						
Future	-0.09	-0.31*					
Disease severity	0.05	0.01	-0.01				
Susceptibility	0.07	-0.08	0.19	0.63**			
Internal locus of control	0.30*	-0.2	0.16	-0.09	0.01		
External locus of control	0.19	0.13	-0.34*	-0.13	-0.14	0.12	
Medication adherence	0.11	0.12	-0.02	0.44**	0.40**	0.19	0.16

* $p < .05$. ** $p < .001$.

Lastly, analysis of categorical responses also suggested several trends between psychological constructs and prescription drug use in the main pathways (Table 6). To start, people who reported higher adherence to drugs for hypertension and diabetes typically had elevated future outlook and internal locus of control. The participants with more present-hedonistic outlooks and external locus of control demonstrated unclear patterns in medication adherence, in comparison. In addition, findings supported the benefit of internal locus of control over external locus of control on health beliefs. The former's influence seemed superior when contrasting means for perception of disease severity and susceptibility to future complications across the highest levels. A similar contrast of health beliefs indicated that future time perspective promoted perception of disease severity and susceptibility to future complications across the highest levels, where these psychological constructs declined based on present-hedonistic time perspective.

Table 6

Mean ± SE for Health Beliefs and Medication Adherence for All Time Perspectives and Health Locus of Control Beliefs

Variable	Present-hedonistic	Future	Internal locus of control	External locus of control
Perception of disease severity				
Least of worries	3.97 ± 0.37	3.65 ± 0.04	5.10 ± 0.90	4.48 ± 0.68
A minor problem	3.16 ± 0.19	3.74 ± 0.15	4.27 ± 0.28	3.26 ± 0.27
A somewhat important problem	3.29 ± 0.10	3.52 ± 0.16	4.56 ± 0.18	3.21 ± 0.19
A serious problem	3.14 ± 0.09	3.67 ± 0.11	4.51 ± 0.15	3.19 ± 0.14
Perceived susceptibility to hypertension complications				
Hardly ever thought about	3.18 ± 0.22	3.44 ± 0.12	4.38 ± 0.40	3.39 ± 0.30
Sometimes thought about with no worry	3.40 ± 0.10	3.37 ± 0.13	4.32 ± 0.14	3.27 ± 0.20
Often thought about with worry	3.24 ± 0.11	3.78 ± 0.14	4.62 ± 0.18	3.18 ± 0.17
Worried about a lot	2.90 ± 0.11	3.94 ± 0.15	4.80 ± 0.17	3.16 ± 0.19
Medication adherence				
Completely nonadherent	3.08 ± 0.21	3.15 ± 0.29	3.72 ± 0.31	3.67 ± 0.45
Slightly adherent	1.13 ± N/A	2.08 ± N/A	1.00 ± N/A	1.08 ± N/A
Adherent on average	3.04 ± 0.22	3.71 ± 0.39	4.27 ± 0.26	3.33 ± 0.36
Mostly adherent	3.18 ± 0.10	3.96 ± 0.11	4.51 ± 0.19	2.98 ± 0.21
Completely adherent	3.33 ± 0.12	3.56 ± 0.13	4.93 ± 0.14	3.53 ± 0.16

*N/A indicates no standard error where only a single participant provided information.

Total Model Fit

I calculated probit regression coefficients to determine the effect of predictors' changes on the probability of outcome change in the total model fit (Figure 2), which was the statistical comparison of psychological pathways and a more restricted baseline model in their ability to predict participants' medication adherence. Among fit indices, a chi-square test yielded a statistically significant result in favor of the hypothesized model ($\chi^2 = 148.26$, df = 31, $p < 0.001$); the root mean square error of approximation exceeded the recommended 0.08 criterion (RMSEA estimate = 0.22, 90% CI [0.18, 0.26], $p < 0.001$); The comparative fit index (CFI) and Tucker-Lewis index (TLI), 0.17 and -0.47 respectively, suggested poorer fit for the hypothesized model because both were considerably below the 0.95 criteria (Hu & Betler, 1999; Muthén, 1998-2004; Yu, 2002). Given the chi-square outcome, I determined that omnibus test collectively showed that the psychological pathways exhibited some influence in observed medication adherence, but the path analysis required further manipulation to determine the best categorical data model of direct and indirect effects between variables (Muthén & Muthén, 1998-2011). I translated the categorical data model to probabilities or reporting different adherence levels according to estimated thresholds. Here, I also interpreted results in terms of standard deviations in the underlying latent variable, because probability change differed depending on how participant information compared to the overall distribution of reported drug use.

