Intentional and unintentional medication nonadherence

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**INTENTIONAL AND UNINTENTIONAL MEDICATION
NONADHERENCE**

**NG SUAT LING JAMIE
SCHOOL OF MECHANICAL AND AEROSPACE ENGINEERING
2016**

INTENTIONAL AND UNINTENTIONAL MEDICATION NONADHERENCE

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Abstract

According to the World Health Organization, chronic diseases are estimated to account for 63% of deaths globally. However, adherence to chronic diseases therapy only averages 50% in developed countries. Despite decades of research, nonadherence to medication remains an unresolved healthcare issue. It is often thought that cognitive deficiency is the main reason for medication nonadherence; however, research showed that patients' active decision not to comply made up around half of the reasons. In the recent years, medication-taking behaviors have been considered from a reasoned decision-making perspective, where the medication nonadherence behaviors are categorized into unintentional or intentional factors. Therefore, a proper framework is necessary to explain intentional and unintentional nonadherence.

In this research, a hypothetical model is investigated to explain Intentional and Unintentional nonadherence and validated with subsequent studies. Two studies to understand medication nonadherence attitude in Singapore are carried out. The investigation revealed that only about 25%-30% of respondents are considered highly adherent to their medication in Singapore, based on the Morisky Medication Adherence Scale. About 40%-55% of the respondents cited "Forgetting" (i.e. unintentional nonadherence) for not taking their medication, while intentional nonadherence made up about 20-25% of the reasons. Differences between Younger and Older adults attitude towards medication adherence are also found. Younger adults are found to be more susceptible to both intentional and unintentional nonadherence, and the latter is influenced more by "busyness" than age.

We propose an Ability-Belief-Context (ABC) framework for understanding predictors of Unintentional and Intentional Medication Nonadherence. Ten variables and constructs are analyzed to identify relationships with intentional and unintentional

nonadherence, through mediation analysis. The variables and constructs are modeled into Ability, Beliefs and Context to study their influence on intentional and unintentional nonadherence: Ability includes: Perceived Prospective Memory, Perceived Ability (to self-manage medication) and Lifestyle Busyness; Belief includes: Trust in Medication, Trust in Doctor and Knowledge; while the Context includes: Social Support and External Cues (e.g. pillbox use).

Attitude, Beliefs, Trust in Medication and Trust in Doctor are consistently found to influence intentional medication nonadherence. Perceived Prospective Memory and Busyness are significantly associated with both adherence and attitude, and mediated by both intentional and unintentional factors. Contextual factors, such as Social Support in reminding an individual to take their medication have an effect on unintentional nonadherence. Pillbox use is however not found to contribute to intentional nor unintentional nonadherence.

This research made several contributions in the understanding of medication nonadherence: First, a comprehensive study on reasons for medication nonadherence in Singapore is studied and validated through subsequently studies. Second, ten factors contributing to intentional and unintentional are analyzed to determine both intentional and unintentional mediating effects. Third, age-related differences and attitudes towards medication nonadherence are analyzed. Fourth, a combination of psychosocial and human factors approaches is adopted to understand medication nonadherence. And last but not least, a framework is proposed to identify the relationships between predictors, mediating factors of intentional and unintentional nonadherence based on Abilities, Beliefs, Context and Age.

Chapter 1   Introduction

1.1 Importance of Medication Nonadherence

Chronic diseases, such as diabetes, heart diseases, cancer and chronic respiratory diseases are the primary cause (63%) of the 57 million global deaths in 2008 (World Health Organization [WHO], 2011). In Singapore, these diseases are estimated to account for 70% of deaths (WHO, 2011). Hypertension, diabetes and high total cholesterol are the top 3 diseases prevalent among adults age 18 to 69 (Ministry of Health Singapore, 2010), accounting for a total of 52.1% of the chronic diseases.

Medication is often prescribed for the management of illness and chronic diseases. However, studies have shown that a substantial proportion of patients do not adhere to the medication regime as prescribed by their doctors (National Community Pharmacists Association [NPCA], 2006). The survey conducted in the United States of America (USA) found that nearly 3 out of 4 American consumers reported not taking their prescription medicine as directed. Almost half of those polled (49%) said they had forgotten to take the prescribed medicine; nearly one-third (31%) had not filled a prescription they are given; nearly three out of 10 (29%) had stopped taking a medicine before the supply ran out; and almost one-quarter (24%) had consumed less than the recommended dosage.

According to the WHO (2003), adherence to chronic diseases therapy averages 50% in developed countries, and is even lower in developing countries. Even for clinical trial, where adherence is expected to be high, reported adherence rate averages 43 to 78 per cent among chronic diseases patients (Osterberg et al., 2005).

Improving medication management, particularly for chronic conditions has been highlighted as a priority area for policy development and healthcare transformation (Naylor et al., 2013; Mitka, 2010). Poor adherence to medication is estimated to cause 33 to 69 percent of medication-related hospital admission (Osterberg et al., 2005), costing approximately \$100 billion annually in USA, and account for 10% of hospital admission, 23% of admission to nursing homes (Virmiere et al. 2001).

Poor adherence to disease management therapy compromises the effectiveness of treatment. Without a system to enhance adherence, it will be difficult for advances in biomedical technology to realize its full potential to reduce the chronic disease burden (WHO, 2003). Poor medication adherence is of such striking magnitude that WHO published an evidence-based guide calling for the healthcare professionals and policy-makers to conduct more research to improve medication adherence strategies (WHO, 2003). Many health organizations, such as the National Council on Patient Information and Education (NCPIE, 2007), American Society of Consultant Pharmacists Foundation (ASCP, 2006), The National Collaborating Centre for Primary Care (NCCPC, 2009), and the American College of Preventive Medicine (ACPM, 2011) have since promoted the issue of medication nonadherence and strategies for improvement.

Singapore is one of the fastest ageing populations in the world. By 2050, Singapore will be the world's 4th largest ageing nation (see Table 1), after Japan, Macao and Korea, with the median age of population at 55 (United Nations, 2012). By 2030, 1 in 5 Singaporeans will be aged 65 and above (Ministry of Community Development, Youth and Sports [MCYS], 2006). With Singapore facing an ageing population, the management of medication for chronic disease will increasingly be more important.

Table 1: By 2050, Singapore will be the world's 4th largest ageing nation (United Nations, 2012)

Percentage of total population age 60 or over		
Country or area	2012	2050
Japan	32	41
Republic of Korea	17	39
China, Macao SAR	12	38
Singapore	15	38
China, Hong Kong SAR	19	37
Bulgaria	25	36
United Arab Emirates	1	36
Poland	20	35
Georgia	20	35
China	13	34

Many older adults are affected by multiple chronic diseases, which often require complex and long term treatment. According to WHO (2003), a study reported that in developed countries, although older adults over 60 years old represent only 12-18% of the population, they consume approximately 50% of all prescription drugs, and are responsible for 60% of medication-related costs. Adherence to treatment is especially important to the well-being of older adults. Failure to adhere to medical treatment increases the likelihood of therapeutic failure, unnecessary complications, increased spending, disability and premature death (WHO, 2003).

Although poor adherence to prescribed regime affects all age groups, the prevalence of cognitive and functional impairment in older adults (Johnson et al., 1999) is said to increase their risk of poor adherence. Multiple co-morbidities in older adults, leading to complex medical regimes further complicates adherence.

Improving medication adherence is found to be associated with lower rates of hospitalization and total medical cost for some chronic medical conditions such as diabetes, hypertension, hypercholesterolemia and congestive heart failure (Sokol et al.,

2005). Improving adherence has the potential to enhance patient safety, result in cost-savings and increase the effectiveness of health interventions (WHO, 2003).

1.2 Limited Understanding of Medication Nonadherence

Becker and Mainman (1975) said that “patient compliance has become the best documented but least understood health behavior.” As shown in Table 2, many factors affect medication nonadherence. A search on “medication nonadherence” in Pubmed lists research as far back as 1975, shows an exponential increase in publications in the recent years, with about 2,000 publications a year from 2010 – 2014 (see Figure 1 below), with over a 1,000 publications by mid 2015. As can be seen from the recent interests in this topic, there remains much to be understood about this health behavior. With rapidly aging global population, researchers have recognized the importance of understanding patients’ adherence behavior in order to achieve therapeutic success. However, despite decades of research attempting to predict and rationalize medication nonadherence factors, nonadherence to medication remains an unresolved healthcare issue (Lehane et al., 2007).

Figure 1: Chart on research papers retrieves for “medication nonadherence” search results by year from PubMed (retrieved from <http://www.ncbi.nlm.nih.gov/pubmed> 22 June 2015)

Table 2: Example of variables in each of the five dimensions affecting adherence (WHO, 2003)

Social and economic factors	Health care team and system	Condition-related factors	Therapy-related factors	Patient-related factors
• Poor socioeconomic status; • Poverty; • Illiteracy; • Low level of education; • Unemployment; • Lack of effective social support networks; • Unstable living conditions; • Long distance from treatment centre; • High cost of transport; • High cost of medication; • Changing environmental situations; • Culture and lay beliefs about illness and treatment; • Family dysfunction.	• Patient-provider relationship; • Health services with inadequate or non-existent reimbursement by health insurance plans; • Poor medication distribution systems; • Lack of knowledge and training for health care providers on managing chronic diseases; • Overworked health care providers; • Lack of incentives and feedback on performance; • Short consultations; • Weak capacity of the system to educate patients and provide follow-up; • Inability to establish community support and self-management capacity; • Lack of knowledge on adherence and of effective interventions for improving it.	• Severity of symptoms; • Level of disability (physical, psychological, social and vocational); • Rate of progression and severity of the disease; • Availability of effective treatments; • Patients' risk perception; • Importance of following treatment; • Co-morbidities, such as depression, diabetes, HIV/AIDS; • Drug and alcohol abuse.	• Complexity of the medical regimen; • Duration of treatment; • Previous treatment failures; • Frequent changes in treatment; • Immediacy of beneficial effects; • Side-effects; • Availability of medical support to deal with them; • Unique characteristics of diseases and/or therapies.	• Patients' resources; • Patients' knowledge, attitude and beliefs about their illness; • Perceptions; • Motivation to manage it; • Confidence (self-efficacy) in their ability to engage in illness-management behaviors; • Expectations of the patient, regarding the outcome of treatment and the consequences of poor adherence; • Forgetfulness; • Psychosocial stress; • Anxieties about possible adverse effects; • Low motivation; • Inadequate knowledge and skill in managing the disease symptoms and treatment; • Lack of self-perceived need for treatment; • Lack of perceived effect of treatment; • Negative beliefs regarding the efficacy of the treatment; • Misunderstanding and non-acceptance of the disease; • Disbelief in the diagnosis; • Lack of perception of the health risk related to the disease; • Misunderstanding of treatment instructions; • Lack of acceptance of monitoring; • Low treatment expectations; • Low attendance at follow-up, or at counseling, motivational, behavioral, or psychotherapy classes; • Hopelessness and negative feelings; • Frustration with health care providers; • Fear of dependence; • Anxiety over the complexity of the drug regimen, and feeling stigmatized by the disease.

In Singapore, about 1 million people are affected by chronic diseases such as diabetes, high blood pressure, high blood cholesterol (National Health Survey, 2010). A study conducted outside of Singapore by Col et al's (1990) with 315 elderly patients found that approximately 11% of the admissions are related to medication noncompliance. It is estimated that about 28% of all admission in the population are

drug-related, with a mean cost of USD\$2,150 per admission associated with medication nonadherence (Balkrishnan, 1998).

In Singapore, Koh et al. (2003) conducted a study on 300 over patients (age 16-97) who are on a mean 7.4 ± 2.1 medications, found that 10.8% of the hospital admissions are drug-related problems (DRP). The problems which included non-compliance are mostly avoidable, and 52% of the cases are older adult patients. Another study by Yeoh et al. (2013) on DRP among 180 elderly cancer patients found that nonadherence to medication made up of 13.3% of the DRP and is among the top three common DRP. With Singapore facing an aging population, the trend in chronic diseases rising and many older adults taking multiple medications, it is increasingly important that the problem of medication nonadherence is looked into.

Given the importance of improving health outcome, reducing drug-related hospitalization admission rates, and realizing the full potential of biomedical technology, it is hence critical to understand the reasons for nonadherence. In-depth understanding of the factors contributing to nonadherence will aid in the development of tools and more effective interventions to improve medication nonadherence. Medication nonadherence has been researched substantially from the psychosocial perspective, as can be seen from the various models and frameworks available for medication nonadherence research such as Health Belief Model (Rosenstock et al., 1988) and the Necessity-Concern Framework (Horne et al., 1999). While psychosocial approaches focus on explaining behaviors and attitudes in a social context, it does not look into human abilities or environmental support; human factors approaches on the other hand, focus more on human abilities, as the human interacts with the environment and society. Combining psychosocial and

human factors approach will result in a more holistic framework to explain medication nonadherence.

1.2.1 Reasons for Medication Non-Adherence

A survey conducted by Boston Consulting Group [BCG] (2003) found that forgetfulness is the top reason cited by subjects for not adhering to medication, accounting for 24% of the reasons (see Figure 2). However, what is more alarming is, patients' active decision to not comply made up majority of the other reasons, or more than 50% of the reasons for nonadherence. These reasons includes "don't want side effects", "drugs cost too much" or, "don't think I need the drug".

Figure 2: Graphical representation showing reasons for medicine nonadherence. (BCG, 2003)

1.3 Limited Understanding of Intentional and Unintentional Medication

Nonadherence

In recent years, medication-taking behaviors have been considered from a reasoned decision-making perspective (Wroe, 2002; Donovan et al., 1992), where medication nonadherence is categorized into unintentional (due to suboptimal cognitive performance) or intentional (due to doubts about the necessity of the medication) factors (Gadkari et al., 2012; Unni et al., 2011, Lehane et al., 2007). The latter represents patient's active decision to forgo the therapy.

It is commonly assumed that the patient is solely responsible for being adherent to their treatment (WHO, 2003). Research found that many other factors affect a patient's capacity to adhere. It is estimated that there are over 200 variables predicting medication nonadherence (Levesque et al., 2012, Cameron 1996, Morisky et al., 1986). WHO (2003) characterized these factors into five dimensions as described below:

- Socio and Economics Factors
- Health Care Team (HCT) and Health System Factors
- Condition-Related Factors
- Therapy-Related factors
- Patient-Related Factors

Figure 3 shows the five dimensions, while Table 2 presented earlier in section 1.2 shows the examples of the variables in each of the five dimensions.

Figure 3: The five dimension of adherence (WHO, 2003)

Although researchers have recognized that medication nonadherence is influenced by intentional and unintentional factors (Gadkari et al., 2012; Unni et al., 2011; Lehane et al., 2007; Wroe, 2002), there is currently no framework to explain what influences intentional and unintentional nonadherence. In addition, from the earlier works surveyed, substantial research and statistics on the medication nonadherence are conducted outside of Singapore (Osterberg et al., 2005; Balkrishnan, 1998). Although there is research in Singapore looking into tools for measuring medication adherence (Wang et al., 2012), medication management interventions (Yeoh et al., 2013) and hospital admission rates due to the medication nonadherence (Koh et al., 2003), research on the adherence rate in Singapore or predictors of the intentional and unintentional factors cannot be found. With Singapore facing an aging population, it is important to establish a baseline on adherence levels in Singapore and the reasons for nonadherence.

1.4 Objective, Scope and Research Approach

The main objective of this research is to develop a framework to explain intentional and unintentional nonadherence to medication. The proposed framework will further contribute to the understanding of the predictors of medication adherence through a combination of human factors (human limitation or unintentional factors) and psychosocial (beliefs or intentional factors) approaches. This can be attained through the following sub-objectives:

1. Survey on the body of research on predictors and frameworks available to explain medication nonadherence.
2. Investigate and validate its applicability to Singapore.
3. Validation of the hypothesis and identification of gaps.
4. Develop a framework that combines human factors considerations with psychosocial models to explain intentional and unintentional medication nonadherence behavior.

1.5 Overview of the Thesis

- Chapter 2 provides a background of medication-adherence problems, literature review and predictors of medication adherence.
- Chapter 3 presents the proposed framework for intentional and unintentional medication nonadherence.
- Chapter 4 presents Study #1 which investigates Age, Lifestyle, Knowledge, Attitude and External Cues effects on intentional and unintentional medication nonadherence.

- Chapter 5 presents Study #2 which seeks to validate the effects of Age, Lifestyle, Knowledge, Attitude and External Cues on intentional and unintentional medication nonadherence.
- Chapter 6 presents Study #3 investigating Trust in Medication, Trust in Doctor, Perceived Prospective Memory, Perceived Ability and Social Support effects on intentional and unintentional medication nonadherence.
- Chapter 7 validates the proposed Ability-Belief-Context (ABC) framework.
- Chapter 8 concludes with general discussion, contribution to research, limitation and suggestions for future research.

Chapter 2   Literature Review, Theoretical Frameworks and Research Gaps

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This chapter presents a literature review of related work, theoretical frameworks and models available, as well as research gaps.

It is suggested that Medication Adherence is an extremely complex behavior, and no single variable can account for the rates of nonadherence that have been observed in various populations (Park et al., 1999). Instead, only by examining a mix of medication, disease, psychosocial and cognitive variables can one begin to understand what factors might drive medication-taking behaviors (Park et al. 1992).

2.1 Definition of Adherence to Medication

Adherence to medication is defined as the extent to which a patient takes his medication as prescribed by his healthcare provider (Osterberg et al., 2005). The term “adherence” is generally preferred compared to the term “compliance”, as the latter suggests that a patient is passively following the doctor’s orders. In other literatures, “concordance” and “persistence” are also used. Where “concordance” is referred to as an agreement between a patient and healthcare professional about when and how medicines are to be taken (Bissell, May and Noyce, 2004); “persistence” is referred to as an act of continuing the treatment for the prescribed duration (Cramer et al., 2008). Regardless of which word is used, medication treatment is only effective if a patient follows the prescribed treatment reasonably closely (Osterberg et al., 2005). For the clarity of discussion, “adherence” will be used for most of this report.

2.2 Measuring Medication Adherence

Measurement of adherence can be broken down into direct and indirect methods (Osterberg et al., 2005). Each has its own advantages and disadvantages. Direct methods include measurement of concentrations of a drug or its metabolite in blood or urine. Direct methods are expensive and tend to be invasive. Indirect methods of measurement of adherence include asking the patient through questionnaire tools, performing pill counts, ascertaining rates of refilling prescriptions, or using electronic medication monitors. While direct method appears to be more objective, it is susceptible to distortion by the patient (Osterberg et al., 2005). As indirect methods are less costly and relatively easy to use, they remain a popular method for measuring adherence.

The Morisky 8-item Medication Adherence scale, a questionnaire tool, has received substantial interests in the medical field in the recent years. This can be seen by several researchers using it to assess medication adherence (Wang et al., 2012; Al-Qazaz et al., 2010; Sakthong et al. 2009, Korb-Savoldelli, 2012). The scale has been validated in various research and is found to have good concurrent and predictive validity for measuring adherence rate (Morisky et al. 2008, Morisky et al., 1986). The scale converts patients answers into an adherence score 0-8 corresponding to High adherence (score=8), Medium adherence (score= 6 to 7) and Low adherence (score < 6), allowing healthcare practitioners to quickly access their patient level of adherence and plan the necessary intervention required. In addition, the scale is simple to understand and relatively easy to administer.

2.3 Predictors of Medication Adherence

Balkrishnan (1998) conducted a search in Medline and retrieved papers from 1962 to 1997. His descriptive analysis revealed that there remains uncertainty about the reasons for noncompliant medication-taking. There are clear association for race, drug and dosage form, number of medications, cost of medication, insurance coverage and physician-patient communication. There is however inconsistent effects of patient's age, sex and socioeconomic status, living arrangement, co-morbidities, number of physician visits, knowledge, attitude and beliefs about health.

In many reports, demographic variables are generally considered to be poor predictors of adherence with the exception of age (Levesque et al., 2012). Some research found that adherence increases with age, with the exception of those above 75 (Mehta et al., 1997). It is suggested that older adults may be more concerned about their mortality and are hence more likely to stick to their treatment regimen compared to younger adults (Karamanidou et al., 2008). In addition, older adults, especially those who are retired, may have more time and are less busy, and hence more able to accommodate medication taking into their routine. The decline in adherence among those above 75 may be attributed to age-related impairments and the more complex medicine regimens needed (Mehta et al.1997).

It is commonly reported that the primary reason for medication nonadherence is forgetfulness (BCG, 2003), in particularly in older adults who are more susceptible to prospective memory failure (Insel et al., 2006; Stilley, 2010). Consistent with BCG's (2003) findings discussed earlier, Osterberg et al. (2005) also reported that typical reasons cited by patients for not taking their medications are forgetfulness (30%),

followed by other priorities (16%), decision to omit doses (11%), lack of information (9%) and emotional factors (7%). As can be seen, although forgetfulness (unintentional nonadherence) may be the top reason frequently cited, patients decision to forego the prescribe therapy (intentional reasons) makes up a total of 43% of the other reasons.

Unintentional nonadherence, as defined by Gadkari et al. (2012), is a passive process where a patient fails to adhere to the prescribed therapy due to forgetfulness, carelessness or circumstances beyond their control. Intentional nonadherence is defined as an active decision on the patient part to forego the prescribed therapy. Wroe (2002) defines unintentional nonadherence as forgetting to take the medication, whereas intentional nonadherence is referred as a conscious decision to miss/alter one's medication doses without first consulting with the physician.

Wroe (2002) found that intentional nonadherence is associated with decision balance; unintentional nonadherence is less strongly associated with decision balance and more strongly associated with demographics, in particularly age. As age-related impairments may lead to forgetfulness, we hence expect older adults to be more susceptible to unintentional nonadherence.