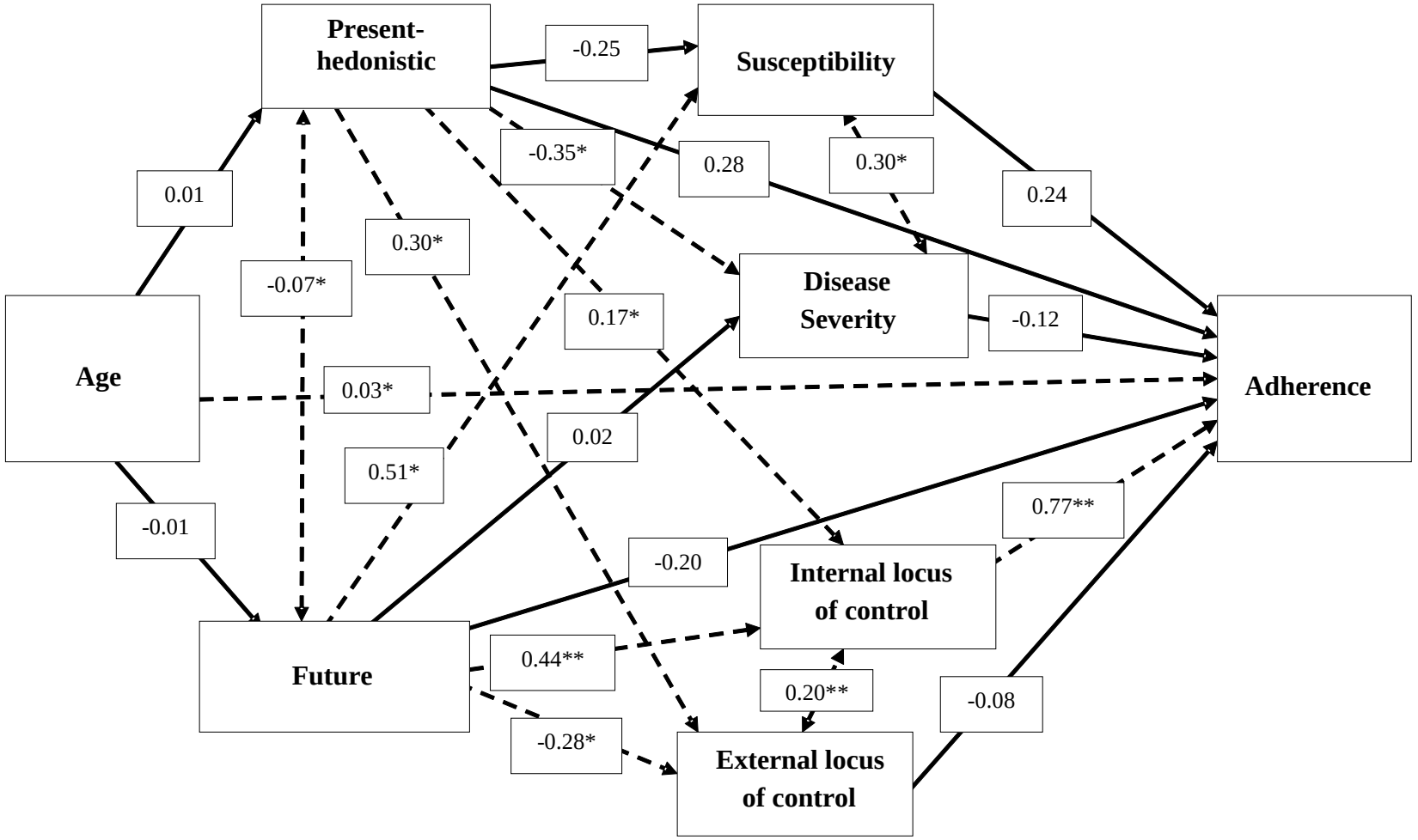

Figure 2. Path diagram of the total model. * p < .05. ** p < .001. Significant paths shown with dashes.

Direct effects

Research question 1a. *What direct influence does age have on medication adherence among people with hypertension or diabetes*? I hypothesized that age would have a direct effect on medication adherence; and I predicted a positive association with the outcome, meaning that older people would report higher adherence than younger people. The direct effect test for the age covariate supported both assumptions (Figure 3. unstandardized parameter estimate = 0.03, SE = 0.01, p = 0.01). An increase in age by a single year predicted a 0.03 standard deviation change in the probability of people being more adherent to prescribed medication. On average, individuals' estimated drug use improved by 0.30 with every additional ten years.

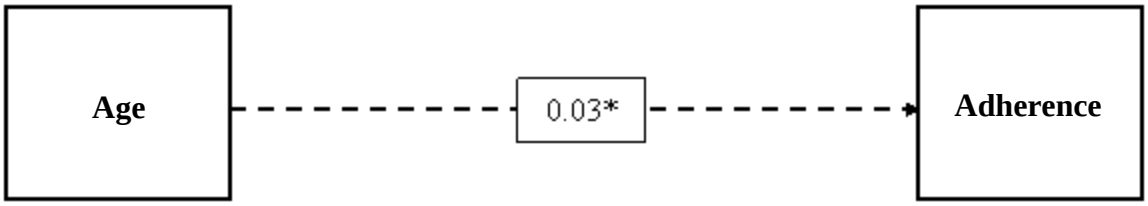

Figure 3. Path diagram of the direct effect of age on medication adherence. *p < .05. **p <.001. Significant path shown with dashes.

Research question 1b. *What direct influence does time perspective have on adherence?* I hypothesized that future time perspective would have a direct effect and a positive association with medication adherence, meaning that individuals with more future outlook would report higher adherence than those with more present-hedonistic

perspectives. Additionally, I predicted that present-hedonistic time perspective would not yield a direct effect on reported drug use. The direct effect test failed to support either assumption about the strength or direction of associations (Figure 4. present-hedonistic time perspective unstandardized parameter estimate = 0.28, SE = 0.29, p = 0.33; future time perspective unstandardized parameter estimate = -0.20, SE = 0.26, p = 0.45).

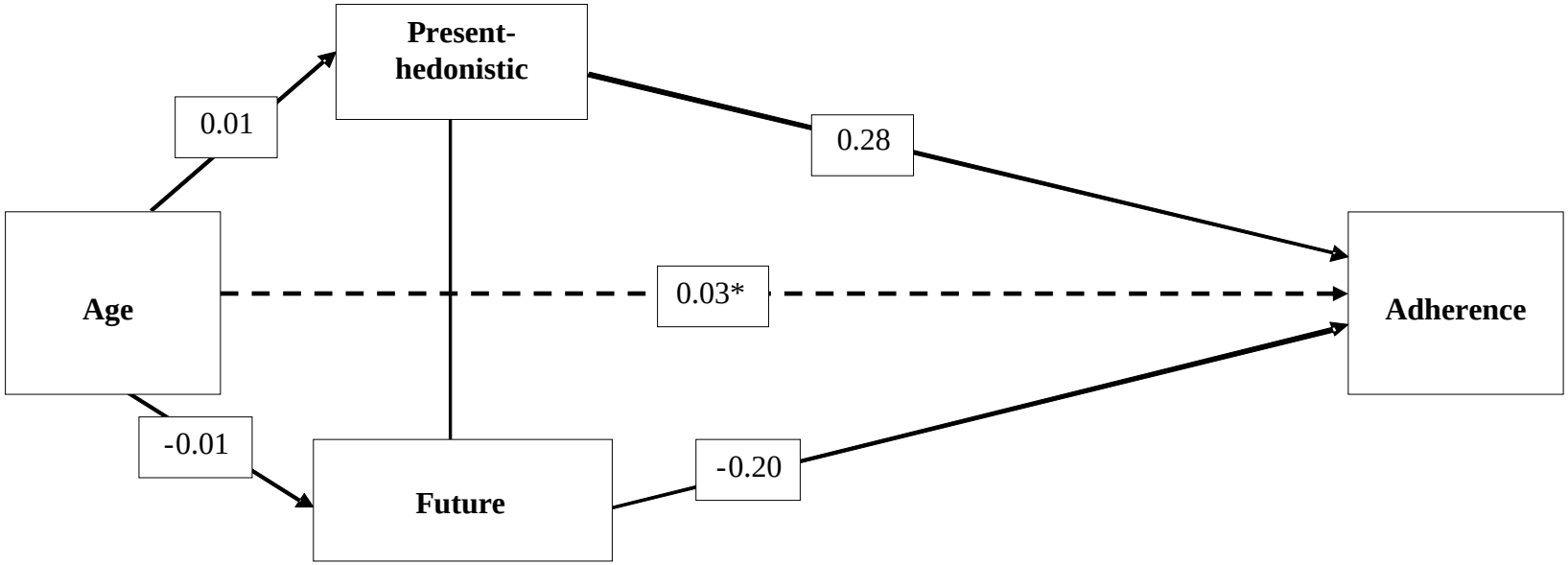

Figure 4. Path diagram of the direct effect of time perspective on medication adherence. * p < .05. ** p < .001. Significant path shown with dashes.

Despite the nonsignificant results, an increase in present-hedonistic outlook by a single unit on the 0 to 5 scale contributed to a 0.28 standard deviation change in the probability of individuals having higher medication adherence, whereas an increase in future time perspective by a single unit on the 0 to 5 scale contributed to a 0.20 standard deviation change in the probability of individuals having lower medication adherence.

In addition to the two previous research questions, I calculated direct effects from all potential mediators on the ordered categorical outcome. Only one of these variables, internal locus of control, had a statistically significant relationship with adherence (Figure 5. unstandardized parameter estimate = 0.77, SE = 0.21, $p < 0.001$). An increase in this health locus of control belief by a single unit on the 0 to 6 scale contributed to a 0.77 standard deviation change in the probability of individuals having higher medication adherence.

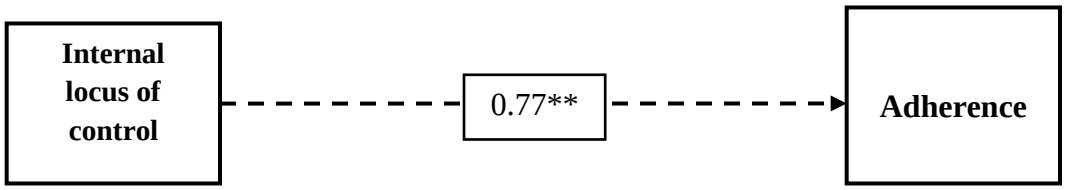

Figure 5. Path diagram of the direct effect of internal locus of control on medication adherence. *p < .05. **p < .001. Significant path shown with dashes.

Conversely, among the nonsignificant results, an increase in external locus of control by a single unit on the 0 to 6 scale contributed to a 0.08 standard deviation change

in the probability of individuals saying they used prescribed medications less often (SE = 0.20, p = 0.68); an increase in perception of disease severity by a single unit on the 0 to 4 scale contributed to a 0.12 standard deviation change in the probability of individuals reporting better adherence (SE = 0.26, p = 0.64); and an increase in perception of susceptibility to future complications by a single unit on the 0 to 4 scale contributed to a 0.24 standard deviation change in the probability of individuals saying they used the prescribed medications less often (SE = 0.20, p = 0.23).

Indirect Effects

Research question 2a. *How is time perspective indirectly associated with adherence through perception of disease severity?* I hypothesized that perception of disease severity would mediate the effect of time perspective on medication adherence differently. I also believed that participants' future and present-hedonistic outlooks could operate through this health belief to influence medication adherence indirectly. Specific indirect effect tests were not in favor of either assumptions (Figure 6. present-hedonistic time perspective → perceived disease severity → medication adherence, unstandardized parameter estimate = 0.04, SE = 0.10, p = 0.66; future time perspective → perceived disease severity → medication adherence, unstandardized parameter estimate = 0.00, SE = 0.02, p = 0.89).

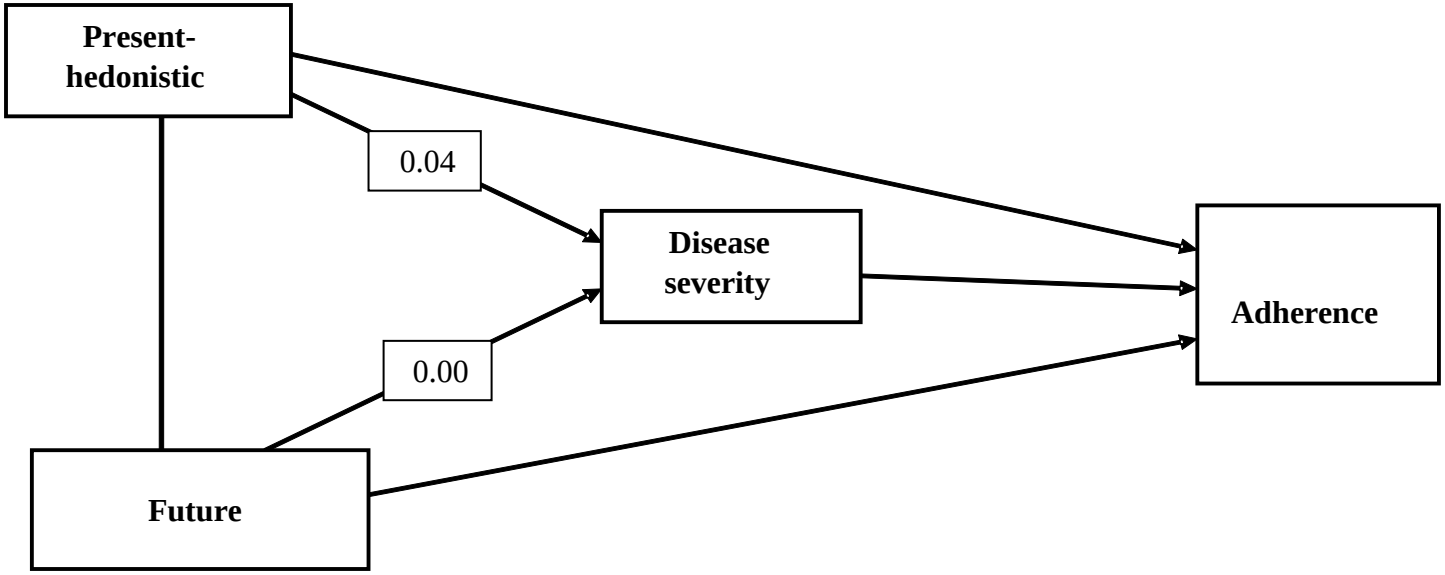

Figure 6. Path diagram of the indirect effect of time perspective on medication adherence through perceived disease severity. *p < .05. **p < .001.