Medication adherence research had been conducted extensively in the medical, psychosocial field, with some work in the human factors domain. To explain human behavior in relation to social cognition, it is found that intentional nonadherence is researched in the psychosocial and medical domain, where many researchers point to medication belief as a root cause for nonadherence (Horne et al., 1999, Rosenstock et al., 1988). Intentional nonadherence is thought of as a decision-making process, where the

patient considers the pros and cons of the expected behavior, as well as self-efficacy evaluation.

The hypothesis is, if a patient does not believe in the need or effectiveness of the medication, they will be less motivated to making the extra effort to take all the medication, seek further information, or bear with its side effects. If the patient does not believe the medication help achieve his goal (i.e. to get well) or that he needs the medication, he will not be motivated to take his medication, hence leading to intentional nonadherence.

Unintentional nonadherence related research is found in the human factors domain, where the problem is seen as caused by cognitive deficiency due to age-related degeneration, or poor design of tools and environment to make up for the human's limitation. Research in this domain covers cognitive processes necessary to support medication adherence (Insel et al., 2006), better medication instruction design to aid recall (Morrow et. al., 1996, Morrow et. al., 1993), strategies and cues for remembering medication (Boron et. al., 2006) and tools to support self-management of medication (Hernandex et. al. 2011). Cognitive deficiency, in particularly working memory and executive function, is found to be a significant predictor of medication nonadherence (Insel et al., 2006). Calling for better technology, contextual and instructions design is recommended to support patients in their medication adherence activity (Hernandex et. al. 2011; Boron et. al., 2006; Morrow et. al., 1996). A conceptual framework to support medication adherence highlighting the role of cognitive functions, external cues and illness representation is proposed by Park et al. (1997). This framework will be discussed

in the next section. On unintentional nonadherence, the research agenda is on understanding human limitation and better design to support the behavior.

2.4 Theoretical Frameworks and Models for Medication Nonadherence

Over the years, several theoretical frameworks and models to guide Medication Adherence behavior research have been developed. The following will be discussed here:

- Theory of Planned Behavior [TPB] (Ajzen, 1991)
- Park's Conceptual Model of Medication Adherence (Park et al., 1997)
- Health Belief Model [HBM] (Rosenstock et al., 1988)
- Necessity-Concern Framework [NCF] (Horne et al., 1999)

TPB, (Ajzen, 1991), HBM (Rosenstock et al., 1988) and NCF (Horne et al., 1999) represent the psychosocial models taking into consideration beliefs and social influence, while Park's Conceptual Model of Medication Adherence represents the human factors model taking into account human abilities and environmental/tools to support adherence.

2.4.1 Theory of Planned Behavior (Ajzen, 1991)

TPB (Ajzen, 1991) has been used widely to explain human behavior and behavioral intention in healthcare, as well as in consumer applications. It is used to explain that a person's intent to act is guided by the person's beliefs, attitude and perceived behavior control. According to Ajzen (1991), intention to perform different kinds of behavior, can be predicted with high accuracy from (i) attitudes towards the behavior, (ii) subject norms and (iii) perceived behavioral control. These intentions, together with the perceived behavioral control, can account for considerable variance in the actual behavior. Figure 4 shows the relationships between these constructs.

Figure 4: Theory of Planned Behavior (Ajzen, 1991)

According to Ajzen's TPB, human behavior is guided by three kinds of beliefs:

- Behavioral Beliefs – belief about the likely outcome of the behavior and the evaluations of these outcomes.
- Normative Beliefs – belief about the normative expectations of others and motivation to comply with these expectations
- Control Beliefs – beliefs about the presence of factors that may facilitate or impede performance of the behavior and perceived power of these factors.

Behavioral beliefs produce a favorable or unfavorable attitude towards the behavior. Normative beliefs result in perceived social pressure or subjective norms. Control beliefs give rise to perceived behavioral control. In combination, attitude toward the behavior, subjective norm and perception of behavioral control lead to the formation of behavioral intention. The more favorable the attitude and subjective norm, and the greater the perceived control, the stronger a person's intention to perform the behavior will be. Given sufficient actual behavioral control, the person is expected to carry out their intentions when opportunity arises.

Intention is assumed to be the immediate antecedent of the behavior. However, behaviors that pose difficulties of execution may limit volitional control; and hence perceived behavioral control needs to be considered in addition to intention. Figure 5 below shows a simplified model of TPB we can potentially use to explain the role of intentional and unintentional nonadherence from a psychosocial perspective.

Figure 5: A Simplified model of TPB (Azjen, 1991) with added description on how it can be used to described intentional and unintentional behaviors

2.4.2 Park's Conceptual Model of Medication Adherence (Park et. al., 1997)

In the body of Human Factors literature, Park et al., (1997) proposed a conceptual model of medication adherence (see Figure 6). The model consists of the following three key constructs to predict adherent behaviors:

- Illness Representation : Patient's representation of his or her illness.
- Cognitive Function : Patient's cognitive functions.
- External Cues : External aids or strategies used by the patient to enhance medication-taking behavior.

Figure 6: A Conceptual Model of Medication (Park et al., 1997)

The model proposed that medication adherence of an older person with a severe chronic condition can be predicted by how serious he thought it was, whether he understood that the medication is important to prevent a stroke (illness representation),

whether he comprehended and remembered the instructions associated with the medication (cognitive function), and whether he developed a strategy of placing his medication in an organizer for memory assistance (external cues).

In the proposed model, Illness Representation is hypothesized to play a much more important role in determining medication adherence than objective disease variables. That is, beliefs about the illness rather than objective symptoms and severity predict adherent behavior. If a person does not believe that he is ill or that the medication does not meet his health objectives, nonadherence is likely to occur, regardless of the symptoms (Park & Jones, 1997). Individual differences, such as education, literacy, social economic status, shape an individual's belief about his illness and need for medication.

Age is expected to function primarily through Cognitive Factors, as age-related decline in processing ability is a well-documented phenomenon. The amount of cognitive resources available to an individual in some circumstances, will determine whether he or she is able to comprehend and remember a complex medication regime.

Social support in the home is included as an External Cue because partners frequently play a role in reminding an individual to take medication. In addition, medication organizers (e.g. pillboxes) and reminder devices help to provide cue to remind patients to take their medication.

According to Park et al. (1997), the model assumes that medication adherence is a good thing and it leads to health and well-being. In addition, the model is congruent

with human factors approach as human factors specialists are concerned with designing materials and interventions to improve performance. The model is said to be a holistic approach as it takes into consideration beliefs and cognitive considerations.

2.4.3 Health Belief Model (Rosenstock et al., 1988)

HBM is a psychosocial model developed for health behavior change (Rosenstock et al., 1988). The model is developed in 1950s and is a widely used theory in health behavior research (Carpenter, 2010; Glanz et. al., 2010). The model asserts that belief about the health outcome is associated with the motivation to take action. The beliefs and attitude can be either influenced by self-evaluation or by social norms. The theoretical constructs are:

- Perceived Severity
- Perceive Susceptibility
- Perceived Benefits
- Perceived Barriers
- Modifying Variables
- Cues to Action
- Self-Efficacy

The Health Belief Model

Figure 7: Health Belief Model (Rosenstock et al., 1988)

The model is one of the most widely used and well-tested models for explaining and predicting health-related behavior (Carpenter, 2010). The model attempts to predict health behaviors by accounting for individual differences in beliefs and attitudes; however it does not account for contextual factors, such as environmental factors that prevent an individual from engaging in the desired behavior (Janz et al., 1984) or unintentional behaviors (Glanz et al., 2008).

2.4.4 Necessity-Concern Framework (Horne et al., 1991)

NCF is a framework that breakdowns the appraisal of medication beliefs into necessity beliefs and concerns beliefs (Horne et al., 1991).

Figure 8: Necessity-Concern Framework (Horne et al., 1991)

Assessment of a person's belief towards their medication can be assessed and scored using an 18-item questionnaire. The questionnaire comprises of 4 factors:

- Specific-Necessity
- Specific-Concerns
- General-Overuse
- General-Harm

The questionnaire is rated on a 5-point Likert scale. Below shows some of the questions in some of the constructs:

Specific-Necessity

- My health, at present, depends on my medicines
- My life would be impossible without my medicines
- Without my medicines , I would be very ill
- My health in the future will depend on my medicines
- My medicines protect me from becoming worse

Specific-Concerns

- Having to take medicines worries me

- I sometimes worry about long-term effects of my medicines
- My medicines are a mystery to me
- My medicines disrupt my life
- I sometimes worry about becoming too dependent on my medicines

The mean score of each factor gives an indication of the beliefs that patients have towards their medication. For example, the higher a score in Specific-Necessity, the stronger the patient believes that taking the medication for his specific condition is necessary. Researchers can correlate the adherence score to indicate how beliefs affect adherence level.

2.5 Research Gaps

From the literature review, although a body of literature exists to explain medication nonadherence, there is currently no framework available to explain what predicts intentional and unintentional nonadherence. In addition, the extent of medication nonadherence in Singapore is not yet well understood. Although it may be argued that past research outcome may be generalized to other countries, WHO's (2003) report showed that medication adherence rate differ between developed and developing countries, and is influenced by social and economic factors, health care team and systems, cultural and lay beliefs about illness and treatment etc (see Table 5). As such, validating the extent of medication nonadherence in Singapore is important for this study. Research covering intentional and unintentional nonadherence through a combination of human factors (prospective memory decline or unintentional factors) and a psychosocial (beliefs or intentional factors) is also lacking. This research will hence investigate and unify the

framework from two different domains and present a more holistic approach to the understanding of intentional and unintentional medication nonadherence.

It is suggested that if the problem with medication adherence is Belief (intentional), then educate and counsel the patient; if the problem is with Cognitive (unintentional), then provide memory aids (Park et al., 1997). However, recent studies have shown that unintentional and intentional nonadherence are correlated (Gadkari et al., 2012, Unni et al., 2011), and that patients may report forgetfulness as a reason for nonadherence because they perceived it to be socially acceptable response (Unni et al., 2011). Ability to more accurately assess if nonadherence is caused by intentional or unintentional factors, can hence enable the right kind of intervention to be provided.

With reference to Figure 4, TPB looks at how different types of beliefs (behavioral, normative and control) affect a patient's behavior. The theory stems from a social cognitive perspective, taking into consideration how social environment (e.g. subjective norms) and perceived self-efficacy (e.g. behavioral control) shape a person's attitude and behavior towards medication adherence. However, the model does not consider subjects' actual ability to manage and remember to take the medication.

In addition, research on social demographics (e.g. age, race, education) and medical factors (e.g. disease severity) predictors often results in conflicting results (Mann et al., 2009). Among the various demographics variables, Age is found to be the strongest predictor of unintentional nonadherence (Levesque et al., 2012; Wroe, 2002). Although we expect older adults to be less adherent due to diminishing cognitive abilities, some research has found adherence increases with age (Mehta et al., 1997). As older

adults consumed a large healthcare, and evidences show that many cognitive functions (such as speed of information processing, working memory capacity and long-term memory) decline with age (Park et al., 2002), it is important that age effect on unintentional nonadherence is validated.

With reference to Figure 6, Park et al. (1997)'s Model of Medication Adherence, social support and medication organizer (pillbox) act as external cue to remind the patient to take their medication. The use of pillbox is often recommended as an intervention to improve adherence (Bosworth et al., 2011, Osterberg et al., 2005), in particularly unintentional nonadherence. However, evidence that pillbox use improves unintentional nonadherence is limited. This research will hence look at validating this.

Another study by Park et al. (1998) on rheumatoid arthritis older adults, who consume an average of 4.18 medications, found that despite high medication load and clear evidence of cognitive decline compared to younger adults, the older adults did not make a single error in their medication regime and showed better adherence than middle-age adults. The study also revealed that self-rated busyness is the most power variable on whether the subjects are adherence or not. Subjects who lead a very engaged and busy lifestyle are the most nonadherent. This suggests that busyness may be a better predictor of unintentional nonadherence than age alone.

Patient's attitude towards their medication necessity and involvement towards their own healthcare decision contribute to their adherent or nonadherent behavior. BCG (2003) has identified four patient segments:

- *Accepting* – patients who rely almost entirely on doctors for information and decisions.
- *Informed* – patients who rely on doctors to make decisions but typically do research after appointment to learn more about diagnosis or prescribed treatment.
- *Involved* – patients who see themselves as partners with their doctors in making healthcare decision.
- *In Control* - patients believe that they are best suited to determine their own care, using information from a variety of sources to diagnose their own conditions and determine which treatments they will request from doctors.

While some patients rely entirely on their doctor's recommendation when it comes to healthcare decisions, other patients are more involved. If patients rely entirely on their doctor's decision and trust their doctors' recommendation, intentional nonadherence is not likely to occur. If patients however rely on their own knowledge to determine the necessity of the medication, or alter their medication regime without informing their doctors, intentional nonadherence may hence occur. We therefore hypothesize that patients who are involved in their own healthcare decisions, are also more interested to know more about their medications. This may lead to intentional nonadherence, if the information about the medication necessity is suboptimal.

In a study by Lee et al. (2007), it is found that patients, who adhere to their medication and follow-up visits, score significantly higher on their disease knowledge test than those who are nonadherent. In another study, Amico et al. (2005) found that adherence information, along with adherence motivation, contributes to adherence

behavioral skills, which in turns result in better adherence. Having the correct knowledge about the medication need affects adherent behavior, which in turns increases motivation and self-efficacy, leading to less intentional nonadherent behaviors.

Based on the literature review, research gaps are identified. In this research, the interests will be to further investigate if Age, Busyness, Prospective Memory, Ability, External Cue and Social Support predict unintentional nonadherence, and if Trust in Medication, Trust in Doctor, Attitude (e.g. feeling Hassled), and Knowledge (e.g. interests to know more about medication) predict intentional nonadherence behavior. As such, this research will validate the relationships between these variables in relation to intentional and unintentional nonadherence.

Chapter 3 Development of Ability-Belief-Context (ABC) Framework

This chapter presents the proposed framework to study intentional and unintentional nonadherence.

3.1 Development of Ability-Belief-Context (ABC) Framework

With reference to Fishbein & Azjen (1975)'s Belief, Attitude, Intention and Behavior relationship (see Figure 9) and Parks (1997)'s model of medication adherence (see Figure 10), an Ability-Belief-Context (ABC) Framework is proposed to study the effects of predictors on intentional and unintentional nonadherence as shown in Figure 11.

Figure 9: Fishbein & Azjen (1975)'s Belief, Attitude, Intention and Behavior

Figure 10: Parks (1997)'s Conceptual Model of Medication Adherence

Figure 11: Proposed Ability-Belief-Context (ABC) Framework for intentional and unintentional nonadherence.

3.1.1 Ability and Medication Adherence

Human Factors is concerned with human abilities, environment, tools and support. With the high incident of unintentional nonadherence as discussed earlier, it is important that prospective memory is assessed if it predicts unintentional nonadherence. A prospective memory questionnaire has been developed by Smith et al. (2000). This study will look into adapting some of the questions to evaluate perceived prospective memory of the respondents to evaluate its relationship with unintentional nonadherence. Lott et al., (2010) found that adherence to medication is low because the administration process is complex. If a person cannot manage his own medication, this might cause him to unintentionally not adhere due to inability. As such perceived ability to self-manage one's medication will also be studied as one of the variables. Lifestyle busyness can prevent one's ability to adhere to their medication (Park et. al., 1998), as such it will be evaluated to study its relationship to unintentional nonadherence.

3.1.2 Belief and Medication Nonadherence

As discussed earlier, several psychosocial researchers have found that belief affects intentional nonadherence. Menckeger et al. (2008) found that higher necessity of medication and lower concerns are associated with higher adherence. Trust in one's medication that it will help in one's well-being is hence important for one to intend to adhere. Schneider et al. (2004) showed that physician-patient's relationship plays a key role in improving medication adherence. Altice et al. (2001) found an 8% increase in medication acceptance and adherence for patient's per unit increase in doctor's trust. Trust in Doctor is thus important to be considered when evaluating intentional medication adherence. Atkin et al., (2006) found that lack of information on the benefits and negative impact of a treatment lead to nonadherence, as such knowledge will be assessed to understand its effects on intentional nonadherence.

3.1.3 Context and Medication Nonadherence

Park et al. (2007) highlighted the importance of considering contextual factors when studying medication adherence. Park et al. (1997)'s conceptual model of medication adherence considers social support in the home and medication organizers to provide external cues to remind a patient to take his medication. Simoni et al (2006) found that social support in the form of reminders from family, friends and caregivers does improve medication adherence. As such use of pillboxes and social support will be evaluated to understand its effects on unintentional nonadherence.

Chapter 4   Study #1: Investigating Relationships between Age, Lifestyle Busyness, Knowledge, Attitude and External Cues with Intentional and Unintentional Nonadherence

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The first part of the research examines (i) Age, (ii) Lifestyle Busyness, (iii) Knowledge, (iv) Attitude and (v) External cue effects on Intentional and Unintentional Nonadherence.

Two data collections are carried out in Singapore to understand the medication adherence rate in Singapore, how participants manage their medication and to examine the effects of the above variables on intentional and unintentional nonadherence. Data is collected by surveying the general public through convenience sample. From the first data collection, we found out about the extent of medication nonadherence in Singapore, and examined the following variables (i) Age, (ii) Lifestyle Busyness, (iii) Knowledge, (iv) Attitude and (v) External cue effects on Intentional and Unintentional Nonadherence (i.e. Study #1). In the second data collection, we collected similar data so as to further validate the effects of the above five variables on nonadherence (Study #2). From Study #1's data analysis and further literature survey, we found the potential of other variables' influence on intentional and unintentional nonadherence. These variables are (vi) Trust in Medication (vii) Trust in Doctor (viii) Perceived Prospective Memory (ix) Perceived Ability and (x) Social Support. Questions to investigate the effects of these variables are hence included in the second data collection, which will form analysis Study #3. A three study structure is adopted for this report.

This section describes the study design, analysis and outcome of study #1.

4.1 Study Design

The first data collection is a survey to understand the extent of medication nonadherence in Singapore, reasons for nonadherence, medication management

strategies and interests in health literacy. The target respondents are subjects above 21 years of age, who have been taking the same medication for at least two months. A hypothetical model is developed to examine the effects of (i) Age, (ii) Lifestyle Busyness, (ii) Knowledge, (iii) Attitude, and (v) External cue on intentional and unintentional nonadherence. Details of the data collection questionnaire for study 1 can be found in the Appendix A.

As proposed by WHO (Lwanga et al., 1999; Naing, 2003), sample size requirement for health studies can be estimated based on the following:

$$n = \left(\frac{z}{\Delta}\right)^2 p (1 - p) \quad (1)$$

Where,

n is the sample size estimation.

p is expected proportion of individuals in the sample with the characteristic of interests.

z is the z value (e.g. 1.96 for 95%,).

Δ is the confidence interval or margin of error (e.g. expressed in decimal 0.05 = ± 5).

According to WHO (2003), the adherence to chronic disease therapy averages 50% in developed countries, hence $p=0.5$ will be used. To estimate the proportion of Singaporeans who are adherent to their medication within ± 5 confidence interval ($\Delta = 0.05$) with 95% confidence ($z=1.96$), a sample size of $n=384$ will be required. For both studies, the initial aim is to target for 400 respondents, however due to difficulty and challenges faced during recruitment, 349 respondents were recruited for the first data

collection and 293 respondents were recruited for the second data collection. For analysis, 347 responses are admitted for analysis for Study 1 and 267 responses are admitted for analysis for Study 2 and 3. Hence the sample size estimate the proportion of Singaporean who are adherent to their medication to within ± 5 to ± 6 (margin of error) with 95% confidence (Lwanga et al., 1999).

4.1.1 Procedure

Participants are first screened to ensure that they met the minimum requirements. Participants are then provided with a brief introduction of the study and the survey is administered verbally. The data collected is then collated and analyzed. Results on adherence rate in Singapore based on Morisky score, as well as factors contributing to the adherence are computed and analyzed. The hypothetical model is then analyzed for the medicating effects of intentional and unintentional on nonadherence.

4.1.2 Hypothesis

A hypothetical model to examine the effects of predictors on intentional and unintentional nonadherence is developed. Figure 12 shows the first hypothetical model of the predictors of unintentional and intentional nonadherence.

Figure 12: Proposed Hypothetical Model of Medication Nonadherence

The following hypotheses are tested:

- ***H1: Age effect on Nonadherence is mediated by Unintentional only.***

As discussed in Sections 2.3 and 2.5, age is found to be a strong predictor of unintentional nonadherence (Levesque et al., 2012; Wroe, 2002). As there are evidence that many cognitive functions, such as working memory capacity and long-term memory decline with age (Park et al., 2002), we hence hypothesize that age effect on nonadherence is mediated by unintentional, and not intentional.

- ***H2: Busyness effect on Nonadherence is mediated by Unintentional only.***

Park et al. (1998) found that self-rated busyness is a powerful predictor of non-adherence. However, studies associating busyness to intentional and unintentional nonadherence could not be found. Here we hypothesize that busyness effect on nonadherence is mediated by unintentional but not intentional, since a person with the intention to take medication may fail to do so due to lifestyle busyness.

- ***H3: External Cue effect on Nonadherence is mediated by Unintentional only.***

External cue (e.g. pillbox) is often suggested as a simple solution to improve adherence (Park et al., 1997; Osterberg et al., 2005). External Cue effect on nonadherence is mediated by unintentional will hence be tested. We do not expect nonadherence to be mediated by intentional, since pillbox provides cues to remind and to make it convenient for the patients to take their medications and does not affect a person's belief.

- ***H4: Attitude effect on Nonadherence is mediated by Intentional only.***

Intentional nonadherence is predicted by the balance of individuals' reasons for and against medication (e.g. knowledge and attitude). Attitude (feeling hassled by medication) effect on nonadherence is hence hypothesized to be mediated by intentional and not unintentional, since patients may not believe enough about the necessity of the medication to take it, leading to nonadherence.