Research question 2b. *How is time perspective indirectly associated with adherence through perception of susceptibility to future complications?* I hypothesized that perception of susceptibility to future complications would mediate the effect of time perspective on medication adherence differently. I believed that participants' future and present-hedonistic outlooks could operate through this health belief to influence medication adherence indirectly. Specific indirect effect tests failed to support either hypotheses (Figure 7. present-hedonistic time perspective → perceived susceptibility → medication

adherence, unstandardized parameter estimate = -0.06, SE = 0.06, p = 0.29; future time perspective → perceived susceptibility → medication adherence, unstandardized parameter estimate = 0.13, SE = 0.11, p = 0.26).

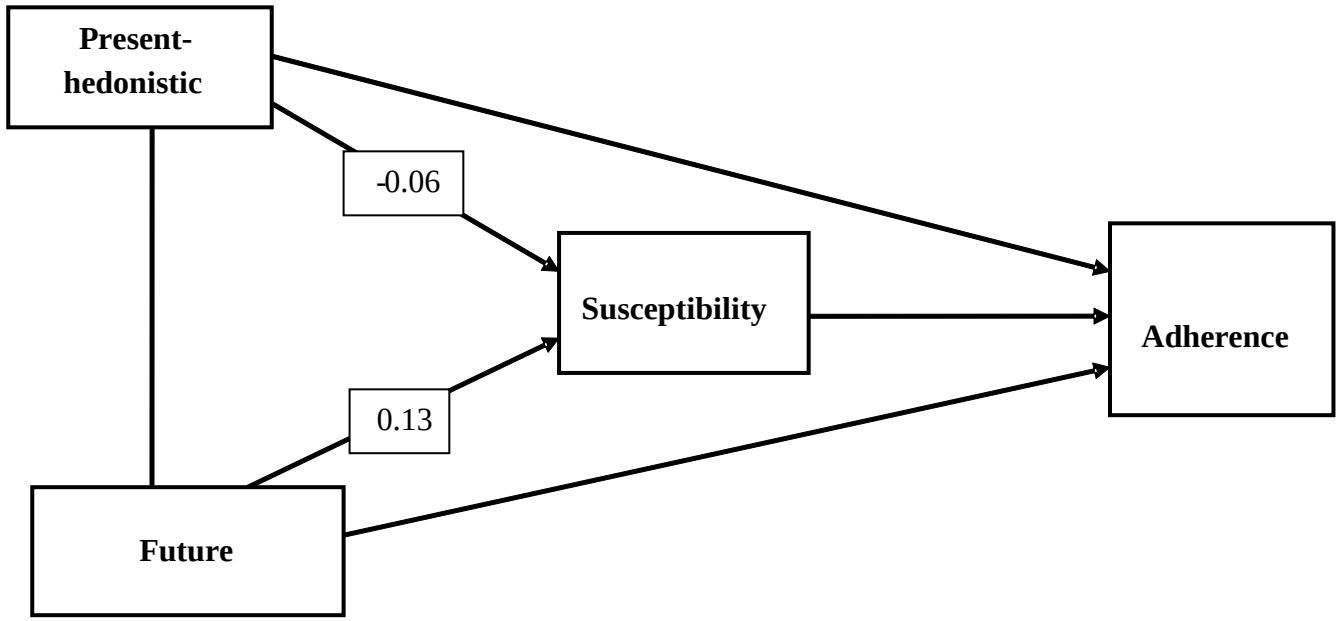

Figure 7. Path diagram of the specific indirect effect of time perspective on medication adherence through perceived susceptibility to future complications. *p < .05. **p < .001.

Research question 3. *How is time perspective indirectly associated with adherence through internal locus of control?* I hypothesized that internal locus of control would mediate the effect of time perspective on medication adherence; and I predicted a positive association between this HLC belief and MA, meaning that time perspective would operate through elevated internal locus of control to increase drug use. Among the results, specific indirect effect tests indicated that internal locus of control mediated the effect of time perspective on adherence (Figure 8. present-hedonistic time perspective → internal

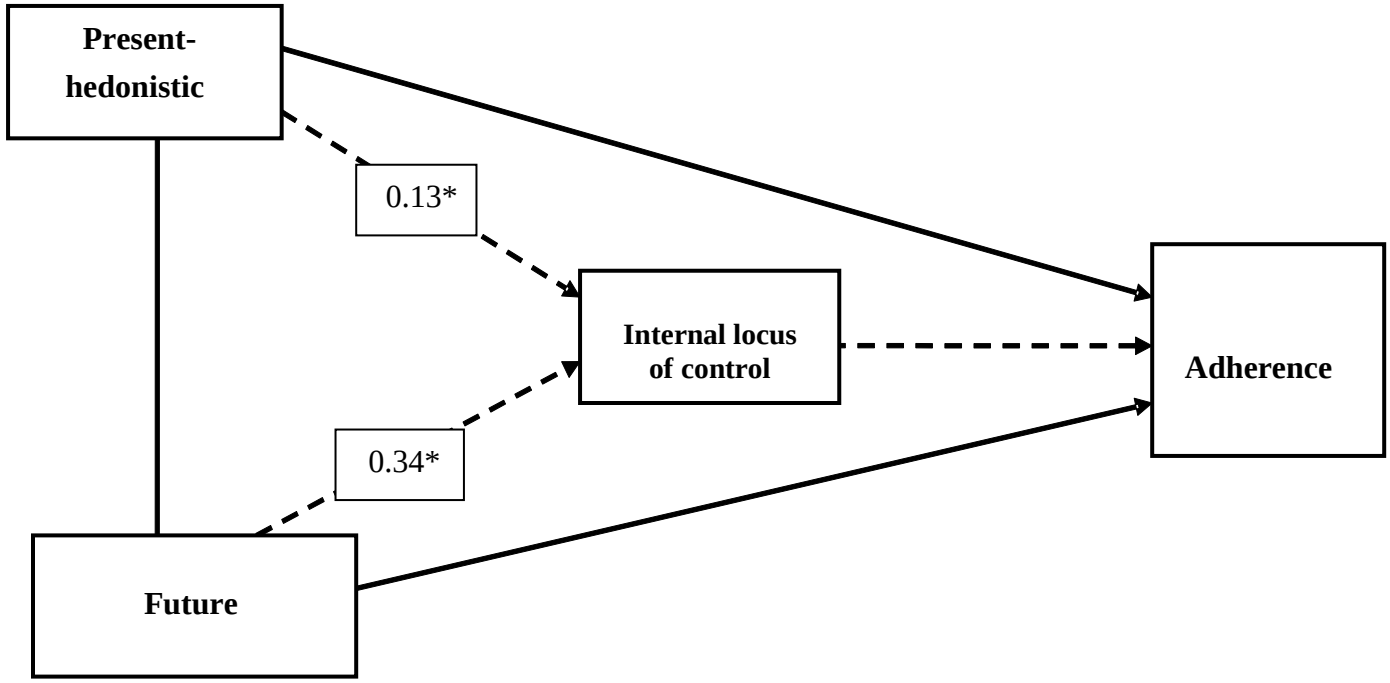

Figure 8. Path Diagram of the specific indirect effect of time perspective on medication adherence through internal locus of control. *p < .05. **p < .001. Significant paths shown with dashes.