- ***H5: Knowledge (interest to know more about their medication) effect on Nonadherence is mediated by Intentional only.***

Kim (2007) found that knowledge is associated with intentional nonadherence but not unintentional nonadherence. We hence hypothesized that Knowledge (interest to know more about their medication) effect on nonadherence is mediated by intentional, as a patient may feel that he does not know enough about the medication and its necessity to adhere to the medication regime. This may lead to intentional nonadherence due to suboptimal belief or information about the medication.

- *H6a: Unintentional effect on Nonadherence is not mediated by Intentional factor.*
- *H6a: Intentional effect on Nonadherence is not mediated by Unintentional factor.*

Unintentional nonadherence, as defined by Gadkari et al. (2012), is a passive process where a patient fails to adhere to the prescribed therapy due to forgetfulness, carelessness or circumstances beyond their control. Intentional nonadherence is defined as an active decision by the patient to forego the prescribed therapy. We hence do not expect unintentional effect on nonadherence to be mediated by intentional, and vice versa.

4.1.3 Measurement of Adherence

To measure level of medication adherence, a self-reported questionnaire based on the 8-items Morisky Medication Adherence Scale (MMAS-8) (Morisky et al., 2008) is adopted. Table 3 shows the eight questions used in the MMAS-8. The labels in square brackets, after each question, represent the short form for each question.

Table 3: Questions and scoring system used in Morisky Medication Adherence Scale (Morisky et al., 2008)

No.	Questions	Construct/Variable	Score
1	Do you sometimes forget to take your medications? [Forget]	Unintentional	Y=0, N=1
2	How often do you have difficulty remembering to take all your medication? [DiffRemember] (a) Never/Rarely (b) Once in a while (c) Sometimes (d) Usually (e) All the time	Unintentional	A=1, B-E=0
3	When you travel or leave home, do you sometimes forget to bring along your medications? [Travel]	Unintentional	Y=0, N=1
4	Have you ever cut back or stopped taking your medication without telling your doctor because you felt	Intentional	Y=0, N=1

	worse when you took it? [Worse]		
5	When you feel like your condition is under control, do you sometimes stop taking your medications? [Better]	Intentional	Y=1, N=0
6	Over the past 2 weeks, were there any days when you did not take your medications? [2 weeks]	Nonadherence	Y=0, N=1
7	Did you take your medications yesterday? [Yesterday]	Nonadherence	Y=0, N=1
8	Taking medication everyday is a real inconvenience for some people. Do you ever feel hassled about sticking to your treatment plan? [Hassled]	Attitude	Y=0, N=1

A score of 0 is given to each “Yes” answer for question 1 through 7, except for question 5. For question 5, the answer “No” is given a score of 0. For question 8, the answer “Never/Rarely” is given a score of 1 points and the rest of the answers are given a score of 0. Below shows the classification of adherence level based on the score:

- 8 = High Adherence
- 6-7 = Medium Adherence
- <6 = Low Adherence

4.1.4 Statistical Analysis

To estimate the main effect size of an independent variable on the dependent variable, ϕ , the phi coefficient on contingency tables, as described in Rosnow and Rosenthal (2008), will be used. A value of 0.1 is considered a small effect, a value of 0.3 is considered a moderate effect and a value of 0.5 is considered a large effect (Cohen, 1988). To estimate power, based on the current sample size, G*power computer programme (Faul et al, 2009) will be used. A power value greater than 0.8 will mean that the probability of a type II error (β) is under 20%. The α level (Type I) of $p < .05$ will be used for the analysis.

As highlighted by Preacher and Kelly (2011), indirect effect does not fit any of the classic effect size measures. As such, to test the mediating effect of unintentional and intentional on nonadherence, the casual approach for social psychological research proposed by Baron and Kenny (1986) is used (see Figure 13). To validate the indirect effects, a non-parametric resample procedure called bootstrapping is used. This is performed by drawing several thousands of samples from the original data of equal size, and then used it to compute the mediated effect and test its significance. As recommended by Hayes et al. (2009), a bootstrapping procedure with 5000 samples is used. The probability distribution is then used to calculate the bias-correct confidence interval and bootstrap estimated standard error of the mediated effect. If the confidence interval did not include a zero, then the indirect effect is considered significant.

Figure 13: Mediation Statistical Analysis (Baron and Kenny, 1986)

The independent, mediating and dependent variables to be tested are as follows:

Independent Variables (IV)

- Age
- Busyness
- External Cue (pillbox use)
- Attitude (feeling hassled about medication taking)
- Knowledge (desire to know more about medication)

Mediating Variables (MV)

- Unintentional Factors (forgetting)
- Intentional Factors (patient's active decision to alter medication)

Dependent Variables (DV)

- Nonadherence (miss medication yesterday or/and two weeks ago)

4.1.5 Variables and Latent Construct

Below describes the variables and questions associated with it (with reference to Appendix A: Medication Adherence Survey Questionnaire 1).

4.1.5.1 Independent Variables

- Age (Q4b) – Among the demographics variables, Age is found to be the strongest predictor of nonadherence (Levesque et al., 2012; Wroe, 2002). In this study, Age data is initially collected in 5-points Likert scale. However, as we had fewer respondents for the younger adults group, age is consolidated and defined into three categories for analysis: Younger adults (21-39), Middle-age adults (40-59) and Older adults (>60).
- Busyness (Q2i) –With reference to the definition by Festini et. al. (2016), Busyness here is defined as the subjective evaluation that one has many things to do in every day living. Park et al. (1998) found that self-rated busyness is the most power variable on whether subjects are adherence to their medication or not. Their findings suggested that it is potentially a more powerful predictor than age. Busyness here is collected as one of the reasons for nonadherence and is defined as a dichotomous.
- External Cue (Q3b) – Tulving and Thompson (1973) encoding specificity principal emphasized on the importance of contextual information to access episodic memory. The theory states that memory is improved when there is

an overlap of retrieval cue and memory trace. As pillbox is often used for managing medication, its usage may minimize unintentional nonadherence. The presence of external cue here refers to whether respondents use pillboxes for managing medication or not, and is defined as a dichotomous variable.

- Attitude (Q2g) – The term ‘hassle’ is defined as “irritating inconvenience” in the Oxford English Dictionary. In the context of Morisky medication adherence scale, ‘hassled’ is one of the eight items for measuring nonadherence. In Griffin et al. (2011)’s paper, hassled is translated into other languages to mean: disturbed, overwhelmed, a nuisance, cumbersome, difficult, bothersome, troubling, tiresome, irksome, burdensome and complicated. Attitude is defined here as whether respondent feel hassled about medication taking, and is collected as a dichotomous response (i.e. Yes or No).
- Knowledge (Q2k) – Oxford English Dictionary defines knowledge as “facts, information and skills acquired through experience or education”. As discussed in section 2.5 Research Gaps, a patient’s interest about their medication purpose may be linked to intentional nonadherence. Here, Knowledge variable is used to represent a respondent’s interests to acquire information about their medication and is collected also as a dichotomous response (i.e. Yes or No).

4.1.5.2 Latent Constructs (Mediating Variables and Dependent Variables)

Table 4 shows the questions in each of the latent construct: Unintentional, Intentional and Nonadherence. The total scores for the constructs are created by summing the raw items and then transforming them to a normalized z score.

Table 4: Latent Constructs for Unintentional, Intentional and Nonadherence

Constructs	Questions	Score
Unintentional	- Do you sometimes forget to take your medications? - How often do you have difficulty remembering to take all your medication? (a) Never/Rarely (b) Once in a while (c) Sometimes (d) Usually (e) All the time	Y=0, N=1 A=1,B-E=0
	When you travel or leave home, do you sometimes forget to bring along your medications?	Y=0, N=1
	Is “Simply Forget” some of the reasons for your nonadherence.	Y=0, N=1
Intentional	Have you ever cut back or stopped taking your medication without telling your doctor because you felt worse when you took it?	Y=0, N=1
	When you feel like your condition is under control, do you sometimes stop taking your medications?	Y=0, N=1
Nonadherence	Did you take your medications yesterday?	Y=1, N=0
	Over the past 2 weeks, were there any days when you did not take your medications?	Y=0, N=1

4.2 Results of Study #1

A total of 349 survey respondents are recruited from housing estates, polyclinics, community homes, eateries and shopping centers. As two of the self-reported data had ambiguous data, they are removed. Leaving with 347 self-report data analyzed. An extract of the demographics is shown below, while the details of the data generated can be found in Appendix B.

4.2.1 Demographics of Participants

About half of the respondents are male (51.3%) and majority of the respondents are above 60 years of age (64.8%) (see Table 5). Less than half of the respondents had above secondary school education (26.4%).

Table 5: Extract of Data Generated

N=347		Medication Adherence Score (as measured by MMAS-8 Scale)			
Gender		High	Medium	Low	Total
	Male	53 (15%)	59 (17%)	66 (19%)	178 (51.3%)
	Female	49 (18%)	58 (17%)	62 (14%)	169 (48.7%)
	Overall	102 (29.4%)	117 (33.7%)	128 (36.9%)	347 (100%)
Age Range (Years)					
	21-29	1 (0.3%)	3 (0.9%)	13 (3.7%)	17 (4.9%)
	30-39	1 (0.3%)	4 (1.2%)	3 (0.9%)	8 (2.3%)
	40-49	2 (0.6%)	5 (1.4%)	18 (5.2%)	25 (7.2%)
	50-59	23 (6.6%)	19 (5.5%)	30 (8.6%)	72 (20.7%)
	>60	75 (21.6%)	86 (24.8%)	64 (18.4%)	225 (64.8%)
Educational Experience					
	None	23 (6.6%)	29(8.4%)	14(4%)	66(19%)
	Primary	27 (7.8%)	33(9.5%)	30(8.6%)	90(25.9%)
	Secondary	32 (9.2%)	25(7.2%)	42(12.1%)	99(28.5%)
	JC/Polytechnic	10 (2.9%)	17(4.9%)	22(6.3%)	49(14.1%)
	Undergrad	6 (1.7%)	7(2%)	10(2.9%)	23(6.6%)
	Post Grad	2 (0.6%)	4(1.2%)	7(2%)	13(3.7%)
	Others	2(0.6%)	2(0.6%)	3(0.9%)	7(2%)

4.2.2 Adherence Rate in Singapore

Based on the 8-item Morisky Medication Adherence Scale (MMAS-8), the study revealed that only one-third (29.4%) of respondents are considered highly adherent to their medication regime, with one third (36.9%) of respondent falling into the low adherence group. Table 6 and Figure 14 show the distribution.

Table 6: Descriptive Statistics of Adherence Score based on MMAS

Adherence score	Frequencies	Percent
High (8)	102	29.4%
Medium (6-7)	117	33.7%
Low (<6)	128	36.9%
Total	347	100%

Figure 14: Medication adherence level in Singapore based on Morisky MMAS-8 scale (Study 1)

The mean score for medication adherence scale is 5.98 (SD=1.95). The item-total correlations are >0.3 except for 1 item, on whether the subject took his medication yesterday. The internal consistency Cronbach's $\alpha = 0.722$ ($p < 0.001$).

Figure 15: Reasons for nonadherence

With reference to Figure 15 and the labels for each questions in the Morisky MMAS-8 scale (section 4.1.3), Forget (40.9%), followed by Hassled (38.9%) and Difficulty Remembering (36.6%) made up the top reasons for nonadherence.

4.2.2.1 Reasons for Nonadherence vs. Adherence Levels

When comparing between adherence groups, finding medication taking a Hassled made up about 38% of the respondents in the Medium adherence group (see Figure 16), compared to the next highest reasons, Forget, which made up 26% of the reasons. In the Low adherence group, Difficulty Remembering and Forget are the top reasons (86% and 85% respectively), while Hassled made up 67% of the reasons (see Figure 17).

Figure 16: Graphical representation of responses in the Medium Adherence group

Figure 17: Graphical representation of responses in the Low Adherence group

4.2.3 Prevalence of Unintentional and Intentional Nonadherence

About half (50.7%) of the self-reported respondents reported at least one of the four unintentional nonadherent behaviors in the past 2 weeks (see Table 7). Simply Forget is the most common (45.2%), followed by Sometimes Forget (40.9%). About one fifth of the respondents (20.5%) reported at least one of the intentional nonadherent behaviors.

Table 7: Prevalence of Unintentional and Intentional Nonadherence

Unintentional Nonadherence (n=374)	N	%
Sometimes forget to take medication.	142	40.9
Have difficulty remembering to take all the medication.	134	38.6
When travelling or leaving home, sometimes forget to bring medication.	73	21.0
Simply forget	157	45.2
Reported <u>at least one</u> of the four unintentional nonadherent behaviors.	176	50.7
Intentional Nonadherence (n=374)	N	%
Cutback or stopped taking medication without telling doctor because felt worse when taking it.	38	11.0
Sometimes stop taking the medication because felt the condition is under control.	55	15.9
Reported <u>at least one</u> of the two intentional nonadherent behaviors.	71	20.5

4.2.4 Significance of Predictors

4.2.4.1 Age

4.2.4.1.1 Age vs. Adherence Levels

A χ^2 test of independence is conducted, and a significant difference is found between age groups and level of adherence (χ^2 (2,347) = 22.93, $p < 0.01$). Pearson correlation revealed a significant positive relationship ($r = 0.228$, $p < 0.001$). The correlation is weak in strength. Contrary to expectations that older adult will be less adherent due to diminished cognitive ability, our findings revealed that as age increases, adherence to medication also increases.

Within the 21-39 age group, 64% are found to be of low adherence, compared to just 28.4% in the older adults group (>60) (see Table 8). Younger adults are expected to have better cognitive ability to remember their medication and hence better adherence. However the result showed otherwise, younger adults are less adherent to their medications.

Table 8: Cross Tabulation of Age Group and Adherence Level

Age Group	Adherence			Total
	Low	Medium	High	
21-39	16 (64%)	7 (28%)	2 (8%)	25 (100%)
40-59	48 (49.5%)	24 (24.7%)	25 (25.8%)	97 100%
>60	64 (28.4%)	86 (38.2%)	75 (33.3%)	225 (100%)
Total	128 (36.9%)	117 (33.7%)	102 (29.4%)	347 (100%)

4.2.4.1.2 Age vs. Reasons for Nonadherence

With reference to Table 9, difficulty remembering, hassled by medication taking and forgetting to take medication, made up the top three reasons for all the age groups.

Table 9: Cross Tabulation of Age Group and Individual Questions

AGE	Difficult to Remember	Hassle	Forget	2WksMiss	Travel	BetterStop	WorseStop	Yesterday Miss
21-39 (n=25)	72%	68%	64%	44%	44%	44%	16%	8%
40-59 (n=97)	46%	48%	47%	34%	32%	19%	13%	8%
>60 (n=225)	32%	32%	36%	22%	15%	12%	9%	8%

Among the younger group (21-39), 72% of the respondents found it difficult to remember to take their medications, 68% found medication taking a hassle and 64% had sometimes forgotten to take medication (see Figure 18). This is double the older adults (>60), where only 32-36% of the respondents made up the top three reasons for nonadherence.

Figure 18: Graphical representation of responses to Morisky Questions vs. Age

For the age group 40-59, the major three reasons are taking medication is a hassle (48%), forgotten to take medication sometimes (47%), followed by difficulty remembering (46%).

4.2.4.2 Busyness

4.2.4.2.1 Busyness vs. Adherence Level

Busyness is found to be a significant factor ($\chi^2 (2,347) = 18.156, p < 0.001$) between adherence group. Pearson correlation revealed a significant negative weak relationship ($r = -0.229, p < 0.001$). Higher levels of busyness are associated with lower levels of adherence. With reference to table 10, a total of 65.7% from the Low adherence group cited busyness as one of the factors, compared to 31.4% from the Medium adherence group.

Table 10: Cross Tabulation of Busyness vs. Adherence Level

Busy	Adherence Level			Total (row)
	L	M	H	
0	105(33.7%)	106 (34.0%)	101 (32.4%)	312 (100%)
1	23 (65.7%)	11 (31.4%)	1 (2.9%)	35 (100%)
Total	128 (36.9%)	117 (33.7%)	102 (29.4%)	347 (100%)

4.2.4.2.2 Busyness vs. Age

A significant difference between age groups and busyness is found ($\chi^2(2, 347) = 8.922, p < 0.05$). Pearson correlation revealed a significant negative weak relationship ($r = -0.126, p < 0.05$). High level of busyness is associated with lower age. More than double the proportion of younger adults (12.0%) and middle-age adults (17.5%) cited busyness as a reason for nonadherence, compare to the older adults (6.7%) (see Table 11).

Table 11: Cross Tabulation of Busyness vs. Age Group

Age Group	Busyness		Total
	0	1	
21-39	22 (88.0%)	3 (12.0%)	25 (100%)
40-59	80 (82.5%)	17 (17.5%)	97 (100%)
>60	210 (93.3%)	15 (6.7%)	225 (100%)
Total	312 (89.9%)	35 (10.1%)	347 (100%)

4.2.4.3 External Cue

4.2.4.3.1 External Cue vs. Adherence Level

External Cue is modelled by whether pill box is used. No significant difference is found between External Cue and Adherence groups ($\chi^2(2, 347) = 1.077, p > 0.58$.) Table 12 shows the frequency distribution.

Table 12: Cross Tabulation of External Cue vs. Adherence Level.

External Cue	Adherence Level			Total (row)
	L	M	H	
0	91(36.1%)	83 (32.9%)	78 (31%)	252 (100.0%)
1	37 (38.9%)	34 (35.8%)	24 (25.3%)	95 (100%)
Total	128 (36.9%)	117 (33.7%)	102 (29.4%)	347 (100%)

About 33.7% of the respondents use specific strategies to manage their medication. Of which, 81.2% use pillboxes, while the rest use other methods. A χ^2 test revealed there is no significance difference between adherence groups who manage their medication ($\chi^2 (2,347) = 1.213, p>0.545$), nor those who uses pillboxes ($\chi^2 (2,347) = 1.077, p>0.584$). Use of pillboxes or managing medication alone do not determine if the subjects are more or less adherent.

4.2.4.3.2 External Cue vs. Attitude

Among those who find medication taking a hassle, 68.1% do not use pillbox; only 31.9% use pillbox. The χ^2 test did not find any significance difference between External Cue and Attitude.

4.2.4.3.3 External Cue vs. Age

No significance between External cue and Age is found.

4.2.4.4 Attitude

Attitude is modelled by whether patients feel hassled by their medication. Among those who manage their medication (of which 81.2% use pillboxes), 17.9% (21 of 117) find managing their medication troublesome, citing reasons: “need to refill regularly”, “alarm rings at the most inconvenient times” and “still forget to take when rushing for time”.

Although no significant relation is found between pillbox use and those who find medication taking a hassle, a significant relationship is found between those who find their current method of medication management troublesome and finding medication

taking a hassle ($\chi^2(1,347 = 4.975)$, $p < 0.05$). Pearson correlation revealed a significant positive weak relationship ($r = 0.120$, $p < 0.05$). People who are hassled by medication taking are more likely to find managing their medication troublesome.

4.2.4.4.1 Attitude vs. Adherence

A significant between groups for attitude and adherence is found ($\chi^2(2, 347 = 108.465)$, $p < 0.001$). Pearson correlation revealed a significant negative strong relationship ($r = -0.553$, $p < 0.001$). Those who feel hassled by their medication are more likely to be less adherent (see Table 13).

Table 13: Cross Tabulation of Attitude vs. Adherence

Attitude	Adherence Level			Total (row)
	L	M	H	
0	42 (19.8%)	68 (32.1%)	102 (48.1%)	277 (100.0%)
1	86 (63.7%)	49 (23.2%)	0 (0.0%)	135 (100%)
Total	128 (36.9%)	117 (33.7%)	102 (29.4%)	347 (100%)

4.2.4.4.2 Attitude vs. Age

A significant between groups for age and hassled is also found ($\chi^2(2, 347 = 17.738)$, $p < 0.001$). Pearson correlation revealed a significant negative relationship ($r = -0.226$, $p < 0.001$). The correlation is weak in strength. Younger adults are more likely to find medication taking a hassle compare to older adults (see Table 9).

4.2.4.4.3 Attitude vs. Intentional Medication Nonadherence

A χ^2 analysis revealed a significant difference between subjects who have intentional nonadherence tendency and those who felt hassled by medication ($\chi^2(1, 347)=17.62$, $p < 0.001$). Pearson correlation revealed a significant positive weak relationship ($r = 0.225$, $p < 0.001$). A total of 60.6% of subjects who have intentional

nonadherence tendency, also find medication taking a hassle; compared to 33.3% who do not have intentional nonadherence tendency (see Table 14).

Table 14: Cross Tabulation of Attitude vs. Intentional.

Intentional	Attitude		Total
	0	1	
0	184 (66.7%)	92 (33.3%)	276 (100%)
1	28 (39.4%)	43 (60.6%)	49 (100%)
Total	212 (61.8%)	135 (38.9%)	347 (100%)

4.2.4.5 Knowledge

4.2.4.5.1 Knowledge vs. Adherence Level

Knowledge is modeled by respondent's interest to know more about their medication. A chi square analysis did not find a significant difference between adherence levels and knowledge (desire to know more about their medication) at a 95% confidence interval ($\chi^2(2,347) = 5.488, p > 0.064$). Table 15 shows the frequency distribution.

Table 15: Cross Tabulation of Knowledge vs. Adherence Level

Knowledge	Adherence Level			Total (row)
	L	M	H	
0	95(34.3%)	100 (36.1%)	82 (29.6%)	277 (100.0%)
1	33 (47.8%)	16 (23.2%)	20 (29%)	69 (100%)
Total	128 (36.9%)	117 (33.7%)	102 (29.4%)	347 (100%)

4.2.4.5.2 Knowledge vs. Age

There is also no significance between age and knowledge groups ($\chi^2(2,347) = 4.560, p > 0.102$).