locus of control → medication adherence, unstandardized parameter estimate = 0.13, SE = 0.06, p = 0.03; future time perspective → internal locus of control → medication adherence, unstandardized parameter estimate = 0.34, SE = 0.13, p = 0.01). The findings showed that both time perspectives operated through the mediator to improve reported drug use. In combination with the indirect effect from internal locus of control, an increase in present-hedonistic outlook on a 0 to 5 scale predicted a 0.13 standard deviation change in the probability of people being more adherent to prescribed medication, where an increase in future outlook predicted a 0.34 standard deviation change.

Research question 4. *How is time perspective indirectly associated with adherence through external locus of control?* I hypothesized that external locus of control would mediate the effect of time perspective on medication adherence differently. Specific indirect effect tests determined that external locus of control did not mediate the effect of time perspective on adherence (Figure 9. present-hedonistic time perspective → external locus of control → medication adherence, unstandardized parameter estimate = -0.03, SE = 0.06, p = 0.67; future time perspective → external locus of control → medication adherence, unstandardized parameter estimate = 0.02, SE = 0.06, p = 0.69).

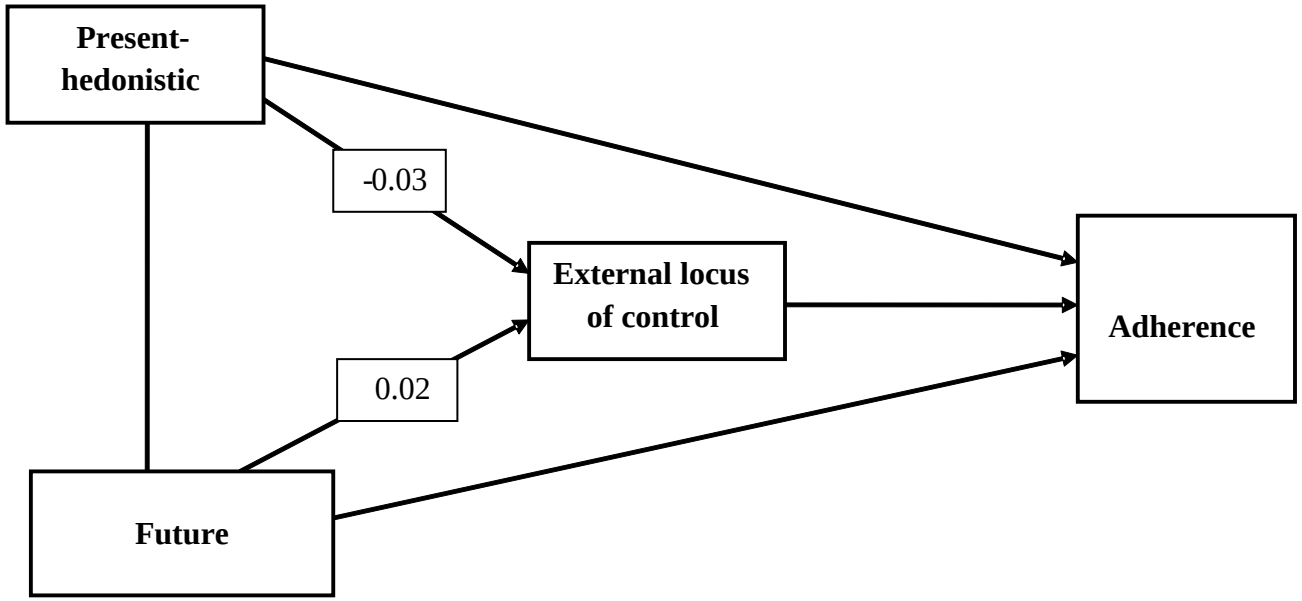

Figure 9. Path diagram of the specific indirect effect of time perspective on medication adherence through internal locus of control. *p < .05. **p < .001.

CHAPTER 5

Conclusion

In this final chapter, I discuss how the categorical data modeling supported or failed to support the six research questions. I also elaborate on how findings contribute implications for theory and practice as they pertain to health behavior counseling. To conclude, I share the study's limitations and future directions to advance medication adherence studies.

Discussion

The current study provided the first statistical evidence of the strength and direction of simultaneous associations between time perspective, health beliefs, health locus of control (HLC) beliefs, and medication adherence (MA). Most notably, the analysis did not detect any direct effect from either future or present-hedonistic time perspectives, where older age and greater internal locus of control predicted drug use. Internal locus of control outperformed all other predictors- its magnitude suggested the largest increase in likely change from *adherent on average* to *completely adherent*. Among indirect effect tests, participants' internal locus of control also mediated the effect of time perspective on adherence. The findings showed that both present-hedonistic and future orientation operated through the mediator to boost reported drug use.

Implications for Theory

The findings further validate existing knowledge that adherence improves as patients get older (Barclay et al., 2007; Hashmi et al., 2007). Among people with hypertension or diabetes, an increase in age by a single year may bring a 0.03 change in the likelihood of being more adherent to prescribed medication; and, moreover, drug use

can rise from *adherent on average* to *completely adherent* with every additional ten years. The observed increase in adherence corresponds with prior evidence that older patients' adherence rates can be twice as high as those for their younger peers, especially considering a 92% compliance rate for individuals between 70- and 80-years-old (Hashmi et al., 2007). Two implications emerge from this finding: older adults can be less at-risk for poor adherence; and younger adults can be more at-risk for poor adherence. It is possible that MA is better in older individuals because they have prior medical conditions that have warranted medication use and helped to condition adherence behavior. Therefore, older people's medication adherence could be attributed to making decisions and goals that effectively enable this habit, perhaps even when controlling for complications associated with comorbidity or polypharmaceutical regimens. Younger individuals, in comparison, can have less concern for mortality or future consequences; and they may not have medical histories requiring prolonged drug use.

A direct effect test failed to support the hypothesis that future or present-hedonistic time perspectives singularly impact medication adherence. The findings do not corroborate evidence that future outlook is better affiliated with health-promoting behaviors than present outlooks. It is possible that the current study does not support any direct effect, particularly a positive association with future time perspective (Sansbury et al., 2012), due to the introduction of internal locus of control as a mediator.

Indirect effect tests indicated that medication adherence can increase for a person with either elevated future orientation or present-hedonistic orientation if he or she develops more internal locus of control. According to comparison of path diagrams for the total model and specific effects, the mediator decreases the magnitude of the present-

hedonistic time perspective's effect from 0.28 to 0.13, yet it makes the influence from the distal psychological construct statistically significant. An increase in present-hedonistic orientation by a single unit operates through internal locus of control for a 0.13 change in the likelihood of individuals being more adherent to prescribed medication. Similarly, another implication is that the mediator alters the direction of the association between future time perspective and reported drug use from -0.20 to 0.34 for people with hypertension or diabetes, and it makes the influence from the distal psychological construct statistically significant, here again. An increase in future time perspective by a single unit operates through the HLC belief for a 0.34 change in the likelihood of being more adherent to drugs. The findings support existing evidence that internal locus of control is a superior predictor of future drug use (Macrodimitris & Edner, 2001; Morowatisharifabad et al., 2009; O'Hea et al., 2005; Surgenor et al., 2000).

Indirect effect tests also yielded several nonsignificant results related to mediation from health beliefs and external locus of control. The results do not substantiate evidence from a recent meta-analysis that individuals who refer to chronic diseases as severe are on average 22% less likely to be completely adherent (DiMatteo et al., 2007). They also fail to support that elevated perception of susceptibility to future complications promotes higher MA. Lastly, he current study does provide some indication in favor of growing evidence that internality and externality beliefs can simultaneously affect health behaviors (Atkins & Fallowfield, 2006; Barclay et al., 2007), yet the findings demonstrate that external locus of control can be less influential than internal locus of control in predicting drug use for people with hypertension and diabetes. According to descriptive statistics, people who reported higher adherence to drugs for hypertension and

diabetes typically have elevated internal locus of control, but it still unclear how external locus of control directly contributed to people's medication adherence. More research is needed to determine significant structural relationships between perception of disease severity, perception of future complications related to chronic disease, external locus of control, and prescription drug use.

Implications for Counseling Practice

Another major implication is that behavioral counselors may apply new knowledge of these psychological pathways so people with diabetes or hypertension can better manage symptoms and even complications brought on by treatment. Doing so will likely impact medication adherence and even reduce macro-level outcomes like lost days at work or school (Lurie et al., 2000), fewer available appointments with primary care providers (Bender & Rand, 2004), unnecessary healthcare expenses (Pai & Drotar, 2010), and avoidable deaths each year (Takiya et al., 2004), as a consequence. The findings validate other existing efforts to accomplish these goals by investigating how internal phenomena motivate health behaviors over time (Broadbent et al., 2011; DiMatteo et al., 2007; Mann et al., 2009), especially by offering that time perspective operates through internal locus of control to boost MA. Counselors can partner with the medical community to develop individual and structural interventions that target patient health behaviors with the new knowledge.

To start at the individual level, there is considerable literature suggesting that training health professionals in both cognitive-behavioral techniques (Graves, Roberts, Rapoff, & Boyer, 2010; Grey, Boland, Davidson, Li & Tamborlane, 2000; Payne, 2012) and motivational interviewing strategies (van Eijk-Hustings, Daemen, Schaper, &

Vrijhoef, 2011; Hood, 2010; Zwinker et al., 2012) can improve medication adherence. Cognitive-behavioral theory (Beck, 1993, 1999) proposes that learned thoughts direct feelings and behaviors related to chronic disease management. The results offer that a person's cognitions surrounding internal locus of control and time perspective play integral roles in chronic disease management. Whether he or she has largely future or present-hedonistic outlooks, one implication is that counselors can target his or her beliefs about altering health status based on personal action to boost use of prescription drugs. Intrinsically-motivated patients will likely respond well to more preventative techniques like brief psychoeducation and technology-based skill courses (Duff & Latchford, 2010). Behavioral counselors can train healthcare providers, in the event that there are small challenges to adherence, to put these individuals back on course with behavioral strategies or contingency planning. The long list of clinical techniques includes self-monitoring through journaling or homework assignments, Socratic questioning about treatment challenges, role play, rehearsing positive self-talk, and thought stopping. According to small case studies and meta-analyses, using such cognitive behavioral interventions allows patients to practice coping skills to handle general life stressors and even conflicts specific to chronic disease management (Hood, 2010; Payne, 2012); it can also empower them and family members to unlearn unhealthy patterns through techniques that have long-term usefulness and cost benefit (Graves et al., 2010).

It appears that motivational interviewing can be another platform for targeting medication adherence through time perspective and internal locus of control. This strategy, unlike more directive cognitive-behavioral techniques, seems uniquely

appropriate to treat patients with less readiness to take prescribed drugs for diabetes and hypertension. The current study indicates that difficulties with completing drug regimens are reality for over 50% of people. An implication is that they can benefit by working through disbelief that personal action will change health status. Along these lines, motivational interviewing seems better suited for the individuals who must resolve ambivalence toward nonadherence without feeling misjudged or rejected by health professionals (Borrelli, Riekert, Weinstein, & Rather, 2007; Miller & Rollinick, 2002). The emphasis would not be on confronting an individual about his or her time perspectives or internal locus of control. Instead, a clinician uses person-centered techniques to promote change talk and to build a therapeutic alliance that serve as powerful levers for building new intrinsic motivation, as a result.

Health behavior counselors can elicit change talk with six major components-rolling with resistance, expressing empathy, avoiding arguments, developing discrepancy, promoting self-efficacy, supporting behavior change in the patient-provider alliance (Miller & Rollnick, 2002). The first and three final skills especially resonate with the current findings. For example, rolling with resistance involves acknowledging and normalizing when patients have intrinsic and perhaps practical barriers to taking prescribed drugs (Krishna-Pillai, 2012). Open dialogue about natural resistance or defensiveness will likely review repetitive and nonreoccurring life experiences associated with how they formed related points of view. Notably, the findings imply that a person's memories inform internal locus of control and time perspective. The next skill, developing discrepancy, is critical for targeting poor adherence (Krishna-Pillai, 2012). The emphasis is on identifying conflict between values (e.g., importance of raising a

family) and behavior (e.g. not taking medication that will prevent morbidity and mortality). Recognizing such discrepancy generally compels an individual's efforts to move toward treatment goals. Next, promoting self-efficacy involves celebrating minor successes as people approximate intended health behaviors (Miller & Rollinick, 2002). There is consistent evidence that the reinforcement fosters new confidence that encourages internal locus of control (Brodie et al., 2007; Pinto et al., 2005; Schmaling et al., 2001). Finally, the effective transition from contemplative change talk to better medication-taking behaviors relies on a supportive climate in the patient-provider relationship (Miller & Rollnick, 2002). Health professionals work as collaborators in visits, instead of experts in patients' lives, in order to bolster faith in personal ability to overcome barriers to adherence; and, by default, they strengthen individuals' autonomy related to make healthy choices at home. Overall, meta-analyses of contemporary studies suggest that these tenets of motivational interviewing fortify internal locus of control (Burke et al, 2004; Rubak et al., 2005; Thompson, 2011), which this study identifies as a crucial psychological pathway for interpreting drug use.