4.2.4.5.3 Knowledge vs. Intentional Nonadherence

Significant difference between subjects who are intentionally nonadherent and knowledge is however found ($\chi^2(1, 347) = 10.85, p < 0.01$). Pearson correlation revealed a significant positive weak relationship ($r = 0.177, p < 0.001$). Those who have intentional

nonadherence tendency (33.8%) have more interests to know about their medication, compared to those who do not have intentional nonadherence tendency (16.3%), see Table 16.

Table 16: Cross Tabulation of Knowledge vs. Intentional

Intentional	Knowledge		Total
	0	1	
0	231 (83.7%)	45 (16.3%)	276 (100%)
1	47 (66.2%)	24 (33.8%)	71 (100%)
Total	278 (80.1%)	69 (19.9%)	347 (100%)

4.2.5 Mediation Analysis

A significant moderate effect of unintentional on nonadherence is found ($r=0.314$, $p<0.001$). Based on G*power computer programme (Faul et al, 2009), the sample of 347 participants yield a high statistical power of 99.995% ($\alpha=0.05$). A significant moderate effect of intentional on nonadherence is also found ($r=0.307$, $p<0.001$) with similar high power = 99.991%. Next, we will test Age, Busyness, External Cue, Attitude and Knowledge for their direct and indirect effects on nonadherence, when mediated by unintentional and intentional.

4.2.5.1. Age effect on Nonadherence mediated by Intentional and Unintentional

H1: Age effect on Nonadherence is mediated by Unintentional only.

A χ^2 test of independence showed a significant difference between age groups and unintentional ($\chi^2 (2,347) = 13.653$, $p<0.01$), intentional ($\chi^2 (2,347) = 15.974$, $p<0.01$) and nonadherence ($\chi^2 (2,347) = 6.249$, $p<0.05$). Pearson correlation revealed significant negative relationships between age and unintentional ($r = -0.198$, $p < 0.001$), between age and intentional ($r = -0.183$, $p < 0.001$) and between age and nonadherence ($r = -$

0.132, $p < 0.05$) between age and unintentional. As age decreases, nonadherence increases. Within the same age group, the younger adults (21-39) are more likely to cite both unintentional (76%) and intentional (44%) reasons for nonadherence compared to older adults (44% and 16% respectively), see Table 17.

Table 17: Cross Tabulation of Unintentional, Intentional and Nonadherence across Age Groups

IV	MV				DV	
	Unintentional		Intentional		Nonadherence	
Age Group	0	1	0	1	0	1
21-38 ($n=25$)	10 (24.0%)	19 (76.0%)	14 (56.0%)	11 (44.0%)	14 (56.0%)	11 (44.0%)
40-59 ($n=97$)	39 (40.2%)	58 (61.7%)	73 (75.3%)	24 (25.5%)	60 (61.9%)	37 (39.4%)
>60 ($n=225$)	126 (56.0%)	99 (44.0%)	189 (84.0%)	36 (16.0%)	165 (73.3%)	60 (26.7%)
Total	171 (49.3%)	176 (50.7%)	276 (79.5%)	71 (20.5%)	239 (68.9%)	108 (31.1%)

A significant moderate main effect of age on nonadherence is found ($\phi = 0.134$, $p < 0.05$) with statistical power = 0.601. This means there is a 39.9% chance of a type II error (β), i.e. a 39.9% chance incorrectly concluding there is an effect. Increasing the sample size to 438 would have increased the power to 0.8. However, based on the current sample size of 347, the confidence to conclude with certainty that age has a main effect on nonadherence is hence not high. However, Age main effect on Unintentional is found ($\phi = 0.198$, $p < 0.001$) with high observed power = 0.921. Post-hoc tests for age effect on unintentional revealed that pairwise comparison of younger adults with older adults is significant ($p < 0.01$), middle-age adults and older adults is also significant ($p < 0.05$), pairwise comparison between younger adults and middle-age adults is however not significant ($p = 0.429$). Age main effect on Intentional is also found ($\phi = 0.189$, $p < 0.05$) with high observed power = 0.893. As such, we will examine the indirect effect of age on nonadherence, mediated by intentional and unintentional.

Multiple regression analyses are conducted to assess each component of the proposed mediation model. First, it is found that age is negatively associated with nonadherence ($B = -0.17$, $t(345) = -3.14$, $p < 0.01$), see Figure 19 c-path. Age is also found to be negatively related to unintentional ($B = -0.28$, $t(345) = -5.42$, $p < 0.001$), see Figure 19 a-path. The results indicated that the mediator, unintentional, is positively associated with nonadherence ($B = 0.35$, $t(345) = 6.64$, $p < 0.001$), see Figure 19 b-path.

As both the a-path and b-path are significant, the mediation analysis is tested using the bootstrapping method as described earlier in section 4.1.4. The 95% confidence intervals of the indirect effects are obtained with 5000 bootstrap resample (Preacher & Hayes, 2008). Results of the mediation analysis confirmed the mediating role of unintentional ($B = -0.10$; $CI = -0.16$ to -0.05) in the relation between age and nonadherence. Indirect effect is significant from the bootstrap analysis since 0 is not included in the confidence interval (CI). The results also indicated that the direct effect of age on medication nonadherence is not significant ($B = -0.02$, $t(345) = -4.77$, $p > 0.64$) when controlling for unintentional (Figure 19, c' path), thus suggesting total mediation. Age effect on nonadherence is totally mediated by unintentional nonadherence. Figure 19 below displays the results.

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 19: Indirect/Direct effect of Age on Nonadherence mediated by Unintentional

Age is also found to be negatively related to intentional ($B = -0.22$, $t(345) = -4.19$, $p < 0.001$) and the mediator, intentional, is positively associated with nonadherence ($B = 0.20$, $t(345) = 3.92$, $p < 0.001$). Results of the mediation analysis confirmed the mediating role of intentional factors ($B = -0.05$; $CI = -0.09$ to -0.02) in the relation between age and nonadherence. Bootstrap analysis further confirmed the indirect effect, suggesting total mediation for intentional factor. Figure 20 displays the results for age on nonadherence through intentional factor.

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 20: Indirect/Direct effect of Age on Nonadherence mediated by Intentional

We hence reject H1 and conclude that Age effect on Nonadherence is totally mediated by both Unintentional and Intentional factors.

4.2.5.2. Busyness effect on Nonadherence mediated by Intentional/Unintentional

H2: Busyness effect on Nonadherence is mediated by Unintentional only.

Unintentional nonadherence is found to be significantly associated with a busy lifestyle, ($\chi^2(1, 347) = 33.562, p < 0.01$). Pearson correlation revealed a significant positive relationship ($r = 0.311, p < 0.001$). The correlation is moderate in strength. A total of 97% of those who cited busyness as a reason for nonadherence also indicated unintentional reasons for nonadherence (see Table 18). Intentional nonadherence is not found to be significantly associated with a busy lifestyle ($\chi^2(1, 347) = 0.835, p > 0.36$).

Table 18: Cross Tabulation of Unintentional, Intentional and Nonadherence across Busyness

IV	MV				DV	
	Unintentional		Intentional		Nonadherence	
Busy	0	1	0	1	0	1
0	170 (54.5%)	142 (45.5%)	249 (79.8%)	63 (20.2%)	220 (70.5%)	92 (29.5%)
1	1 (2.9%)	34 (97.3%)	27 (77.1%)	8 (22.9%)	19 (54.3%)	16 (45.7%)
Total	171 (49.3%)	176 (50.7%)	276 (79.5%)	71 (20.5%)	239 (68.9%)	108 (31.1%)

A significant moderate effect of busyness on nonadherence is found ($\phi = 0.106$, $p < 0.05$) with statistical power = 0.506. Based on the current sample, the chance of a type II error is 50%. The likelihood of the significant direct effect of busyness on nonadherence could be due to chance. A significant moderate main effect of Busyness on Unintentional is found ($\phi = 0.311$, $p < 0.001$), with high observed power = 0.999. Busyness main effect on Intentional is not found to be significant ($\phi = 0.02$, $p = 0.711$). As such, we will examine the indirect effect of knowledge on nonadherence, mediated by unintentional only.

When testing for indirect effect however, busyness is found to be positively and significantly related to unintentional mediator ($B = 0.70$, $t(345) = 4.00$, $p = 0.001$), and unintentional is also significantly and positively associated with nonadherence ($B = 0.36$, $t(345) = 6.83$, $p < 0.001$). Since both a-path and b-path are significant, bootstrap is conducted and the mediating role of unintentional ($B = 0.251$; CI = 0.15 to 0.40) in the relation between busyness and nonadherence is further confirmed.

The results showed that the direct effect (c' path) of busyness on nonadherence is not significant ($B = -0.058$, $t(345) = -0.359$, $p > 0.72$) when controlling for unintentional, thus suggesting total mediation. Busyness effect on nonadherence is totally mediated through unintentional factors (see Figure 21).

We accept H2 and conclude that Busyness effect on Nonadherence is totally mediated by Unintentional. There is no direct or indirect effect on Intentional.

Figure 21 : Indirect/Direct effect of Busy on Nonadherence mediated by Unintentional/Intentional

4.2.5.3 External Cue on Nonadherence mediated by Intentional/Unintentional

H3: External Cue effect on Nonadherence is mediated by Unintentional only.

Neither unintentional nor intentional nonadherence is found to be associated with pillbox use. A Chi square analysis showed no significance at a confidence level of 95% ($\chi^2(1, 347) = .844, p > 0.358$) and ($\chi^2(1, 347) = 1.114, p > 0.291$) for either intentional or unintentional for pillbox use. Table 19 shows the frequency distribution.

Table 19: Cross Tabulation of Unintentional, Intentional, and Nonadherence across External Cue

IV	MV				DV	
	Unintentional		Intentional		Nonadherence	
External Cue	0	1	0	1	0	1
0	128 (50.8%)	124 (49.2%)	204 (81.0%)	48 (19.0%)	167 (66.3%)	85 (33.7%)
1	43 (45.3%)	52 (54.7%)	72 (75.8%)	23 (24.2%)	72 (75.8%)	23 (24.2%)
Total	171 (49.3%)	176 (50.7%)	276 (79.5%)	71 (20.5%)	239 (68.9%)	108 (31.1%)

No significant main effect of external cue on nonadherence is found ($\varphi = 0.092$, $p = 0.09$). There is also no significant main effect of external cue on unintentional ($\varphi = 0.049$, $p = 0.358$) nor intentional ($\varphi = 0.057$, $p = 0.288$). Mediation analysis further confirmed there are no significant indirect effects of external cue on nonadherence through intentional or unintentional factors (See Figure 22 and Appendix C).

Figure 22 : Indirect/Direct effect of Pillbox on Nonadherence mediated by Unintentional/Intentional

We reject H3 and conclude that External Cue has no direct nor indirect effect on Nonadherence when mediated by Intentional or Unintentional.

4.2.5.4. Attitude on Nonadherence mediated by Intentional/Unintentional

H4: Attitude effect on Nonadherence is mediated by Intentional only.

A χ^2 test of independence showed a significant difference between Attitude (feeling hassled by medication) and Unintentional ($\chi^2 (2,347) = 34.135$, $p < 0.001$), as well as Attitude and Intentional ($\chi^2 (2,347) = 17.617$, $p < 0.01$). Pearson correlation revealed a significant positive moderate relationships between attitude and unintentional ($r = 0.314$, $p < 0.001$), and a positive weak relationships between attitude and intentional ($r = 0.225$, $p < 0.001$). A total of 70.4% of subjects who gave unintentional reasons for

nonadherence, also found medication taking a hassle compared to those who did not find medication taking a hassle (see Table 20).

Table 20: Cross Tabulation of Unintentional, Intentional, and Nonadherence across External Cue

IV	MV				DV	
	Unintentional		Intentional		Nonadherence	
Attitude	0	1	0	1	0	1
0	131 (61.8%)	81 (38.2%)	184 (86.8%)	28 (13.2%)	154 (72.6%)	58 (27.4%)
1	40 (29.6%)	95 (70.4%)	92 (68.1%)	43 (31.9%)	85 (63.0%)	50 (37.0%)
Total	171 (49.3%)	176 (50.7%)	276 (79.5%)	71 (20.5%)	239 (68.9%)	108 (31.1%)

The main effect of Attitude on Nonadherence is barely not significant ($\varphi=0.102$, $p=0.058$), power = 0.476. As the statistical power is low, there is hence low confidence to conclude an effect. A significant moderate main effect of Attitude on Unintentional is however found ($\varphi = 0.314$, $p < 0.001$), with high observed power = 1.0. Attitude main effect on Intentional is also found to be significant ($\varphi = 0.225$, $p = 0.011$), with high observed power = 0.987. As such, we will examine the indirect effect of attitude on nonadherence, mediated by unintentional and intentional.

Mediation analysis found that attitude is significantly and positively related to unintentional ($B = 0.74$, $t(345) = 7.17$, $p < 0.001$) and the mediator, unintentional, is also positively associated with nonadherence ($B = 0.39$, $t(345) = 7.14$, $p < 0.001$). Indirect effect (both a-path and b-path) of attitude on nonadherence, mediated by unintentional factors is significance. Bootstrap further confirmed the mediating role of unintentional ($B = 0.282$; $CI = 0.19$ to 0.42) in the relation between Attitude and Nonadherence. The results indicated that the direct effect of Attitude on Nonadherence is not significant ($B = -0.183$, $t(345) = -1.755$, $p > 0.08$) when controlling for unintentional, suggesting total mediation. Attitude effect on Nonadherence is totally mediated by Unintentional (see Figure 23).

Attitude is also positively related to intentional ($B = 0.40, t(345) = 3.71, p < 0.01$). The mediator, intentional, is also positively associated with actual nonadherence ($B = 0.21, t(345) = 4.14, p < 0.001$). The indirect effect of Attitude on nonadherence, mediated by intentional factors is found to be significant and this is further confirmed by bootstrapping ($B = 0.085; CI = 0.03 \text{ to } 0.17$). There is total mediation since Attitude direct effect on Nonadherence is not significant ($B = -0.183, t(345) = -1.755, p > 0.08$) when controlling for intentional factor. Figure 23 displays the results.

Figure 23 : Indirect/Direct effect of Attitude on Nonadherence mediated by Unintentional/Intentional

We hence reject H4 and conclude that Attitude effect on Nonadherence is totally mediated by both Unintentional and Intentional.

4.2.5.5 Knowledge effect on Nonadherence mediated by Intentional/Unintentional

H5: Knowledge effect on Nonadherence is mediated by Intentional only.

Intentional nonadherence is found to be associated with Knowledge (desire to know more about medication) ($\chi^2(1, 347) = 10.85, p < 0.001$). Pearson correlation revealed a significant weak positive relationship ($r = 0.177, p < 0.001$). Unintentional

nonadherence is not found to be associated with Knowledge ($\chi^2(1, 347) = 0.653$, $p > 0.419$). Table 21 shows the frequency distribution.

Table 21: Cross Tabulation of Unintentional, Intentional and Nonadherence across Knowledge

IV	MV				DV	
	Unintentional		Intentional		Nonadherence	
Knowledge	0	1	0	1	0	1
0	140 (50.4%)	138 (49.6%)	231 (83.1%)	47 (16.9%)	198 (17.2%)	80 (28.8%)
1	31 (44.9%)	38 (55.1%)	45 (65.2%)	24 (34.8%)	41 (59.4%)	28 (40.6%)
Total	171 (49.3%)	176 (50.7%)	276 (79.5%)	71 (20.5%)	239 (68.9%)	108 (31.1%)

No significant main effect of knowledge on nonadherence is found ($r = 0.102$, $p = 0.058$). No significant main effect of Knowledge on Unintentional is found ($\phi = 0.043$, $p < 0.419$). A significant weak main effect of Knowledge on Intentional is however found ($\phi = 0.177$, $p = 0.011$), with high observed power = 0.909. As such, we will examine the indirect effect of knowledge on nonadherence, mediated by intentional.

Knowledge is instead positively associated with intentional ($B = 0.43$, $t(345) = 3.24$, $p < 0.01$), and mediator intentional, is also positively associated with nonadherence ($B = 0.20$, $t(345) = 3.78$, $p < 0.001$). Mediation analysis revealed that for intentional mediating variable, both the a-path and b-path are significant. Bootstrapping further confirmed the mediating role of intentional factors ($B = 0.086$; $CI = 0.02$ to 0.2) in the relation between knowledge and nonadherence. As the direct effect (c-path) of knowledge on medication nonadherence is not significant ($B = 0.141$, $t(345) = 1.168$, $p > 0.24$) when controlling for intentional, this suggesting total mediation. Knowledge effect on nonadherence is hence totally mediated by intentional factors. Figure 24 displays the results.

We accept H5 and conclude that Knowledge effect on Nonadherence is mediated by Intentional factor only.

Figure 24 : Indirect/Direct effect of Knowledge on Nonadherence mediated by Unintentional/Intentional

4.2.5.6 Unintentional and Intentional Effects on Nonadherence

H6a: Unintentional effect on Nonadherence is not mediated by Intentional.

H6b: Intentional effect on Nonadherence is not mediated by Unintentional.

Next we look at unintentional effects on nonadherence. when mediated by intentional. A chi square analysis revealed that unintentional is associated with intentional ($\chi^2(1, 347) = 25.54, p < 0.001$). Pearson correlation revealed a significant weak positive relationship ($r = 0.271, p < 0.001$). Unintentional and intentional is associated with nonadherence ($\chi^2(1, 347) = 34.21, p < 0.001$) and ($\chi^2(1, 347) = 32.71, p < 0.001$) respectively. Pearson correlation revealed significant moderate positive relationships between unintentional and nonadherence ($r = 0.314, p < 0.001$), as well as intentional and nonadherence ($r = 0.307, p < 0.001$). Table 22 and Table 23 show the distribution.

Unintentional main effect on Intentional is significant ($\phi = 0.271, p < 0.001$), observed power = 0.999. The main effect Intentional on Unintentional is the same.

Table 22: Cross Tabulation of Intentional and Nonadherence across Unintentional

Unintentional	Intentional		Nonadherence	
	0	1	0	1
0	155 (90.6%)	16 (9.4%)	143 (83.6%)	28 (16.4%)
1	121 (68.8%)	55 (31.3%)	96 (54.5%)	80 (45.5%)
Total	276 (79.5%)	71 (20.5%)	239 (68.9%)	108 (31.1%)

Table 23: Cross Tabulation of Unintentional and Nonadherence across Intentional

Intentional	Unintentional		Nonadherence	
	0	1	0	1
0	155 (56.2%)	121 (43.8%)	210 (76.1%)	66 (23.9%)
1	16 (22.5%)	55 (77.5%)	29(40.8%)	42(59.2%)
Total	276 (79.5%)	71 (20.5%)	239 (68.9%)	108 (31.1%)

Multiple regression analyses found that unintentional factors is positively associated with nonadherence ($B = 0.43$, $t(345) = 8.93$, $p < 0.001$). Unintentional is also positively related to intentional nonadherence ($B = 0.34$, $t(345) = 6.73$, $p < 0.001$). The mediator, intentional, is also positively associated with nonadherence ($B = 0.26$, $t(345) = 5.25$, $p < 0.001$). Bootstrapping confirmed the mediating role of intentional nonadherence in the relation between unintentional and nonadherence ($B = 0.089$; $CI = 0.04$ to 0.15). Results indicated that the direct effect of unintentional factor on medication nonadherence is significant ($B = 0.34$, $t(345) = 6.92$, $p < 0.001$) when controlling for intentional, thus suggesting partial mediation. Below Figure 25 displays the results.

Intentional is positively associated with nonadherence ($B = 0.34$, $t(345) = 6.73$, $p < 0.001$) and positively related to unintentional ($B = 0.38$, $t(345) = 7.59$, $p < 0.001$). The results indicated that the mediator, unintentional is positively associated with nonadherence ($B = 0.36$, $t(345) = 6.92$, $p < 0.001$). Bootstrap analysis further confirmed the mediating role of intentional nonadherence in the relation between unintentional and nonadherence ($B = 0.14$; $CI = 0.08$ to 0.21). Results indicated that the direct effect of intentional factor on medication nonadherence is significant ($B = 0.21$, $t(345) = 4.02$, p

< 0.001) when controlling for unintentional, suggesting partial mediation. Figure 26 below displays the results.

We hence reject H6a and H6b, concluding that Unintentional effect on Nonadherence is partially mediated by Intentional; Intentional effect on Nonadherence is also partially mediated by Unintentional.

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 25 : Indirect/Direct effect of Unintentional on Nonadherence mediated by Intentional

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 26 : Indirect/Direct effect of Intentional on Nonadherence mediated by Unintentional

4.3 Discussion on Study #1

From the data generated with 347 subjects, we found only about 30% of respondent are considered highly adherent to their medication.

Close to 50% of the respondent cited unintentional nonadherence as the reason for not taking their medication, whereas intentional nonadherence made up about 20% of the reasons. A deeper analysis showed that a high percentage of respondents (about 40%) found medication taking a hassle contributing to both intentional and unintentional nonadherence.

Figure 27 shows the relationships between the predictors, mediators (intentional, unintentional) and nonadherence, as well as the revised model after mediation analysis.

Figure 27: Revised Model after Mediation Analysis (Study 1)

4.3.1 Age and Nonadherence

Younger adults are found to be less adherent than older adults, and age is found to be negatively mediated by both unintentional and intentional factors. The common belief that older adults are more susceptible to cognitive function decline and hence are more likely to forget their medication is not supported by our findings. In addition, we found a significant relationship between age and busyness, as well as age and attitude towards medication. Younger adults are more likely to find medication taking a hassle, and busyness is likely to contribute to their unintentional nonadherence.

4.3.2 Busyness and Nonadherence

Busyness is found to be associated with age. Middle-age adults are more likely to cite busyness as a reason for nonadherence, followed by younger adults, as compared to older adults. Busyness effect on nonadherence is mediated by unintentional factors but not intentional factors.

4.3.3 External Cue and Nonadherence

No relationships between External Cue with intentional or unintentional nonadherence can be found. There is also no relationship between pillbox use with age nor feeling hassled.