Implications for Counselor Education and Training

The findings provide insights into why one out of every two people with chronic diseases struggle with drug regimens. A staggering reality is that medical risks and costs affiliated with hypertension and diabetes will only continue to increase without comprehensive strategies to improve their adherence (DiMatteo et al., 2012). In the spirit of partnering with the medical community to decrease these burdens, health behavior counselors possess a collection of skills to develop structural interventions that move the discussed implications into more effective practice in the healthcare system. They can

especially contribute expertise in necessary training and evaluation to do so. Through training, clinicians and physicians serving individuals with higher nonadherence can start a more open and nonjudgmental dialogue about health behaviors (Zwikkler et al., 2012). They will likely gain better leverage on resistance to medication adherence if they use motivational interviewing. Health behavior counselors may introduce the needed skills to health professionals in as little as a single hour-long workshop, and they can revisit intervention strategies through basic or in-depth courses if difficulties with cases tempt providers to return to less effective interaction with patients (Britt, Hudson, & Blampied, 2004; van Eijk-Hustings et al., 2011; Mesters, 2009). Preliminary evidence indicates that medical staffs that complete such training can maintain empathy and therapeutic skills up to six months after reviewing motivational interviewing one time (van Eijk-Hustings et al., 2011).

Health behavior counselors' understanding of human development can also aid the medical community in evaluating psychological profiles and the adaptability of interventions in healthcare systems and services. Their expertise will allow them to provide consultation on mental health issues as they pertain to treatment. For instance, anxiety and cognitive deficits may moderately affect medication adherence (DiMatteo, Lepper, & Croghan, 2000; Gonzales et al., 2008), but depression can dramatically reduce adherence by 66% for many individuals (DiMatteo et al., 2000). Clinicians and physicians, after brief psychoeducation by health behavior counselors, that note this relationship in treatment can provide patients warm hand-offs to mental health professionals. Referrals will afford individuals more holistic care with additional

therapies, including counseling and psychotropic medications, so that their psychological profiles sustain prolonged improvements in health behavior.

Similarly, health behavior counselors can apply the same aptitude for evaluation to assess how well healthcare providers adapt to structural interventions aimed at enhancing prescription drug use. Identifying which barriers to MA reoccur in inpatient or outpatient settings is an important first step (DiMatteo et al., 2012). Needs assessment often determines that medication adherence is subject to practical barriers, like transportation and insurance coverage (DiMatteo, 2004), for example. In these cases, healthcare providers that involve family support and community resources have a larger system to combat these challenges (Newell, Bowman, & Cockburn, 2000); and, moreover, continued successes with medication adherence due to this collaboration will only reinforce patients' internal locus of control about managing chronic disease.

Finally, the growing trend toward evidence-based practice necessitates that health behavior counselors acquire empirical data on interventions addressing psychological constructs and adherence (Britt et al., 2004; van Eijk-Hustings et al., 2011; Mesters, 2009). There is overwhelming information indicating that cognitive-behavioral techniques and motivational interviewing are effective in clinical trials with convenient sampling of highly motivated groups. In addition, there is some evidence that both give patients and providers better tools for managing chronic diseases in outpatient and inpatient settings (van Eijk-Hustings et al., 2011; Payne 2012), yet there remains room for health behavior counselors to standardize the interventions' essential components into concise plans that others can replicate over time. Medication adherence research stands to

benefit if future investigations evaluate best practices that incorporate the discussed implications for theory and practice.

Limitations

The observed outcomes demonstrated that a number of psychological pathways along with age can influence a person's medication adherence. Nonetheless, the standard fit index for categorical data models, root mean square error of approximation (RMSEA), exceeded the recommended 0.08 criterion. Subsequent attempts to rearrange parameter effects of noninfluential psychological constructions around internal locus of control and time perspective did not bring the RMSEA estimate to the recommended cutoff. Future studies must determine the best possible arrangement for the total model.

The primary benefit of using the 4-item MMAS is that it quickly captures past medication-taking behaviors, which can be the best predictor of future behavior (DiMatteo et al., 2012; Turner, Weiner, Yang, & TenHave, 2004). Even still, the 4-item MMAS has marginal internal consistency ($\alpha = .61$), which compelled Morisky and colleagues to generate a second inventory after the NIH collected the current data. The results should be confirmed with other measures with more optimal psychometric properties, including the 8-item MMAS (Morisky, Ang, Krousel-Wood, & Ward, 2008), which has higher internal consistency ($\alpha = .83$).

Another limitation is that the path analysis does not compare medication adherence for people taking antihypertensives and antidiabetics. Rather, it treats both as similar examples of health behaviors for chronic disease management. Other adherence studies have recently provided several rationales for simultaneously investigating hypertension and diabetes care (Broadbent et al, 2011; Mann et al., 2009; Schimittdiel et

al., 2008). Most notably, individuals with both diagnoses initially take oral prescriptions and experience few symptoms (Lau & Nau, 2004). Medications for these conditions typically have delayed tangible health benefits, meaning that the advantages of adhering on a daily basis accrue over time. Moreover, the results demonstrated statistical evidence that individuals had similar behaviors for most antihypertensive and antidiabetic drug use.

One last limitation highlights strengths and weaknesses of results derived from community-based observational studies. Primarily, our findings contribute information amid a growing need to improve medication adherence (DiMatteo et al., 2007; Pinto et al., 2005). Similar efforts to collect data in community settings may decrease self-reporting bias and improve the validity of self-reported medication adherence, whereas convenient recruitment at research hospitals often captures opinions of patients with more resources and motivation to improve health (Hood, 2011; Patel & Taylor, 2002). Our study demonstrates how insights from more diverse populations derive valuable information about chronic disease management.

Nonetheless, one must interpret the results of categorical data modeling with some caution. The nature of observational studies requires several additional steps, namely replication studies and clinical trials, to say conclusively medication adherence will improve based on tailoring treatment to patients' psychological motivators. For instance, health behavior counselors will benefit from future studies with larger sample sizes diagnosed with a variety of chronic conditions. Any new knowledge, whether it replicates or challenges the presented data models, will provide them additional information on barriers to prescription drug use. Secondly, health professionals must

determine the effectiveness of targeting time perspective and internal locus of control in individual interventions to increase adherence. Future efforts to compare clinicians' advice-giving versus cognitive-behavior techniques or motivational interviewing will further incentivize more health systems to adopt health behavior counseling. Given evidence that patients with hypertension or diabetes struggle with medication adherence, another important step is implementing population-based randomized clinical trials to verify the benefit of training and evaluation related to patient motivation to reduce medical risks and costs across in-patient and outpatient settings.

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Appendix

List of Items om Medication Adherence, Time Perspective, Health Beliefs, and Health Locus of Control Beliefs

Variable	Item	
Medication adherence	1	Do you ever forget to take your medicine?
	2	Are you careless at times about taking your medicine?
	3	When you feel better do you sometimes stop taking your medicine?
	4	Sometimes if you feel worse when you take the medicine, do you stop taking it?
Time perspective		
Present-hedonistic	1	I believe that getting together with one's friends to party is one of life's important pleasure
	2	I do things impulsively.
	3	When listening to my favorite music, I often lose track of time.
	4	I try to live my life as fully as possible, one day at a time.
	5	Ideally, I would live each day as if it wre my last.
	6	I make decisions on the spur of the moment.
	7	It is important to put excitement in my life.
	8	I feel that it is more important to enjoy what you are doing than to get work done on time.
	9	Taking risks keeps my life from being boring.
	10	It is more important to me to enjoy life's journey than to focus only on the destination.
	11	I take risks to put excitement in my life.
	12	I often follow my heart more than my head.
	13	I find myself getting swept up in the excitement of the moment.
	14	I prefer friends who are spontaneous rather than predictable.
	15	I like my close relationships to be passionate.

List of Items om Medication Adherence, Time Perspective, Health Beliefs, and Health Locus of Control Beliefs (Continued)

Variable		Item
Time perspective		
Present-fatalistic		
	1	Fate determines much in my life.
	2	Since whatever will be will be, it does not really matter what I do.
	3	It takes joy out of the process and flow of my activities, if I have to think about goals, outcomes, and products.
	4	You can't really plan for the future because things change so much.
	5	My life path is controlled by forces I cannot influence.
	6	It does not make sense to worry about the future, since there is nothing that I can do about it anyway.
	7	Life is too complicated; I would prefer the simpler life of the past.
	8	Spending what I earn on pleasures today is better than saving for tomorrow's security.
	9	Often luck pays off better than hard work.
Future		
	1	I believe that a person's day should be planned ahead each morning.
	2	If things do not get done on time, I do not worry about it (reversed).
	3	When I want to achieve something, I set goals and consider specific means for reaching those goals.
	4	Meeting tomorrow's deadlines and doing other necessary work comes before tonight's play.
	5	It upsets me to be late for appointments.
	6	I meet my obligations to friends and authorities on time.
	7	I take each day as it is rather than try to plan it out (reversed).
	8	Before making a decision, I weigh the costs against the benefits.
	9	I complete projects on time by making steady progress.
	10	I make lists of things to do.
	11	I am able to resist temptations when I know that there is work to be done.
	12	I keep working at difficult, uninteresting tasks if they will get me ahead.
	13	There will always be time to catch up on my work (reversed).

List of Items om Medication Adherence, Time Perspective, Health Beliefs, and Health Locus of Control Beliefs (Continued)

Variable	Item	
Health beliefs		
Perception of disease severity	1	Which of the following statements best describes your view of high blood pressure?
Perception of susceptibility to future complications	1	High blood pressure can increase a person's risk of having stroke, heart trouble, or kidney failure in the future. Which of the following statements best describes how you think about your high blood pressure?
Health locus of control beliefs		
Internal locus of control		
	1	If I get sick, it is my own behavior which determines how soon I get well again.
	2	I am in control of my health.
	3	When I get sick, I am to blame.
	4	The main thing which affects my health is what I myself do.
	5	If I take care of myself, I can avoid illness.
	6	If I take the right actions, I can stay healthy.
Chance		
	1	No matter what I do, if I going to get sick, I will get sick.
	2	Most things that affect my health happen to me by accident.
	3	Luck plays a big part in determining how soon I will recover from an illness.
	4	My good health is largely a matter of good fortune.
	5	No matter what I do, I'm likely to get sick.
	6	If it's meant to be, I will stay healthy.
Powerful others		
	1	Having regular contact with my physician is the best way for me to avoid illness.
	2	Whenever I don't feel well, I should consult a medically trained professional.
	3	My family has a lot to do with my becoming sick or staying healthy.
	4	Health professions control my health.
	5	Whenever I recover from an illness, it's usually because other people have (for example, doctors, nurses, family, friends) have been taking good care of me.
	6	Regarding my health, I can only do what my doctor tells me to do.

Institutional Review Board Approval

The University of Memphis Institutional Review Board, FWA00006815, has reviewed and approved your submission in accordance with all applicable statuses and regulations as well as ethical principles.

PI NAME: Brittany Sansbury
CO-PI:
PROJECT TITLE: Path Analysis of Psychological Factors Associated with Medication Adherence for Individuals with Chronic Diseases.
FACULTY ADVISOR NAME (if applicable): Chrisann Schiro-Geist
IRB ID: #2543
APPROVAL DATE: 3/18/2013
EXPIRATION DATE: 1/28/2014
LEVEL OF REVIEW: Expedited

Please Note: Modifications do not extend the expiration of the original approval

Approval of this project is given with the following obligations:

1. If this IRB approval has an expiration date, an approved renewal must be in effect to continue the project prior to that date. If approval is not obtained, the human consent form(s) and recruiting material(s) are no longer valid and any research activities involving human subjects must stop.

2. When the project is finished or terminated, a completion form must be completed and sent to the board.

3. No change may be made in the approved protocol without prior board approval, whether the approved protocol was reviewed at the Exempt, Exedited or Full Board level.

4. Exempt approval are considered to have no expiration date and no further review is necessary unless the protocol needs modification.

Thank you,

Ronnie Priest, PhD
Institutional Review Board Chair
The University of Memphis.