4.3.4 Attitude and Nonadherence

Hassled is found to be associated with age. Younger adults are more like to find medication taking a hassle. Hassle effect on nonadherence is found to be mediated by both unintentional and intentional factors. Our initial assumption that patients feel hassled by their medication needs because of their lack of beliefs is not entirely true. Feeling hassled affects unintentional nonadherence ($B=0.7$) more than intentional

nonadherence ($B=0.4$). One possible explanation is that patients may feel hassled because of their already busy lifestyle, and hence forget to take their medications.

4.3.5 Knowledge and Nonadherence

Knowledge is not found to be associated to age. Knowledge effect on nonadherence is found to be mediated by intentional but not unintentional. Consistent with our original hypothesis, attitude of patients to get involved in healthcare decisions affects intentional nonadherence.

4.3.6 Unintentional and Intentional Nonadherence

Contrary to our initial hypothesis that unintentional nonadherence and intentional nonadherence are not related, our findings showed otherwise. The findings indicated that unintentional medication nonadherence is mediated by intentional nonadherence, and vice versa. This may suggest that suboptimal belief about medication necessity lowers the importance of medication adherence behavior, leading to nonadherence due to busyness or other priorities. At the same time, when patients miss a dose or two due to unintentional reason, and realize that they are still “fine” without the medication, they may start to doubt the necessity of the medication. This may hence lead them to adjust their doses without fully understanding the future consequences of their actions or informing their doctors, hence leading to intentional nonadherence.

4.4 Summary of Findings

Below summarizes the results of Study 1:

- Adherence rate in Singapore: High (29.4%), Medium (33.7%), Low (36.9%)
- Top 3 reasons for nonadherence: (i) Forget (40.9%) (ii) Hassled (38.9%) (iii) Difficult to remember (36.6%)
- Prevalence of Unintentional (50.7%) and Intentional (20.5%) nonadherence is found.

Significant χ^2 relationships are found between the following groups:

- Age vs. Adherence level
- Busyness vs. Adherence; Busyness vs. Age.
- Attitude vs. Adherence, Attitude vs. Age, Attitude vs. Intentional nonadherence.
- Knowledge vs. Intentional nonadherence.

NO significant χ^2 relationships are found between the following groups:

- External cue vs. Adherence; External cue vs. Attitude; External cue vs. Age,
- Knowledge vs. Adherence, Knowledge vs. Age,

Hypothesis Testing

- H1 Age effect on Nonadherence is mediated by Unintentional only. – *Rejected.*
Age effect on Nonadherence is mediated by both Unintentional and Intentional.
- H2: Busyness effect on Nonadherence is mediated by Unintentional only. – Accepted.
- H3: External Cue effect on Nonadherence is mediated by Unintentional only. – *Rejected. External Cue has no effect on Unintentional or Intentional.*
- H4: Attitude effect on Nonadherence is mediated by Intentional only – *Rejected.*
Attitude effect on Nonadherence is mediated by both Unintentional and Intentional.

- H5: Knowledge effect on Nonadherence is mediated by Intentional only. – Accepted.
- H6a: Unintentional effect on Nonadherence is not mediated by Intentional. – *Rejected. Unintentional effect on Nonadherence is mediated by both Intentional.*
- H6b: Intentional effect on Nonadherence is not mediated by Unintentional. – *Rejected. Intentional effect on Nonadherence is mediated by both Unintentional*

Mediation analysis summary results is shown in Table 24.

Table 24: Summary of Mediation Effect

Independent Variable	Indirect Effect mediated by Unintentional	Indirect Effect mediated by Intentional	Direct Effect on on Nonadherence
Age	Significant	Significant	Not significant
Busyness	Significant	Not significant	Not significant
External Cue (Pillbox)	Not significant	Not significant	Not significant
Attitude	Significant	Significant	Not significant
Knowledge	Not significant	Significant	Not significant
Unintentional	N/A	Significant	Significant
Intentional	Significant	N/A	Significant

From study 1, only 30% of the respondents are considered to be highly adherent. Prevalence of Unintentional (50.7%) and Intentional (20.5%) nonadherence is found. Top 3 reasons for nonadherence: (i) Forget (40.9%) (ii) Hassled (38.9%) (iii) Difficult to remember (36.6%). Age and Attitude effect on nonadherence, is found to be mediated by both intentional and unintentional, while Busyness is only mediated by unintentional and Knowledge only by intentional. Unintentional effect on nonadherence is found to be mediated by intentional and vice versa. Pillbox use has no direct nor indirect effect on nonadherence.

Chapter 5   Study #2: Validating Relationships between Age, Lifestyle Busyness, Knowledge, Attitude and External Cues with Intentional and Unintentional Nonadherence

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The second part of the research seeks to validate (i) Age, (ii) Lifestyle Busyness, (iii) Knowledge, (iv) Attitude and (v) External cue's effects on Intentional and Unintentional Nonadherence. A second survey is carried out in Singapore to collect data on these variables and to validate the findings from study 1. Data is collected by surveying the general public through convenience sampling. This section describes the study design, analysis and outcome of study #2.

5.1 Study Design

The second data collection is made up of a 66-items questionnaire survey to further validate the medication adherence levels in Singapore. The study also seeks to understand the management of medication by the respondents, as well as to validate the relationships of (i) Age, (ii) Lifestyle Busyness, (iii) Knowledge, (iv) Attitude and (v) External cue on intentional and unintentional nonadherence. Similarly, the target respondents are subjects above 21 years of age, who have been taking the same medication for at least two months. In addition, the study also seeks to examine the relationships between (vi) Trust in Medication (vii) Trust in Doctor (viii) Ability (ix) Prospective Memory and (x) Social Support on intentional and unintentional nonadherence. Variables (vi) to (x) will be analyzed and discussed in the subsequent chapter. In this chapter, the hypothetical model from Study 1 is used to validate the effects of (i) Age, (ii) Lifestyle Busyness, (iii) Knowledge, (iv) Attitude and (v) External cue on intentional and unintentional nonadherence based on the second set of data collected. Details of the questionnaire for study 2 can be found in Appendix D.

5.1.1 Procedure, Measurement of Adherence, Statistical Analysis and Latent Constructs

The procedure for this study, statistical analysis and latent constructs is similar to 4.1.1 and 4.1.4, 4.1.5.2 respectively and will not be repeated here. For the measurement of adherence (see 4.1.3), the Morisky MMAS-8 questionnaire is used here as well, with a slight variation, where the data is collected based on a 5-points Likert scale, so as to increase the sensitivity for analysis.

5.1.1.1 Independent Variables

Below describes the variables and questions associated with the independent variables (see Appendix D: Medication Adherence Survey Questionnaire Study 2 and Study 3). More details about the definitions and justification for Age, Busyness, External Cue, Attitude and Knowledge can be found in section 4.1.5.1.

- Age (Q61) – age data is collected in free-form with the attempt to obtain a richer set of data. However, in order to compare the data with study 1, the data is re-grouped into the same three categories as in section 4.1.5.1 for analysis: Younger adults (21-39), Middle-age adults (40-59) and Older adults (>60).
- Busyness (Q13b) – similarly, busyness is collected as one of the reasons for nonadherence and is defined as a dichotomous variable here.
- External Cue (40a) – pillbox use is collected as one of the ways the respondents managed their medication and is defined as a dichotomous variable here, e.g. whether pillbox is used or not.
- Attitude (Q17) – feeling hassled about medication taking is collected as a 5-points Likert scale to increase sensitivity for qualitative analysis, but is

redefined as a dichotomous variable for comparison with Study 1 (see section 4.1.5.1) .

- Knowledge (Q47) - similarly, desire to know more about medication is collected as a 5-points Likert scale, but redefined into dichotomous for consistent comparison with Study 1.

5.1.2 Hypothesis

Based on the results of Study 1, the following hypotheses are tested (see Figure28):

Figure 28: Hypothesis of Relationships between Variables and Constructs (Study 2)

- ***H7: Age effect on Nonadherence is mediated by both Unintentional and Intentional.***

As shown in 4.2.5.1, age is found to be mediated by both unintentional and intentional. Hence the data collected from study 2 will be used to re-test the hypothesis here.

- ***H8: Busyness effect on Nonadherence is mediated by Unintentional only.***

As shown in 4.2.5.2, busyness effect on nonadherence is found to be mediated by unintentional only, this hypothesis will be tested with study 2 results.

- ***H9: External Cue does not have any direct or indirect effect on Nonadherence.***

To analysis if pillbox use has no effect on nonadherence as found in 4.2.5.3, data from study 2 will be use to validate this hypothesis.

- ***H10: Attitude effect on Nonadherence is mediated by both Unintentional and Intentional.***

From 4.2.5.4, attitude effect on nonadherence is found to be mediated by both unintentional and intentional; this hypothesis will be re-validated here.

- ***H11: Knowledge (interest to know more about their medication) effect on Nonadherence is mediated by Intentional only.***

The results in 4.2.5.1 showed that knowledge effect on nonadherence is mediated by intentional only. We will hence validate this with data from study 2.

- ***H12a: Unintentional effect on Nonadherence is mediated by Intentional***
- ***H12a: Intentional effect on Nonadherence is mediated by Unintentional.***

As shown in section 4.2.5.6, intentional nonadherence is found to be mediated unintentional, and vice versa. This hypothesis will be tested here.

Results of study 2 are discussed next.

5.2 Results of Study #2

A total of 293 survey respondents are collected from the general public. As there are 26 surveys that were incomplete or had ambiguous data, a total 267 surveys are analyzed. Below shows an extract of the demographics of the respondents, while the details can be found in Appendix E.

5.2.1 Demographics of Participants

About half of the respondents are male (49.8%) and 40.9% of the respondents are above 60 years of age (see Table 25). About 38.6% of the respondents had above secondary school education.

Table 25: Extract of Data Generated (Study 2)

N=267		Medication Adherence Score (as measured by MMAS-8 Scale)			
Gender		High	Medium	Low	Total
	Male	34 (12.7%)	60 (22.5%)	39 (14.6%)	133(49.8%)
	Female	35 (13.1%)	51 (19.1%)	48 (18%)	134 (50.2%)
	Overall	69 (25.8%)	111 (41.6%)	87 (32.6%)	267 (100%)
Age Range (Years)					
	21-29	2 (0.8%)	6 (2.3%)	22 (8.3%)	30 (11.4%)
	30-39	4 (1.5%)	8(3.0%)	7 (2.7%)	19 (7.2%)
	40-49	6 (2.3%)	16(6.1%)	14 (5.3%)	36 (13.6%)
	50-59	17 (6.4%)	32 (12.1%)	22 (8.3%)	71 (26.9%)
	60-74	28 (10.6%)	33 (12.5%)	15 (5.7%)	76 (28.8%)
	≥75	12 (4.5%)	14 (5.3%)	6 (2.3%)	32 (12.1%)
Educational Experience					
	Primary and below	23 (8.6%)	35 (13.1%)	24 (9.0%)	82 (30.7%)
	Secondary	23 (8.6%)	29 (10.9%)	21 (7.9%)	73 (27.3%)
	Junior College	8 (3.0%)	7 (2.6%)	4 (1.5%)	19 (7.1%)
	Diploma/Professional	22 (8.20%)	21 (7.9%)	10 (3.7%)	53 (19.9%)
	Degree and above	8 (3.0%)	15 (5.6%)	8 (3.0%)	31 (11.6%)

5.2.2 Adherence Rate in Singapore

Based on the 8-item Morisky Medication Adherence Scale (MMAS-8), the survey revealed that only one-quarter (25.8%) of the respondents are considered highly adherent to their medication regime, with one third (32.6%) of the respondent falling into the low adherence group. Figure 29 and Table 26 shows the distribution.

Table 26: Descriptive Statistics of Adherence Score based on MMAS (Study 2)

Adherence score	Frequencies	Percent
High (8)	69	25.8%
Medium (6-7)	111	41.6%
Low (<6)	87	32.6%
Total	267	100%

Figure 29: Medication adherence levels in Singapore based on Morisky MMAS-8 scale (Study 2)

The mean score for medication adherence scale is 5.99 (SD=1.97). The item-total correlations are >0.306 . The internal consistency Cronbach's $\alpha = 0.734$ ($p < 0.001$). A one-way between subjects ANOVA is conducted to compare the differences in adherence score between study 1 ($M=5.98$, $SD=1.95$) and study 2 ($M=5.99$, $SD=1.97$). Results showed that there is no significant difference in adherence scored between the two surveys ($F(1,612) = 0.01$, $p=0.922$). As shown, the mean and standard deviation are rather close. Table 27 shows the differences in adherence levels between the 2 studies.

Adherence	Study 1	Study 2	Difference
High	29.4%	25.8%	-3.6%
Medium	33.7%	41.6%	7.9%
Low	36.9%	32.6%	-4.3%

Table 27: Comparing Adherence Levels between Study 1 and Study 2.

With reference to Figure 30 and the labels for each questions in the Morisky MMAS-8 scale (section 4.1.3), Forget (40.9%), followed by Hassled (28.1%), Difficulty

Remembering (24.7%) and Travel (24.7%) made up the top reasons for nonadherence in Study 2. Table 28 shows the differences between the 2 studies.

Figure 30: Ranking of Reasons for Nonadherence (Study 2)

Question	Study 1	Study 2	Difference
Forget	40.9%	56.2%	15.3%
Hassled	38.9%	28.1%	-10.8%
Difficult Remember	36.6%	24.7%	-11.9%
2 Weeks Missed	26.8%	22.8%	-4.0%
Travel	21.9%	24.7%	2.8%
Better	15.9%	21.3%	5.4%
Worse	11.0%	16.1%	5.1%
Yesterday	8.4%	6.7%	-1.7%

Table 28: Comparing Adherence Questions Results between Study 1 and 2.

5.2.2.1 Reasons for Nonadherence vs. Adherence Levels

With reference to Figure 31, in the Medium adherence group, Forget made up about 65.8% of the respondents, followed by Hassled (17.1%) and Forget to bring when Travelling (14.4%). In the Low adherence group (see Figure 32), Forget is also the top reason (88.5%), while Hassled made up 64.4% of the reasons, followed by Difficulty Remembering (63.2%). The low adherence group also showed a higher intentional

nonadherence frequencies (e.g. Better 58.6%, Worse 41.4%) in comparison to the medium adherence group (e.g. Better 5.4%, Worse 6.3%).

Figure 31: Graphical representation of responses in the Medium Adherence group (Study 2)

Figure 32: Graphical representation of responses in the Low Adherence group (Study 2)

5.2.3 Prevalence of Unintentional and Intentional Nonadherence

More than half (64.0%) of the respondents reported at least one of the four unintentional nonadherent behaviors (see Table 29). Forget is the most common (56.2%), followed by Simply Forget (40.4%). About one fourth of the respondents (25.8%) reported at least one of the intentional nonadherent behaviors.

Table 29: Prevalence of Unintentional and Intentional Nonadherence (comparing Study 1 and 2)

Unintentional Nonadherence (n=267)	N	Study 2	Study 1	Difference
Sometimes forget to take medication.	150	56.2%	40.9%	15.3%
Have difficulty remembering to take all the medication.	66	24.7%	38.6%	-13.9%
When travelling or leaving home, sometimes forget to bring medication.	66	24.7%	21.0%	3.7%
Simply forget	108	40.4%	45.2%	-4.8%
Reported at least one of the four unintentional nonadherent behaviors.	171	64.0%	50.7%	13.3%
Intentional Nonadherence (n=267)	N	Study 2	Study 1	Difference
Cutback or stopped taking medication without telling doctor because felt worse when taking it.	43	16.1%	11.0%	-5.1%
Sometimes stop taking the medication because felt the condition is under control.	57	21.3%	15.9%	-5.4%
Reported at least one of the two intentional nonadherent behaviors.	25.8%	25.8%	20.5%	5.3%

5.2.4 Significance of Predictors

5.2.4.1 Age

5.2.4.1.1 Age vs. Adherence Levels

A χ^2 test of independence is conducted, and a significant difference is found between age groups and level of adherence ($\chi^2 (2,267) = 28.19, p < 0.001$). Pearson correlation revealed a significant positive relationship ($r = 0.308, p < 0.001$). The correlation is moderate in strength. Consistent with study 1, higher proportion of younger adults of age 21-39 are found to be of low adherence (59.2%), compare to just 19.4% in the older adults group (>60) (see Table 30).

Table 30: Cross Tabulation of Age Group and Adherence Level (Study 2)

Age Group	Adherence			Total
	Low	Medium	High	
21-39	29 (59.2%)	14 (28.6%)	5 (12.2%)	49 (100%)
40-59	36 (33.6%)	48 (44.9%)	23 (21.5%)	107 100%
>60	21 (19.4%)	47 (43.5%)	40 (37.0%)	108 (100%)
Total	86 (32.6%)	109 (41.3%)	69 (26.1%)	264 (100%)

5.2.4.1.2 Age vs. Reasons for Nonadherence

With reference to Table 31, Forget made up the top reasons for all age groups (46.4%-68.6%). While Hassled remain the top 3 reasons for the younger and middle-age group, forgetting to bring medication when Travelling (25.0%) made up the other top 3 reasons for the older adults.

Table 31: Cross Tabulation of Age Group and Individual Questions (Study 2)

AGE	Forget	Hassle	Difficult to Remember	2 Weeks Missed	Travel	Better Stop	Worse Stop	Yesterday Missed
21-39 (n=49)	68.8%	50.0%	39.6%	39.6%	39.6%	45.8%	20.8%	14.6%
40-59 (n=107)	60.2%	33.3%	25.9%	23.1%	18.5%	19.4%	19.4%	7.4%
>60 (n=108)	46.3%	13.0%	17.6%	13.9%	25.0%	12.0%	10.2%	1.9%

Figure 33: Graphical representation of responses to Morisky Questions vs. Age

For the age group 21-39, intentional nonadherence (i.e. stop medication when feeling better) (45.8%) is among the top 3 reasons for nonadherence (See Table 32). For all the reasons of nonadherence, there are consistently higher proportion of younger adults (21-39) compared to older adults (>60) (See Figure 33).

5.2.4.2 Busyness

5.2.4.2.1 Busyness vs. Adherence Level

Busyness is found to be a significant factor ($\chi^2 (2,267) = 24.707, p<0.001$) between adherence groups. Pearson correlation revealed a significant negative moderate relationship ($r = -0.304, p < 0.001$). Similar to study 1, more Low adherence group respondents cited busyness (57.4%) as one of the factor compared to those in the Medium adherence group (42.6%) (see Table 32).

Table 32: Cross Tabulation of Busyness vs. Adherence Level

	Adherence Level			
Busy	L	M	H	Total (row)
0	60(27.6%)	91 (41.9%)	66 (30.4%)	217 (100%)
1	27 (57.4%)	20 (42.6%)	0 (0%)	47 (100%)
Total	87(33.0%)	111 (42.0%)	66 (25.0%)	347 (100%)

5.2.4.2.2 Busyness vs. Age

Similar to study 1, both middle and younger adults double the proportion of older adults citing busyness as a reason for forgetting to take their medication (22% vs. 11%). The difference between age groups and busyness ($\chi^2(2, 347 = 5.406, p>0.067)$) fell short of significance at $p< 0.05$ (see Table 33). Pearson correlation revealed a significant negative weak relationship ($r = -125, p < 0.05$).

Table 33: Cross Tabulation of Busyness vs. Age Group

	Busyness		
Age Group	0	1	Total
21-39	38 (77.6%)	11 (22.4%)	49 (100%)
40-59	82 (77.4%)	24 (22.6%)	106 (100%)
>60	94 (88.7%)	12 (11.3%)	106(100%)
Total	214 (82.0%)	47 (18.0%)	261 (100%)

5.2.4.3 External Cue

5.2.4.3.1 External Cue vs. Adherence Level

A significant difference is found between adherence group and External Cue ($\chi^2(2,267) = 5.975, p < 0.05$). However, Pearson correlation did not find a significant relationship ($r = -0.024, p = 0.691$). About 41.9% of the respondents uses pillbox. Respondents with medium and low adherence made up the majority (88.9%) who uses pillbox to manage their medication. Table 34 shows the frequency distribution.

Table 34: Cross Tabulation of External Cue vs. Adherence

External Cue	Adherence Level			Total (row)
	L	M	H	
0	54 (34.8%)	55 (35.5%)	64 (29.7%)	155 (100.0%)
1	33 (38.9%)	56 (50.0%)	24 (20.5%)	112 (100%)
Total	87 (32.6%)	111 (41.6%)	69 (25.8%)	267 (100%)

5.2.4.3.2 External Cue vs. Attitude

Among those who find medication taking a hassle, 30.4% use pillboxes to manage their medication. The χ^2 test did not find any significance difference between External Cue and Attitude.

5.2.4.3.3 External Cue vs. Age

No significance between age and pillbox use is found either.

5.2.4.4 Attitude

5.2.4.4.1 Attitude vs. Adherence

A significant difference between groups for Attitude (hassled by medication) and adherence is found ($\chi^2(2, 267) = 90.254, p < 0.001$). Pearson correlation revealed a significant strong negative relationship ($r = -0.558, p < 0.001$). Those of low adherence are more likely to find medication taking a hassle (see Table 35).

Table 35: Cross Tabulation of Attitude vs. Adherence

	Adherence Level			
Attitude	L	M	H	Total (row)
0	31 (16.1%)	92 (47.9%)	69 (35.9%)	192 (100.0%)
1	56 (74.7%)	19 (25.3%)	0 (0%)	75 (100.0%)
Total	87 (32.6%)	111 (41.6%)	69 (25.8%)	267 (100.0%)

5.2.4.4.2 Attitude vs. Age

A significant difference between Age and Attitude is found ($\chi^2(2, 267) = 24.487$, $p < 0.001$). Pearson correlation revealed a significant moderate negative relationship ($r = -0.303$, $p < 0.001$). Younger adults are more likely to find medication taking a hassle compared to older adults (49.0% vs. 13.0%) (see Table 36). This is consistent with Study 1.

Table 36: Cross Tabulation of Attitude vs. Age

	Attitude		
Age Group	0	1	Total
21-39	25 (51.0%)	24 (49.0%)	49 (100.0%)
40-59	71 (66.4%)	36 (33.6%)	107 (100.0%)
>60	94 (87.0%)	14 (13.0%)	108 (100.0%)
Total	190 (72.0%)	74 (28.0%)	264 (100.0%)

5.2.4.4.3 Attitude vs. Intentional

A χ^2 analysis revealed a significant difference between subjects who have intentional nonadherence tendency and Attitude ($\chi^2(1, 267) = 33.537, p < 0.001$). Pearson correlation revealed a significant moderate positive relationship ($r = 0.354, p < 0.001$). About 83.9% of the subject who do not find medication taking hassle, also do not have intentional nonadherence tendency (see Table 37). Half of subjects (50.7%) who have intentional nonadherence tendency also found medication taking a hassle.

Table 37: Cross Tabulation of Attitude vs. Intentional

Attitude	Intentional		Total
	0	1	
0	161 (83.9%)	31 (16.1%)	192 (100.0%)
1	37 (49.3%)	38 (50.7%)	75 (100.0%)
Total	192 (71.9%)	75 (28.1%)	267 (100.0%)

A significant difference between Attitude and Unintentional is found ($\chi^2(1, 267) = 13.537, p < 0.001$). Pearson correlation revealed a significant weak positive relationship ($r = 0.225, p < 0.001$). A total of 81.3% of subjects who find medication taking a hassle, also have unintentional nonadherence tendency compared to those who do not (18.7%) (see Table 38).

Table 38: Cross Tabulation of Attitude vs. Unintentional

Attitude	Unintentional		Total
	0	1	
0	82 (42.7%)	110 (57.3%)	192 (100.0%)
1	14 (18.7%)	61 (81.3%)	75 (100.0%)
Total	96 (36.0%)	171 (64.0%)	267 (100.0%)

5.2.4.5 Knowledge

5.2.4.5.1 Knowledge vs. Adherence Level

A chi square analysis found significant difference between adherence levels and knowledge at 95% confidence interval ($\chi^2 (2,267) = 6.107, p < 0.05$). Pearson correlation revealed a significant weak negative relationship ($r = -0.145, p < 0.05$). Table 39 shows the frequency distribution. Among those who have interests to know more about their medication, 40.3% are from the medium adherence group, while 36.4% are from the low adherence group.

Table 39: Cross Tabulation of Knowledge vs. Adherence Level

Knowledge	Adherence Level			Total (row)
	L	M	H	
0	12 (20.0%)	28 (46.7%)	20 (33.3%)	60 (100.0%)
1	75 (36.4%)	83 (40.3%)	48 (23.3%)	206 (100.0%)
Total	87 (32.7%)	111 (41.7%)	68 (25.6%)	266 (100.0%)

A significance difference between age and knowledge is found ($\chi^2 (2,267) = 24.741, p < 0.001$). Pearson correlation revealed a significant negative relationship ($r = -0.222, p < 0.05$). The correlation strength is weak. A higher proportion of middle-age and younger adults are more interested to know about their medications compared to older adults (see Table 40).

Table 40: Cross Tabulation of Knowledge vs. Age

Age	Knowledge		Total (row)
	0	1	
21-39	9 (15.3%)	40 (81.6%)	49 (100.0%)
40-59	10 (16.9%)	97 (90.7%)	107 (100.0%)
>60	40 (37.4%)	67 (62.6%)	107 (100.0%)
Total	59 (22.4%)	204 (77.6%)	263 (100.0%)

5.2.4.5.2 Knowledge vs. Intentional Nonadherence

For study 2, no significant difference between subjects who are intentionally nonadherent and Knowledge is found ($\chi^2(1, 267) = 3.468, p > 0.63$) (see Table 41).

Table 41: Cross Tabulation of Knowledge vs. Intentional

Intentional	Knowledge		Total
	0	1	
0	50 (25.4%)	147 (74.6%)	197 (100.0%)
1	10 (14.5%)	59 (85.5%)	69 (100.0%)
Total	60 (22.6%)	206 (77.4%)	266 (100.0%)

5.2.5 Mediation Analysis

A significant main effect of unintentional on nonadherence is found ($\varphi = 0.298, p < 0.001$), with high observed power = 0.998. A significant moderate effect of intentional on nonadherence is also found ($r = 0.363, p < 0.001$), with high observed power = 1.000. Main effects and indirect effects of Age, Busyness, External Cue, Attitude and Knowledge on nonadherence, when mediators unintentional or intentional are present, are investigated next.

5.2.5.1. Age effect on Nonadherence mediated by Intentional and Unintentional

H7: Age effect on Nonadherence is mediated by both Unintentional and Intentional.

A χ^2 test of independence showed a significant difference between age groups and unintentional ($\chi^2(2, 267) = 8.608, p < 0.05$) as well as intentional ($\chi^2(2, 267) = 23.131, p < 0.001$). Pearson correlation revealed a significant negative relationship between age and unintentional ($r = -0.176, p < 0.01$), as well as between age and intentional ($r = -0.288, p < 0.001$). A significant difference between age and nonadherence is also found

(χ^2 (2,267) = 15.318, $p < 0.001$). Pearson correlation revealed a significant negative relationship ($r = -0.234$, $p < 0.001$). As age decreases, nonadherence increases. The younger adults (21-39) are more likely to cite both unintentional (79.6%) and intentional (51.0%) reasons for nonadherence compared to older adults (55.6% and 14.8% respectively) (see Table 42). This is consistent with study 1.

Table 42: Cross Tabulation of Unintentional, Intentional and Nonadherence across Age Groups

IV	MV				DV	
	Unintentional		Intentional		Nonadherence	
Age Group	0	1	0	1	0	1
21-38 ($n=25$)	10 (20.4%)	39 (79.6%)	24 (49.0%)	25 (51.0%)	27 (55.1%)	22 (44.9%)
40-59 ($n=97$)	37(34.6%)	70 (65.4%)	80 (74.8%)	27 (25.2%)	82 (76.6%)	25 (23.4%)
>60 ($n=225$)	48 (44.4%)	60 (55.6%)	92 (85.2%)	16 (14.8%)	92(85.2%)	16 (14.8%)
Total	95(36.0%)	169 (64.0%)	196(74.2%)	68 (25.8%)	201(76.1%)	63(23.9%)

Table 43: Mediation Analysis and Bootstrapping Results

	a-path IV to Mediator	b-path Direct Effect of Mediator on DV	c'-path Direct Effect of IV on DV	c-path Total Effect of IV on DV	Bootstrap (95% CI)
AGE>INT	-0.21***	0.21***	0.09	-0.13*	-0.09 to -0.02
AGE>UINT	-0.20***	0.31***	-0.07	-0.13*	-0.12 to -0.2

A significant main effect of age on nonadherence is found ($\varphi = 0.241$, $p < 0.001$), observed power = 0.95. Post-hoc tests (Bonferroni correction) revealed that pairwise comparison of younger adults with older adults is significant ($p < 0.001$), younger adults with middle-age adults is also significant ($p < 0.05$), pairwise comparison between middle-age adults and older adults is however not significant ($p = 0.310$). Age main effect on Unintentional is found ($\varphi = 0.177$, $p < 0.05$), with observed power = 0.738. Age main effect on Intentional is also found ($\varphi = 0.303$, $p < 0.001$), with high observed power = 0.996. We will next examine the indirect effect of age on nonadherence, mediated by intentional and unintentional.

Multiple regression analyses are conducted to assess each component of the proposed mediation model (see Table 43). Results are similar to study 1, where age is found to be negatively associated with nonadherence ($B = -0.13$, $t(265) = -2.33$, $p < 0.05$), as seen in Figure 34 c-path. Age is also found to be negatively related to unintentional factor ($B = -0.20$, $t(265) = -3.52$, $p < 0.001$), as seen in Figure 34 a-path. The mediator, unintentional, is positively associated with nonadherence ($B = 0.27$, $t(265) = 4.19$, $p < 0.001$), as seen in Figure 34 b-path.

As both the a-path and b-path are significant, the mediation analysis is tested using the bootstrapping method as described earlier in section 4.1.4. The 95% confidence intervals of the indirect effects are obtained with 5000 bootstrap resample (Preacher & Hayes, 2008). Results of the mediation analysis confirmed the mediating role of unintentional factor ($B = -0.055$; $CI = -0.11$ to -0.02) in the relation between age and nonadherence. Indirect effect is significant from the bootstrap analysis since 0 is not included in the CI. The results also indicated that the direct effect of age on medication nonadherence is not significant ($B = -0.06$, $t(265) = -1.0$, $p > 0.31$) when controlling for unintentional (Figure 34, c' path), thus suggesting total mediation. Age effect on nonadherence is totally mediated by unintentional nonadherence. Figure 34 below displays the results.

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 34 : Indirect/Direct effect of Age on Nonadherence mediated by Unintentional (Study 2)

Age is negatively related to intentional ($B = -0.21$, $t(265) = -3.66$, $p < 0.001$), but the mediator, intentional, is not significantly associated with nonadherence ($B = 0.21$, $t(265) = 3.50 > 0.001$). Age effect on nonadherence is found to be mediated by intentional factors (See Figure 35).

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 35 : Indirect/Direct effect of Age on Nonadherence mediated by Intentional (Study 2)

H7 is accepted. Similar to Study 1, Age effect on Nonadherence is totally mediated by both Unintentional and Intentional. The direct effect on Nonadherence is insignificant.

5.2.5.2. Busyness effect on Nonadherence mediated by

Intentional/Unintentional

H8: Busyness effect on Nonadherence is mediated by Unintentional only.

Unintentional is found to be significantly associated with a busy lifestyle, ($\chi^2(1, 267) = 31.098, p < 0.001$). Pearson correlation revealed a significant moderate positive relationship ($r = 0.346, p < 0.001$). Among those who cited busyness as a reason for nonadherence, 100% indicated unintentional reasons for nonadherence (see Table 44). Intentional nonadherence is not found to be significantly associated with a busy lifestyle ($\chi^2(1, 267) = 1.851, p > 0.17$).

Table 44: Cross Tabulation of Unintentional, Intentional and Nonadherence across Busyness

IV	MV				DV	
	Unintentional		Intentional		Nonadherence	
Busy	0	1	0	1	0	1
0	96 (42.9%)	124 (57.1%)	167 (75.6%)	53 (24.4%)	173 (78.3%)	47 (21.75%)
1	0 (0%)	47 (100%)	31 (66.0%)	16 (34.0%)	29 (61.7%)	18 (38.3%)
Total	93 (35.2%)	171 (64.8%)	195 (73.9%)	69 (26.1%)	199 (75.4%)	65 (24.6%)

A significant main effect of busyness on nonadherence is found ($\phi = 0.15, p < 0.05$), observed power = 0.688. There is hence 31.2% chance of a type II error. A significant moderate main effect of Busyness on Unintentional is however found ($\phi = 0.346, p < 0.001$), with high observed power = 1.0. Busyness main effect on Intentional is not found to be significant ($\phi = 0.087, p = 0.157$). We will next look at busyness indirect effect when a mediator is present. Table 45 and Figure 36 shows the mediation analysis results.

Table 45: Mediation Analysis and Bootstrapping Results for Busyness mediated by Unintentional/Intentional

	a-path IV to Mediator	b-path Direct Effect of Mediator on DV	c'-path Direct Effect of IV on DV	c-path Total Effect of IV on DV	Bootstrap (95% CI)
Busyness>INT	0.13*	0.22***	0.14*	-0.16**	0.04 to 0.07
Busyness>UINT	0.32***	0.30***	0.07	-0.16**	0.05 to 0.17

Figure 36 : Indirect/Direct effect of Busyness on Nonadherence mediated by Unintentional/Intentional (Study 2)

For Study 2, H8 is rejected. Busyness is found to have significant indirect effect on Nonadherence when mediated by Unintentional and Intentional. The direct effect on Nonadherence is also found to be significant when mediated by Intentional. Although there was no main effect of Busyness on Intentional, when testing for Busyness effect on Nonadherence with mediator Intentional present, a significant partial indirect was found.

5.2.5.3 External Cue on Nonadherence mediated by Intentional/Unintentional

H9: External Cue does not have any direct or indirect effect on Nonadherence.

Unintentional is not found to be associated with pillbox use ($\chi^2(1, 267) = 1.4$, $p=0.236$). A significance association between pillbox use with intentional is found for study 2 ($\chi^2(1, 267) = 6.42$, $p<0.05$). Pearson correlation however did not revealed a significant relationship ($r = 0.073$, $p < 0.238$). Table 46 shows the frequency distribution.

Table 46: Cross Tabulation of Unintentional, Intentional, and Nonadherence across External cue

IV	MV				DV	
	Unintentional		Intentional		Nonadherence	
External Cue	0	1	0	1	0	1
0	60 (38.7%)	95 (61.3%)	106 (68.4%)	49 (31.6%)	115 (74.2%)	40 (25.8%)
1	36 (32.1%)	76(67.9%)	92 (82.1%)	20 (17.9%)	87 (77.7%)	25 (22.3%)
Total	96 (36.0%)	171 (64.0%)	198 (74.2%)	69 (25.8%)	202 (75.7%)	65 (24.3%)

No significant main effect of external cue (i.e. pillbox use) on nonadherence is found ($\varphi = 0.029$, $p=0.635$). No significant main effect of external cue on unintentional was found ($\varphi = 0.073$, $p=0.237$). A significant moderate main effect of External Cue on Intentional is however found ($\varphi = 0.153$, $p < 0.05$), with observed power = 0.705. There is however a 29.5% chance of Type II error. Mediation analysis indicated no indirect effect of external cue on nonadherence when controlling for intentional or unintentional mediators (See Figure 22 and Appendix C).

Table 47: Mediation Analysis and Bootstrapping Results for External Cue mediated by Unintentional/Intentional

	a-path IV to Mediator	b-path Direct Effect of Mediator on DV	c'-path Direct Effect of IV on DV	c-path Total Effect of IV on DV	Bootstrap (95% CI)
Pillbox>INT	-0.19	0.24***	0.04	-0.001	-0.12 to 0.003
Pillbox>UINT	0.14	0.33***	-0.05	-0.001	-0.03 to 0.14

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 37 : Indirect/Direct effect of External Cue on Nonadherence mediated by Unintentional/Intentional (Study 2)

H9 is accepted. Similar to Study 1, External Cue has no significant direct or indirect effect on Nonadherence when mediated by Unintentional and Intentional (see Table 47 and Figure 37). A significant weak main effect of External Cue on Intentional was found, however, the power fall short of our expected power of 0.8/

5.2.5.4. Attitude effect on Nonadherence mediated by Intentional/Unintentional

H10: Attitude effect on Nonadherence is mediated by both Unintentional and Intentional.

A χ^2 test of independence showed a significant difference between Attitude and Unintentional ($\chi^2 (2,267) = 13.537, p < 0.001$) as well as between Attitude and Intentional ($\chi^2 (2,267) = 33.537, p < 0.001$). Pearson correlation revealed significant positive relationships between attitude and unintentional ($r = 0.225, p < 0.001$), as well as between attitude and intentional ($r = 0.354, p < 0.001$). A total of 81.3% of subjects who found medication taking a hassle also gave unintentional reasons for nonadherence compared to those who did not. About half of the respondents (50.7%) who have intentional nonadherence tendency found medication taking a hassle (see Table 48).

Table 48: Cross Tabulation of Unintentional, Intentional, and Nonadherence across Attitude

IV	MV				DV	
	Unintentional		Intentional		Nonadherence	
Attitude	0	1	0	1	0	1
0	82 (42.7%)	110 (57.3%)	161 (83.9%)	31 (16.1%)	155 (80.7%)	37 (19.3%)
1	14 (18.7%)	61 (81.3%)	37 (49.3%)	38 (50.7%)	47 (62.7%)	28 (37.3%)
Total	96 (36.0%)	171(64.0%)	198(74.2%)	69 (25.8%)	202 (75.7%)	65 (24.3%)

A significant main effect of attitude on nonadherence is found ($\varphi = 0.189, p < 0.01$), with high observed power = 0.87. A significant moderate main effect of

Attitude on Unintentional is found ($\varphi = 0.225$, $p < 0.001$), with high observed power = 0.957. Attitude main effect on Intentional is also found to be significant ($\varphi = 0.354$, $p < 0.001$), with high observed power = 1.0. From mediation analysis, in the presence of intentional and unintentional mediators, significant indirect effects are also found (see Table 49 and Figure 38).

Table 49: Mediation Analysis and Bootstrapping Results for Attitude mediated by Unintentional/Intentional

	a-path IV to Mediator	b-path Direct Effect of Mediator on DV	c'-path Direct Effect of IV on DV	c-path Total Effect of IV on DV	Bootstrap (95% CI)
Attitude>INT	0.43***	0.20**	0.08	0.17**	0.03 to 0.17
Attitude>UINT	0.41***	0.31***	0.04	0.17**	0.07 to 0.21

Figure 38 : Indirect/Direct effect of Attitude on Nonadherence mediated by Unintentional/Intentional (Study 2)

H10 is accepted. Similar to Study 1, Attitude effect on Nonadherence is totally mediated by both Unintentional and Intentional when these mediators are present.

5.2.5.5 Knowledge effect on Nonadherence mediated by

Intentional/Unintentional

H11: Knowledge effect on Nonadherence is mediated by Intentional only.

In study 2, both Intentional and Unintentional is not found to be significantly associated with Knowledge ($\chi^2(1, 267) = 3.468, p=0.063$) and ($\chi^2(1, 267) = 1.196, p=0.274$). Table 50 shows the frequency distribution.

Table 50: Cross Tabulation of Unintentional, Intentional and Nonadherence across Knowledge

IV	MV				DV	
	Unintentional		Intentional		Nonadherence	
Knowledge	0	1	0	1	0	1
0	26 (41.7%)	35 (58.3%)	51 (83.3%)	10 (16.7%)	50 (81.7%)	11 (18.3%)
1	70 (34.0%)	136(66.0%)	147 (71.4%)	59 (28.6%)	152 (73.8%)	54 (26.2%)
Total	95 (35.7%)	171(64.3%)	197 (74.1%)	69 (25.9%)	201 (75.6%)	65 (24.4%)

No significant main effect of knowledge on nonadherence is found ($\phi = 0.08, p=0.191$). No significant main effect of knowledge on intentional ($\phi = 0.076, p=0.217$) is also found. The main effect of knowledge on unintentional was barely insignificant ($\phi = 0.117, p=0.055$). In the presence of intentional mediator, no significant indirect effect is found (see Table 51 and Figure 39). However, in the presence of Unintentional mediator, a significant indirect effect was found ($B = -0.042$; $CI = -0.11$ to -0.01).

Table 51: Mediation Analysis and Bootstrapping Results for Knowledge mediated by Unintentional/Intentional

	a-path IV to Mediator	b-path Direct Effect of Mediator on DV	c'-path Direct Effect of IV on DV	c-path Total Effect of IV on DV	Bootstrap (95% CI)
Knowledge>INT	0.01	0.23***	-0.06	-0.06	-0.03 to 0.04
Knowledge >UINT	-0.16*	0.32***	-0.01	-0.06	-0.11 to -0.01

Figure 39 : Indirect/Direct effect of Knowledge on Nonadherence mediated by Unintentional/Intentional (Study 2)

H11 is rejected. In study 2, Knowledge is found to have significant indirect effect on Nonadherence when mediated by Unintentional instead of Intentional.

5.2.5.6 Unintentional and Intentional Effects on Nonadherence

H12a: Unintentional effect on Nonadherence mediated by Intentional factor.

H12b: Intentional effect on Nonadherence mediated by Unintentional factor.

Unintentional and intentional are also associated nonadherence ($\chi^2(1, 267) = 23.667, p < 0.001$) and ($\chi^2(1, 267) = 35.156, p < 0.001$) respectively. Pearson correlation revealed significant positive relationships between unintentional and nonadherence ($r = 0.298, p < 0.001$), as well as intentional and nonadherence ($r = 0.363, p < 0.001$). Unintentional is also associated with intentional ($\chi^2(1, 267) = 16.184, p < 0.001$). Pearson correlation revealed a significant positive relationship ($r = 0.246, p < 0.001$). Table 52 and Table 53 show the distribution. Unintentional main effect on Intentional is also significant ($\phi = 0.246, p < 0.001$), with high observed power = 0.980. The main effect Intentional on Unintentional is the same. Mediation analysis is carried out next to test for the indirect effects (see Table 54 and Figure 40).

Table 52: Cross Tabulation of Intentional and Nonadherence across Unintentional

Unintentional	Intentional		Nonadherence	
	0	1	0	1
0	85 (88.5%)	11 (11.5%)	89 (92.7%)	7(7.3%)
1	113 (66.1%)	58 (33.9%)	113 (66.1%)	58 (33.9%)
Total	198 (74.2%)	69 (25.8%)	202 (75.7%)	65 (24.3%)

Table 53: Cross Tabulation of Unintentional and Nonadherence across Intentional

Intentional	Unintentional		Nonadherence	
	0	1	0	1
0	85 (42.95%)	113 (57.1%)	168 (84.8%)	30 (15.2%)
1	11 (15.9%)	58 (84.1%)	34 (49.3%)	35(50.7%)
Total	96 (36.0%)	171 (64.0%)	202 (75.7%)	65 (24.3%)

Table 54: Mediation Analysis and Bootstrapping Results for Unintentional/Intentional mediated by Intentional/Unintentional

	a-path IV to Mediator	b-path Direct Effect of Mediator on DV	c'-path Direct Effect of IV on DV	c-path Total Effect of IV on DV	Bootstrap (95% CI)
UINT>INT	0.39***	0.13*	0.27***	0.32***	-0.01 to 0.12
INT>UINT	0.39***	0.27***	0.13*	0.23***	0.05 0.19

Note: * $p < .05$, **

Figure 40: Indirect/Direct effect of Unintentional on Nonadherence mediated by Intentional (Study 2)

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 41: Indirect/Direct effect of Intentional on Nonadherence mediated by Unintentional (Study 2)

From the mediation analysis results, H12a is rejected. Different from study 1, in study 2, mediation analysis did not reveal a significant indirect effect of Unintentional on Nonadherence when mediated by Intentional.

H12b is accepted. Similar to study 1, when mediated by Unintentional a significant direct and indirect effect of Intentional on Nonadherence is found. (see Table 54 and Figure 41).

Figure 42 shows the revised relationship after mediation analysis.

Figure 42 : Revised model after mediation analysis

5.3 Summary of Findings

Below summarizes the results of Study 2:

- Adherence rate in Singapore: High (25.8%), Medium (41.6%), Low (32.6%)
- Top 3 reasons for nonadherence: (i) Forget (56%) (ii) Hassled (28%) (iii) Difficult to remember (25%) & Travel (25%)
- Prevalence of Unintentional (64.0%) and Intentional (25.8%) nonadherence is found.

Significant χ^2 relationships are found between the following groups:

- Age vs. Adherence
- Busyness vs. Adherence
- External cue vs. Adherence
- Attitude vs. Adherence; Attitude vs. Age; Attitude vs. Intentional nonadherence; Attitude vs. Unintentional nonadherence.
- Knowledge vs. Adherence, Knowledge vs. Age

NO significant χ^2 relationships are found between the following groups:

- Busyness vs. Age.
- External cue vs. Attitude ; External cue vs. Age,
- Knowledge vs. Intentional nonadherence.

Hypothesis Testing

- H7: Age effect on Nonadherence is mediated by both Unintentional and Intentional. – Accepted.

- H8: Busyness effect on Nonadherence is mediated by Unintentional only. – *Rejected. Busyness effect on nonadherence is mediated by both Unintentional and Intentional.*
- H9: External Cue does not have any direct or indirect effect on Nonadherence – Accepted.
- H10: Attitude effect on Nonadherence is mediated by both Unintentional and Intentional. – Accepted.
- H11: Knowledge effect on Nonadherence is mediated by Intentional only. – *Rejected. Knowledge effect on nonadherence is mediated by both Unintentional not Intentional.*
- H12a: Unintentional effect on Nonadherence is mediated by Intentional. – *Rejected.*
- H12b: Intentional effect on Nonadherence is mediated by Unintentional. - *Accepted*

The mediation analysis results is summarized in Table 55.

Table 55: Summary of mediation analysis results

Independent Variable	Indirect Effect mediated by Unintentional	Indirect Effect mediated by Intentional	Direct Effect on on Nonadherence
Age	Significant	Significant	Not significant
Busyness	Significant	Significant*	Not significant (Unintentional) Significant (Intentional)*
External Cue (Pillbox)	Not significant	Not significant	Not significant
Attitude	Significant	Significant	Not significant
Knowledge	Significant*	Not significant*	
Unintentional	n/a	Not significant*	Significant
Intentional	Significant	n/a	Significant

* different from Study 1

From study 2, only 25% of respondents are considered to be highly adherent to their medication. Prevalence of Unintentional (64.0%) and Intentional (25.8%) nonadherence is found. Top 3 reasons for nonadherence are (i) Forget (56%) (ii) Hassled (28%) (iii) Difficult to remember (25%) & Travel (25%). Similar to study 1, Age and Attitude effect on nonadherence, is found to be mediated by both intentional and unintentional. However, in study 2, Busyness effect on nonadherence is found to be mediated by both unintentional and intentional, instead of unintentional only (as in Study 1). Also, different from study 1, Knowledge effect on nonadherence is found to be mediated by unintentional instead of intentional. Unintentional effect on nonadherence is not found to be mediated by intentional in study 2, while intentional effect on nonadherence in study 2 mediated by unintentional is consistent with study 1. Similar to study 1, Pillbox use did not have any direct nor indirect effect on nonadherence in study 2.

Chapter 6   Study #3: Investigating Trust in Medication, Trust in Doctor, Perceived Prospective Memory, Perceived Ability and Social Support on Medication Nonadherence

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The third part of the research seeks to investigate (i) Trust in Medication (ii) Trust in Doctor (iii) Perceived Prospective Memory (iv) Perceived Ability and (v) Social Support effects on Intentional and Unintentional Nonadherence. Based on the data collected in the second survey as discussed in Chapter Five, the relationship between these constructs will be analyzed. This section describes the study design, analysis and outcome of study #3.

6.1 Study Design

Details of the data collection questionnaire for study 3 can be found in Appendix D.

6.1.1 Procedure, Measurement of Adherence, Statistical Analysis and Latent Constructs

The procedure for data collection, mediation analysis, and latent constructs for intentional, unintentional and nonadherence is similar to 4.1.1, 4.1.5.2 and 4.1.4 will not be repeated. For the measurement of adherence (4.1.3), a similar Morisky MMAS-8 questionnaire is used as described in section 5.1.1.

6.1.1.1 Independent Variables

Below describes the definition, justification and questions associated with the independent variables for Study 3 (see Appendix D: Medication Adherence Survey Questionnaire Study 2 and Study 3).

- Trust in Medication (Q22, Q25, Q28, Q34, Q35 and Q43) – Trust is defined as firm belief in the reliability, truth, or ability of someone or something in the Oxford English Dictionary. Here Trust in Medication refers to the respondents' belief in the ability and efficacy of their medication when taken as instructed, and that it is important to their well-being. As discussed in section 2.5 Research Gaps, trust in medication is potentially linked to medication adherence. Here, Trust in Medication is modeled as a construct consisting of 6 questions. More details about this construct is described in section 6.2.1.1. Trust in Medication.
- Trust in Doctor (Q9, Q10, Q25, Q34 and Q35) – Trust in Doctor here refers to respondents' belief in the reliability of the doctors' prognosis and recommendations with regards to the medication necessity. Trust in Doctor here is modeled as a construct consisting of 5 questions. More details about this construct can be found in section 6.2.1.2. Trust in Doctor.
- Perceived Prospective Memory (Q55, Q56, Q57, Q58 and Q59) – As defined by McDaniel and Einstein (2007), "*prospective memory refers to remembering to perform an intended action at an appropriate moment in the future*", such as remembering to take medication. As discussed in section 2.5 Research Gaps, failure to remember to take medication is often thought of as the main reason for nonadherence. Here Perceived Prospective Memory is defined as the subjective evaluation of one's ability to remember to perform an intended task in the future. The independent variable Perceived Prospective Memory is modeled as a construct consisting of five questions. Section 6.2.1.3 provides more information about this construct.

- Perceived Ability (Q42) – Ability is defined as the possession of the means and skill to do something in the Oxford English Dictionary. A patient who has arthritis of the hand may have difficulty retrieving their medication from the packaging and hence may be unintentionally nonadherent. A person who needs assistance with their basic activities of daily living (e.g. transferring or walking) may be physically challenged and is unable to take his medication, even if he remembers or intends to take it. Perceived Ability here refers to the subjective evaluation of one possessing of the means and skill to take his medication at will. Perceived Ability is modeled as a single question response. More information about this construct can be found in section 6.2.1.4. Perceived Ability.
- Social Support (Q38) - Albrecht and Adelman (1984) described social support as “a network or configuration of personal ties where affect and/or instrumental aid is exchanged”. The independent variable Social Support here refers to the respondents’ network of personal ties that assist them with medication adherence, in particularly remembering to take their medication. As discussed in section 2.5 Research Gaps, Park et al. (1997)’s suggests that social support contributes to providing external cue to remind the patients to take their medication. As such, we expect the presence of social support to minimize unintentional medication nonadherence. This variable is modeled as a single question response. Further information about this variable is described in Section 6.2.1.5 Social Support,

6.1.2 Hypothesis

As discussed in section 2.3 and section 2.5, unintentional as defined by Gadkari et al. (2012) is a passive process where a patient fails to adhere to the prescribed therapy

due to forgetfulness. Clifford (2008) found that intentional nonadherers had lower perception on the necessity of their medication and higher levels of concerns about taking it. On the other hand, unintentional nonadherers are not significantly different from adherers. Sewitch (2009) found that patient-doctor relationship is associated with intentional nonadherence. This suggests that Trust in Doctor and trust in medication are associated with intentional nonadherence, whereas unintentional nonadherence is more associated with factors beyond the patient's control or human limitations. Earlier research associating ability or family support to unintentional or intentional nonadherence constructs could not be found. Here, we hence hypothesize that prospective memory, ability and social support are associated with unintentional nonadherence.

The following hypotheses will be analyzed to study the effects of i) Trust in Medication (ii) Trust in Doctor (iii) Perceived Prospective Memory (iv) Ability and (v) Social Support effects on Intentional and Unintentional Nonadherence (See Figure 43):

Figure 43: Hypothesis of Relationships between Variables and Constructs (Study 2)

- Hypothesis 13 (H13) Trust in Medication effect on Nonadherence is mediated by Intentional.
- Hypothesis 14 (H14) Trust in Doctor effect on Nonadherence is mediated by Intentional.
- Hypothesis 15 (H15) Perceived Prospective Memory effect on Nonadherence is mediated by Unintentional.
- Hypothesis 16 (H16) Perceived Ability (to self-manage medication) effect on Nonadherence is mediated by Unintentional.
- Hypothesis 17 (H17) Social Support (to remind to take medication) effect on Nonadherence is mediated by Unintentional.

6.2 Results of Study #3

6.2.1 Significance of Predictors

6.2.1.1 Trust in Medication

Trust in Medication is modeled as a construct consisting of six questions on a 5-points Likert scale. The responses are summed up to a score. The mean score for Trust in Medication construct is 23.76 (SD=3.78). The inter-item correlations are > 0.237 and the ANOVA between items is ($F=65.207$, $p<0.001$). The internal consistency Cronbach's $\alpha = 0.732$. By modeling score <24 as low trust, and score ≥ 24 as high, a χ^2 test of independence analysis is carried out to analyze significance between Adherence Groups, Age and Attitude. Table 56 shows the questions in the construct:

Table 56: Questions in Trust in Medication construct

Trust in Medication construct	Cronbach's α
1. You will only take your medication when the symptoms of your condition show.	0.732
2. Doctors sometimes prescribe too much medication.	
3. You follow all the instructions given by your doctor for taking your medication.	
4. Taking your medication as prescribed is important to you.	
5. You trust your doctor(s) when it comes to your medication needs.	
6. Your doctor(s) only prescribe medication that you need.	

6.2.1.1.1 Trust in Medication vs. Adherence

A significant difference is found between Trust in Medication groups and Adherence ($\chi^2 (2,267) = 39.345, p < 0.001$) (see Table 57). Pearson correlation revealed a significant positive relationship ($r = 0.384, p < 0.001$). Higher trust leads to higher adherence, and lower trust leads to lower adherence.

Table 57: Cross Tabulation of Trust in Medication vs. Adherence Level

Trust in Medication	Adherence			Total
	Low	Medium	High	
Low	60 (49.6%)	48 (39.7%)	13 (10.7%)	121 (100%)
High	27 (18.5%)	63 (43.2%)	56 (38.4%)	146 (100%)
Total	87 (32.6%)	111 (41.6%)	69 (25.8%)	267 (100%)

6.2.1.1.2 Trust in Medication vs. Age

From Table 58, more older adults (62.0%) trust their medication compared to younger adults (42.9%). However the data fell short of statistical significance ($p > 0.05$) based on χ^2 test of independence between Trust in Medication and Age ($\chi^2 (2,267) = 5.207, p = 0.074$). Pearson correlation revealed a significant weak positive relationship ($r = 0.146, p < 0.05$).

Table 58: Cross Tabulation of Trust in Medication vs. Age

Age	Trust in Medication		Total (row)
	Low	High	
21-39	28 (57.1%)	21 (42.9%)	49 (100.0%)
40-59	50 (46.7%)	57 (53.3%)	107 (100.0%)
>60	41 (38.0%)	67 (62.0%)	107 (100.0%)
Total	119 (45.1%)	145 (54.9%)	263 (100.0%)

6.2.1.1.3 Trust in Medication vs. Attitude

A significant difference is found between Trust in Medication groups and Attitude ($\chi^2 (2,267) = 19.182, p < 0.001$). Pearson correlation revealed a significant

negative relationship ($r = -0.267, p < 0.001$). Respondents who have lower trust in their medication felt more hassled by their medication (see Table 59).

Table 59: Cross Tabulation of Trust in Medication vs. Attitude

Attitude	Trust in Medication		Total (row)
	Low	High	
0	71 (37.0%)	121 (63.0%)	192 (100.0%)
1	50 (66.7%)	25 (33.3%)	75 (100.0%)
Total	121 (45.3%)	146 (54.7%)	267 (100.0%)

6.2.1.2 Trust in Doctor

Trust in Doctor is modeled as a construct consisting of five questions on a 5-points Likert scale. The responses are summed up to a score. The mean score for Trust in Doctor construct is 20.96 (SD=2.89). The inter-item correlations are > 0.328 , ANOVA score between items is $F=3.83$ ($p<0.01$). The internal consistency Cronbach's $\alpha = 0.793$. By modeling score <21 as low trust, and score ≥ 21 as high, a χ^2 test of independence analysis is carried out to analyze significance between Adherence Groups, Age, Attitude and Trust in Doctor. Table 60 shows the questions in the construct:

Table 60: Questions in Trust in Doctor construct

Trust in Doctor Construct	Cronbach's α
1. Your doctor(s) only think about what is best for you.	0.793
2. How much do you trust your doctor(s) when it comes to your medication needs?	
3. Taking your medication as prescribed is important to you.	
4. You trust your doctor(s) when it comes to your medication needs.	
5. Your doctor(s) only prescribe medication that you need.	

6.2.1.2.1 Trust in Doctor vs. Adherence

A significant difference is found between Trust in Doctor and Adherence ($\chi^2 (2,267) = 24.594, p < 0.001$). Pearson correlation revealed a significant positive relationship ($r = 0.296, p < 0.001$). Higher Trust in Doctor leads to higher adherence (see Table 61).

Table 61: Cross Tabulation of Trust in Doctor vs. Adherence Level

Trust in Doctor	Adherence			Total
	Low	Medium	High	
Low	57 (47.5%)	44 (36.7%)	19 (15.8%)	120 (100%)
High	30 (20.4%)	67 (45.6%)	50 (34.0%)	147 (100%)
Total	87 (32.6%)	111 (41.6%)	69 (25.8%)	267 (100%)

6.2.1.2.2 Trust in Doctor vs. Age

From the data, older adults (62.0%) trust their doctors more, compared to younger adults (42.9%) (see Table 62). A significance difference is found between Trust in Doctor and Age is ($\chi^2 (2,264) = 7.111, p < 0.05$). Pearson correlation revealed a significant positive weak relationship ($r = 0.164, p < 0.01$).

Table 62: Cross Tabulation of Trust in Doctor vs. Age

Age	Trust in Doctor		Total (row)
	Low	High	
21-39	27 (55.1%)	22 (44.9%)	49 (100.0%)
40-59	53 (49.5%)	54 (50.5%)	107 (100.0%)
>60	38 (35.2%)	70 (64.8%)	108 (100.0%)
Total	118 (44.7%)	146 (55.3%)	264 (100.0%)

6.2.1.2.3 Trust in Doctor vs. Attitude

A significant difference is found between Trust in Doctor and Attitude ($\chi^2 (2,267) = 11.322, p < 0.001$). Pearson correlation revealed a significant negative relationship ($r = -0.206, p < 0.01$). Respondents who have lower trust towards their doctors felt more hassled by medication (see Table 63).

Table 63: Cross Tabulation of Trust in Doctor vs. Attitude

Attitude	Trust in Doctor		Total (row)
	Low	High	
0	74 (38.5%)	118 (61.5%)	192 (100.0%)
1	46 (61.3%)	29 (38.7%)	75 (100.0%)
Total	120 (44.9%)	147 (55.1%)	267 (100.0%)

6.2.1.3 Perceived Prospective Memory

Perceived Prospective Memory is modeled as a construct consisting of five questions on a 5-points Likert scale. The responses are summed up to a score. The mean score for Perceived Prospective Memory construct is 11.89 (SD=3.937). The inter-item correlation is > 0.417 , while the ANOVA between items F value is 26.722 ($p < 0.001$). The internal consistency Cronbach's $\alpha = 0.853$. By modeling score < 12 as high prospective, and score ≥ 12 as low, a χ^2 test of independence analysis is carried out to analyze significance between Adherence Groups, Age, Attitude and Perceived Prospective Memory. Table 64 shows the questions in the construct:

Table 64: Questions in Perceived Prospective Memory construct

Perceived Prospective Memory construct	Cronbach's α
1 You decide to do something later but forget to do it.	0.853
2. You forget about appointments unless you are reminded (e.g. by somebody or via a calendar).	
3. You usually forget to buy something that you planned to, even after seeing the shop.	
4. You usually leave things behind even though they were right in front of you.	
5. You usually take a second look at something without realizing that you have seen it before.	

6.2.1.3.1 Perceived Prospective Memory vs. Adherence

A significant difference is found between Perceived Prospective Memory and Adherence ($\chi^2 (2,267) = 32.826, p < 0.001$). Pearson correlation revealed a significant positive relationship ($r = 0.343, p < 0.001$). Higher prospective memory leads to higher adherence (see Table 65).

Table 65: Cross Tabulation of Perceived Prospective Memory vs. Adherence Level

Prospective Memory	Adherence			Total
	Low	Medium	High	
Low	65 (47.8%)	50 (36.8%)	21 (15.4%)	136 (100%)
High	22 (16.8%)	61 (46.6%)	48 (36.6%)	131 (100%)
Total	87 (32.6%)	111 (41.6%)	69 (25.8%)	267 (100%)

6.2.1.3.2 Perceived Prospective Memory vs. Age

Table 66 shows the cross tabulation of Perceived Prospective Memory and Age. A chi square test showed no significance difference between Perceived Prospective Memory and Age ($\chi^2 (2,267) = 2.872, p = 0.238$).

Table 66: Cross Tabulation of Perceived Prospective Memory vs. Age

Age	Prospective Memory		Total (row)
	Low	High	
21-39	30 (61.2%)	19 (38.8%)	49 (100.0%)
40-59	52 (48.6%)	55 (51.4%)	107 (100.0%)
>60	51 (47.2%)	57 (52.8%)	108 (100.0%)
Total	133 (50.4%)	131 (49.6%)	264 (100.0%)

6.2.1.3.3 Perceived Prospective Memory vs. Attitude

A significant difference is found between Prospective Memory groups and Attitude (hassled by medication) ($\chi^2 (2,267) = 16.246, p < 0.001$). Pearson correlation revealed a significant negative relationship ($r = -0.247, p < 0.001$). Respondents who felt more hassled by medication have lower perceived prospective memory (see Table 67).

Table 67: Cross Tabulation of Perceived Prospective Memory vs. Attitude

Attitude	Prospective Memory		Total (row)
	Low	High	
0	83 (43.2%)	109 (56.8%)	192 (100.0%)
1	53 (70.7%)	22 (29.3%)	75 (100.0%)
Total	136 (50.9%)	131 (49.1%)	267 (100.0%)

6.2.1.4 Perceived Ability

Perceived Ability (to manage medication on their own) is modeled as a single item response, “You have difficulty managing your medication by yourself”, dichotomized and reversed to represent ability to manage own medication (High) and difficulty to manage own medication (Low). A χ^2 test of independence analysis is carried out to analyze significance between Adherence Groups, Age and Attitude.

6.2.1.4.1 Perceived Ability vs. Adherence

A significant difference is found between Perceived Ability and Adherence (χ^2 (2,267) = 15.152, $p < 0.001$). Pearson correlation revealed a significant positive relationship ($r = 0.227$, $p < 0.001$). Higher ability leads to higher adherence, lower ability leads to lower adherence (see Table 68).

Table 68: Cross Tabulation of Ability vs. Adherence Level

Ability	Adherence			Total
	Low	Medium	High	
Low	18 (64.3%)	8 (28.6%)	2 (7.1%)	28 (100%)
High	69 (28.9%)	103 (43.1%)	67 (28.0%)	239 (100%)
Total	87 (32.6%)	111 (41.6%)	69 (25.8%)	267 (100%)

6.2.1.4.2 Perceived Ability vs. Age

With reference to Table 69, no significance difference is found between Perceived Ability and Age (χ^2 (2,264) = 0.347, $p = 0.841$).

Table 69: Cross Tabulation of Ability vs. Age

Age	Ability		Total (row)
	Low	High	
21-39	6 (12.2%)	43 (87.8%)	49 (100.0%)
40-59	10 (9.3%)	97 (90.7%)	107 (100.0%)
>60	12 (11.1%)	96 (88.9%)	108 (100.0%)
Total	28 (10.6%)	236 (89.4%)	264 (100.0%)

6.2.1.4.3 Perceived Ability vs. Attitude

A significant difference is found between Perceived Ability and Attitude ($\chi^2(2,267) = 16.483, p < 0.001$). Pearson correlation revealed a significant negative relationship ($r = -0.248, p < 0.001$). Majority of the respondents with high perceived ability (75.7%) do not feel hassled by their medications (see Table 70). Whereas 60.7% of the respondents with low perceived ability (75.7%) also feel hassled by their medications.

Table 70: Cross Tabulation of Ability vs. Attitude

Ability	Attitude		Total (row)
	0	1	
Low	11 (39.3%)	17 (60.7%)	28 (10.5%)
High	181 (75.7%)	58 (24.3%)	239 (89.5%)
Total	192 (100%)	75 (100%)	267 (100%)

6.2.1.5 Social Support

Social Support (external reminder cue to take medication) is modeled as a single item response “Who reminds you to take your medication?” dichotomized to represent self (score=0) or others (score=1). With reference to Table 71, majority of the subjects (76.8%) rely on themselves to remember to take their medications.

Table 71: Frequency Response of Social Support

Social Support (External cue to take medication)	
Self (score =0)	206 (76.8%)
Others (score=1)	62 (23.0%)
Total	267 (100.0%)

A χ^2 test of independence analysis is carried out to analyze significance between Adherence Groups, Age and Attitude.

6.2.1.5.1 Social Support vs. Adherence

A significant difference is found between Social Support and Adherence (χ^2 (2,267) = 11.151, $p < 0.01$). Pearson correlation revealed a significant negative weak relationship ($r = -0.173$, $p < 0.01$). Higher social support is associated with lower adherence. Among those with social support, 50% are from the low adherence group (see Table 72).

Table 72: Cross Tabulation of Social Support vs. Adherence Level

Social Support	Adherence			Total
	Low	Medium	High	
0	56 (27.3%)	92 (44.9%)	57 (27.8%)	205 (100.0%)
1	31 (50.0%)	19 (30.6%)	12 (19.4%)	62 (100.0%)
Total	87 (32.6%)	111 (41.6%)	69 (25.8%)	267 (100%)

6.2.1.5.2 Social Support vs. Age

With reference to Table 73, no significance difference is found between Social Support and Age (χ^2 (2,264) = 0.864, $p = 0.649$).

Table 73: Cross Tabulation of Social Support vs. Age

Age	Social Support		Total (row)
	0	1	
21-39	36 (73.5%)	13 (26.5%)	49 (100.0%)
40-59	81 (75.7%)	26 (24.3%)	107 (100.0%)
>60	86 (79.6%)	22 (20.4%)	108 (100.0%)
Total	203 (76.9%)	61 (23.1%)	264 (100.0%)

6.2.1.5.3 Social Support vs. Attitude

A significant difference is found between Social Support and Attitude (hassled by medication) ($\chi^2 (2,267) = 9.553, p < 0.01$). Pearson correlation revealed a significant positive relationship ($r = 0.189, p < 0.01$). Higher social support is associated with higher feeling of hassled by medication. Majority of the respondents who do not feel hassled by their medication, also do not have social support to help them with their medication (see Table 74).

Table 74: Cross Tabulation of Social Support vs. Attitude

Attitude	Social Support		Total (row)
	0	1	
0	157 (81.8%)	35 (18.2%)	192 (100.0%)
1	48 (64.0%)	27 (36.0%)	75 (100.0%)
Total	205 (76.8%)	62 (23.2%)	267 (100.0%)

6.2.2 Mediation Analysis

To understand the relationships among (i) Trust in Medication (ii) Trust in Doctor (iii) Perceived Prospective Memory (iv) Perceived Ability and (v) Social Support and their effects on Nonadherence mediated by Intentional and Unintentional, we further analyze these variables for their direct and indirect effects.

6.2.2.1 Trust in Medication effects on Unintentional and Intentional Nonadherence.

H13: Trust in Medication effect on Nonadherence is mediated by Intentional only.

A χ^2 test of independence showed a significant difference between Trust in Medication and Unintentional ($\chi^2 (2,267) = 15.780, p < 0.001$), as well as Intentional ($\chi^2 (2,267) = 37.240, p < 0.001$). Pearson correlation revealed a significant negative

relationships between Trust in Medication and Unintentional ($r = -0.243, p < 0.001$), as well as Trust in Medication and Intentional ($r = -0.373, p < 0.001$). Lower trust in medication is associated with higher unintentional nonadherence, as well as higher intentional nonadherence. Among those with low trust in medication, 76.9% has unintentional nonadherence tendency (see Table 75). Among those with high trust in medication, 89% do not have intentional nonadherence tendency.

Table 75: Cross Tabulation of Trust in Medication Unintentional, Intentional and Nonadherence

IV	MV				DV	
	Unintentional		Intentional		Nonadherence	
	0	1	0	1	0	1
Low	28 (23.1%)	93 (76.9%)	68 (56.2%)	53 (43.8%)	77 (63.6%)	44 (36.4%)
High	68(46.6%)	78(53.4%)	130 (89.0%)	16 (11.0%)	125 (85.6%)	21 (14.4%)
Total	96 (36.0%)	171(64.0%)	198 (74.2%)	69 (25.8%)	202(75.7%)	65 (24.3%)

A significant main direct effect of Trust in Medication on nonadherence is found ($\phi = 0.255, p < 0.001$), with high observed power = 0.986. A significant main effect of Trust in Medication on Unintentional is found ($\phi = 0.243, p < 0.001$), with high observed power = 0.978. Trust in Medication main effect on Intentional is also found to be significant ($\phi = 0.373, p < 0.001$), with high observed power = 1.0. As such, we will examine the indirect effect next, of Trust in Medication on nonadherence, when mediated by unintentional and intentional.

Table 76: Mediation Analysis and Bootstrapping Results for Trust in Medication mediated by Intentional/Unintentional

	a-path IV to Mediator	b-path Direct Effect of Mediator on DV	c'-path Direct Effect of IV on DV	c-path Total Effect of IV on DV	Bootstrap (95% CI)
TrustMed>INT	-0.51***	0.16*	-0.15*	-0.23***	-0.17 to -0.01
TrustMed>UINT	-0.38***	0.28***	-0.13*	-0.23***	-0.18 to -0.05

Figure 44 : Indirect/Direct effect of Trust in Medication on Nonadherence mediated by Unintentional/Intentional

From the mediation analysis (See Table 76 and Figure 44)), Trust in Medication effect on Nonadherence is partially mediated by both Intentional and Intentional, as both indirect and direct effects are significant. H13 is rejected.

6.2.2.2 Trust in Doctor effects on Unintentional and Intentional Nonadherence.

H14: Trust in Doctor' effect on Nonadherence is mediated by Intentional only.

A χ^2 test of independence showed a significant difference between Trust in Doctor and Unintentional ($\chi^2 (2,267) = 9.697, p < 0.01$) as well as Intentional ($\chi^2 (2,267) = 22.795, p < 0.001$). Pearson correlation revealed a significant negative relationships between Trust in Doctor and Unintentional ($r = -0.191, p < 0.01$), as well as Trust in Doctor and Intentional ($r = -0.292, p < 0.001$). Lower trust in doctor is associated with higher unintentional nonadherence, as well as higher intentional nonadherence. Among those with low Trust in Doctor, 74.9% has unintentional nonadherence tendency (see Table 77). Among those with high Trust in Doctor, 85.7% do not have intentional nonadherence tendency.

Table 77: Cross Tabulation of Trust in Doctor vs. Unintentional, Intentional and Nonadherence

IV	MV				DV	
	Unintentional		Intentional		Nonadherence	
Trust in Doctor	0	1	0	1	0	1
Low	31 (25.8%)	89 (74.2%)	72 (60.0%)	548(40.0%)	84 (70.0%)	36(30.0%)
High	65 (44.2%)	82(55.8%)	129 (85.7%)	21(14.3%)	118 (80.3%)	29 (19.7%)
Total	96 (36.0%)	171(64.0%)	198 (74.2%)	69 (25.8%)	202(75.7%)	65 (24.3%)

Main direct effect of Trust in Doctor on nonadherence is found to be barely insignificant ($\phi = 0.119$, $p=0.052$). A significant main effect of Trust in Doctor on Unintentional is found ($\phi = 0.191$, $p < 0.01$), with high observed power = 0.877. A significant main effect of Trust in Doctor on Intentional is also found to be significant ($\phi = 0.292$, $p < 0.001$), with high observed power = 0.998. Indirect effects are analyzed next.

Mediation analysis however showed that the indirect effect of Trust in Doctor on Nonadherence is significant when mediated by Intentional (see Table 78 and Figure 45). In addition, Trust in Doctor's effect on Nonadherence is significantly mediated by Unintentional. As no significant direct effect on Nonadherence is found, total mediation is found. H14 is rejected since Trust in Doctor is mediated by both Unintentional and Intentional.

Table 78: Mediation Analysis and Bootstrapping Results for Trust in Doctor mediated by Intentional/Unintentional

	a-path IV to Mediator	b-path Direct Effect of Mediator on DV	c'-path Direct Effect of IV on DV	c-path Total Effect of IV on DV	Bootstrap (95% CI)
TrustDoc>INT	-0.29***	0.21***	-0.07	-0.13*	-0.12 to -0.02
TrustDoc>UINT	-0.29***	0.31***	-0.04	-0.13*	-0.16 to -0.04

Figure 45 : Indirect/Direct effect of Trust in Doctor on Nonadherence mediated by Unintentional/Intentional

6.2.2.3 Perceived Prospective Memory effects on Unintentional and Intentional nonadherence.

H15: Perceived Prospective Memory effect on Nonadherence is mediated by Unintentional only.

A χ^2 test of independence showed a significant difference between Perceived Prospective Memory and Unintentional ($\chi^2 (2,267) = 9.214, p < 0.01$) as well as Intentional ($\chi^2 (2,267) = 12.921, p < 0.001$). Pearson correlation revealed a significant negative relationships between perceived prospective memory and unintentional ($r = -0.186, p < 0.01$), as well as perceived prospective memory and Intentional ($r = -0.220, p < 0.001$). Lower perceived prospective memory is associated with higher unintentional nonadherence, as well as higher intentional nonadherence. Among subjects with low perceived prospective memory, 72.8% have unintentional nonadherence tendency (see Table 79). Among subjects with high prospective memory, 84% have intentional nonadherence tendency.

Table 79: Cross Tabulation of Perceived Prospective Memory vs. Unintentional, Intentional and Nonadherence

IV	MV				DV	
	Unintentional		Intentional		Nonadherence	
	0	1	0	1	0	1
Perceived Prospective Memory						
Low	37 (27.2%)	99 (72.8%)	88 (64.7%)	48(35.3%)	93 (68.4%)	43 (31.6%)
High	59 (45.0%)	72 (55.0%)	110 (84.0%)	21 (16.0%)	109 (83.2%)	22 (16.8%)
Total	96 (36.0%)	171(64.0%)	198 (74.2%)	69 (25.8%)	202(75.7%)	65 (24.3%)

A significant main effect of Perceived Prospective Memory on nonadherence is found ($\phi = 0.173$, $p < 0.01$), with high observed power = 0.807. A significant main effect of Perceived Prospective Memory on Unintentional is found ($\phi = 0.186$, $p < 0.01$), with high observed power = 0.86. A significant main effect of Perceived Prospective Memory on Intentional is also found to be significant ($\phi = 0.22$, $p < 0.001$), with high observed power = 0.949.

Based on the results of the mediation analysis (see Table 80 and Figure 46), indirect effects are also found. Perceived Prospective Memory effect on Nonadherence is significantly mediated by Unintentional and Intentional. H15 is hence rejected as Perceived Prospective Memory is mediated by both Unintentional and Intentional.

Table 80: Mediation Analysis and Bootstrapping Results for Perceived Prospective Memory mediated by Intentional/Unintentional

	a-path IV to Mediator	b-path Direct Effect of Mediator on DV	c ² -path Direct Effect of IV on DV	c-path Total Effect of IV on DV	Bootstrap (95% CI)
PProMem>INT	-0.19**	0.20***	-0.16*	-0.19**	-0.09 to -0.01
PProMem >UINT	-0.46***	0.30***	-0.06	-0.19**	-0.22 to -0.07

Figure 46 : Indirect/Direct effect of Perceived Prospective Memory on Nonadherence mediated by Unintentional/Intentional

6.2.2.4 Perceived Ability effects on Unintentional and Intentional nonadherence.

H16: Perceived Ability (to self-manage medication) effect on Nonadherence is mediated by Unintentional only.

A χ^2 test of independence showed a significant difference between Perceived Ability and Unintentional ($\chi^2 (2,267) = 6.378, p < 0.05$) as well as Intentional ($\chi^2 (2,267) = 12.550, p < 0.001$). Pearson correlation revealed a significant negative relationships between perceived ability and unintentional ($r = -0.155, p < 0.05$), as well as perceived ability and intentional ($r = -0.217, p < 0.001$). Lower perceived ability is associated with higher unintentional nonadherence, as well as higher intentional nonadherence. Respondents with perceived low ability have higher unintentional nonadherence tendency (85.7%) as well as higher intentional nonadherence tendency (53.6%) (see Table 81).

Table 81: Cross Tabulation of Perceived Ability vs. Unintentional, Intentional and Nonadherence

IV	MV				DV	
	Unintentional		Intentional		Nonadherence	
Ability	0	1	0	1	0	1
Low	4 (14.3%)	24 (85.7%)	13 (46.4%)	15 (53.6%)	16 (57.1%)	12 (42.9%)
High	92 (38.5%)	147 (61.5%)	185 (77.4%)	54 (22.6%)	186 (77.8%)	53 (22.2%)
Total	96 (36.0%)	171(64.0%)	198 (74.2%)	69 (25.8%)	202(75.7%)	65 (24.3%)

A significant main effect of Perceived Ability on nonadherence is found ($\phi = 0.148$, $p < 0.05$), observed power = 0.677. Based on the current sample size, there is a however a 33.3% probability of a type II error. However, Perceived Ability main effect on Unintentional is found ($\phi = 0.186$, $p < 0.01$), with observed power = 0.717. Perceived Ability main effect on Intentional is also found ($\phi = 0.217$, $p < 0.001$), with high observed power = 0.944.

From the mediation results in Table 82 and Figure 47, indirect effect is found to be significant. Perceived Ability (to self-managed medication) effect on Nonadherence is found to be totally mediated by Unintentional. In addition, significant indirect effect of Perceived Ability on Nonadherence, mediated by Intentional, is found. H16 is hence rejected as Perceived Ability is mediated by both Unintentional and Intentional.

Table 82: Mediation Analysis and Bootstrapping Results for Perceived Ability mediated by Intentional/Unintentional

	a-path IV to Mediator	b-path Direct Effect of Mediator on DV	c ² -path Direct Effect of IV on DV	c-path Total Effect of IV on DV	Bootstrap (95% CI)
PAbility>INT	-0.18**	0.21***	-0.09	-0.13*	-0.09 to -0.01
PAbility>UINT	-0.32***	0.31***	-0.03	-0.13*	-0.17 to -0.05

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 47 : Indirect/Direct effect of Ability on Nonadherence mediated by Unintentional/Intentional

6.2.2.5 Social Support effects on Unintentional and Intentional nonadherence.

H17: Social Support (to remind to take medication) effect on Nonadherence is mediated by Unintentional only.

A χ^2 test of independence showed a significant difference between Social Support (external reminder to take medication) and Unintentional ($\chi^2 (2,267) = 4.851$, $p < 0.05$). Pearson correlation revealed a significant weak positive relationships ($r = 0.135$, $p < 0.05$). High social support is associated with high unintentional nonadherence. No significance difference is found between Intentional nonadherence and Social Support ($\chi^2 (2,267) = 0.972$, $p = 0.324$). Among those with high social support, a high proportion has unintentional nonadherence tendency (75.8%) (see Table 83).

Table 83: Cross Tabulation of Social Support vs. Unintentional, Intentional and Nonadherence

IV	MV				DV	
	Unintentional		Intentional		Nonadherence	
Social Support	0	1	0	1	0	1
Low	81 (39.5%)	124 (60.5%)	155 (75.6%)	50 (24.4%)	161 (78.5%)	44 (21.5%)
High	15 (24.2%)	47 (75.8%)	43 (69.4%)	19 (30.6%)	41 (66.1%)	21 (33.9%)
Total	96 (36.0%)	171 (64.0%)	198 (74.2%)	69 (25.8%)	202 (75.7%)	65 (24.3%)

A significant main direct effect of Social Support on nonadherence is found ($\phi = 0.122$, $p < 0.05$), with observed power = 0.513. As the statistical power is close to 50%, there is low confidence to conclude this. A significant main effect of Social Support on Unintentional is found ($\phi = 0.135$, $p < 0.05$), with observed power = 0.597. No significant main effect of Social Support on Intentional is however found ($\phi = 0.06$, $p = 0.324$).

When mediated by Unintentional, significant indirect effect of Social Support on nonadherence is found (Table 84 and Figure 48). When mediated by Intentional, indirect

effect of Social Support on nonadherence is not significant. Based on the mediation analysis, H17 is accepted. Social support effect on nonadherence is mediated by unintentional only.

Table 84: Mediation Analysis and Bootstrapping Results for Social Support mediated by Intentional/Unintentional

	a-path IV to Mediator	b-path Direct Effect of Mediator on DV	c'-path Direct Effect of IV on DV	c-path Total Effect of IV on DV	Bootstrap (95% CI)
SocialSup>INT	0.01	-0.23***	0.10	-0.10	-0.06 to 0.07
SocialSup>UINT	0.36*	0.33***	-0.01	-0.10	0.03 to 0.24

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Figure 48 : Indirect/Direct effect of Social Support on Nonadherence mediated by Unintentional/Intentional

6.3 Summary of Findings

Below summarizes the results of Study 3:

Significant χ^2 relationships are found between the following groups:

- Trust in Medication vs. Adherence; Trust in Medication vs. Age, Trust in Medication vs. Attitude;
- Trust in Doctor vs. Adherence; Trust in Doctor vs. Age, Trust in Doctor vs. Attitude
- Perceived Prospective Memory vs. Adherence; Perceived Prospective Memory vs. Attitude;
- Perceived Ability vs. Adherence; Perceived Ability vs. Attitude;
- Social Support vs. Adherence; Social Support vs. Attitude;

NO significant χ^2 relationships are found between the following groups:

- Perceived Prospective Memory vs. Age
- Perceived Ability vs. Age;
- Social Support vs. Age

Hypothesis Testing

- H13: Trust in Medication effect on Nonadherence is mediated by Intentional only.
– *Rejected. Trust in Medication effect on Nonadherence is mediated by both Unintentional and Intentional.*
- H14: Trust in Doctor effect on Nonadherence is mediated by Intentional only. –
Rejected. Trust in Doctor effect on Nonadherence is mediated by both Unintentional and Intentional.
- H15: Perceived Prospective Memory effect on Nonadherence is mediated by Unintentional only. – *Rejected. Perceived Prospective Memory effect on Nonadherence is mediated by both Unintentional and Intentional.*

- H16: Perceived Ability (to self-manage medication) effect on Nonadherence is mediated by Unintentional only. - *Rejected. Perceived Ability effect on Nonadherence is mediated by both Unintentional and Intentional.*
- H17: Social Support (to remind to take medication) effect on Nonadherence is mediated by Unintentional only. – *Accepted.*

Table 85 summarizes the results of the mediation analysis.

Table 85: Independent, Mediating and Dependent Variables for Age-Ability-Unintentional

Independent Variable	Indirect Effect mediated by Unintentional	Indirect Effect mediated by Intentional	Direct Effect on on Nonadherence when mediator present
Trust in Medication	Significant	Significant	Significant
Trust in Doctor	Significant	Significant	Not significant
Perceived Prospective Memory	Significant	Significant	Not significant (Unintentional) Significant (Intentional)
Perceived Ability	Significant	Significant	Not significant
Social Support	Significant	Not significant	Not significant

From study 3, Trust in Medication, Trust in Doctor, Perceived Prospective Memory, Perceived Ability and Social Support effects on nonadherence, are found to be mediated by unintentional. Trust in Medication, Trust in Doctor, Perceived Prospective Memory and Perceived Ability effects on nonadherence, are also found to be mediated by intentional; Social Support effect on nonadherence is mediated by intentional. Chi square analysis did not show significance difference between Age and Perceived Prospective Memory, Perceived Ability and Social Support. Chi square analysis showed significance difference between Age and Trust in Medication, as well as with Age and Trust in Doctor.

Chapter 7 Development of Ability-Belief-Context Framework for Intentional and Unintentional Nonadherence

This chapter presents the multiple regression analysis for the proposed Ability-Belief-Context framework as discussed in chapter 3.

7.1 Age-Ability-Unintentional

Further multiple regression mediation analysis is performed to test Age effects on Unintentional nonadherence mediated by Ability (see Table 86). Details of the mediation analysis results can be found in Appendix F.

Table 86: Independent, Mediating and Dependent Variables for Age-Ability-Unintentional

Independent Variable	Mediating Variable (Ability)	Dependent Variable
Age	Perceived Prospective Memory	Unintentional
	Perceived Ability	
	Busyness	

Figure 49 shows the relationship between Age, Ability and Unintentional variables and constructs as well as regression results. Table 87 shows the mediation and bootstrapping results.

Figure 49: Multiple regression analysis of Age-Ability-Unintentional.

Table 87: Mediation Analysis and Bootstrapping Results for Age effect on Unintentional mediated by Ability

	a-path IV to Mediator	b-path Direct Effect of Mediator on DV	c'-path Direct Effect of IV on DV	c-path Total Effect of IV on DV	Bootstrap (95% CI)
Age>PProMem	-0.14*	0.44***	-0.14**	-0.20***	-0.12 to -0.01
Age>Busyness	-0.45***	0.28***	-0.08	-0.20***	-0.20 to -0.06
Age>PAbility	-0.01	-0.32***	-0.20***	-0.20***	-0.03 to 0.04

Results showed that indirect effect of Age on Unintentional nonadherence is mediated by Ability (Perceived Prospective Memory and Busyness). Direct effect of Age on Unintentional is significant when mediated by Perceived Prospective Memory and Perceived Ability.

7.2 Belief-Attitude-Intentional

Next mediation analysis is performed to test Belief effects on Intentional nonadherence mediated by Attitude (see Table 88).

Table 88: Independent, Mediating and Dependent Variables for Belief-Attitude-Intentional

Independent Variable (Belief)	Mediating Variable	Dependent Variable
Trust in Medicine	Attitude	Intentional
Trust in Doctor		
Knowledge		

Figure 50 shows the relationship between Belief, Attitude and Intentional variables and constructs as well as regression results. Table 89 shows the mediation and bootstrapping results.

Figure 50: Multiple regression analysis of Belief-Attitude-Intentional

Table 89: Mediation Analysis and Bootstrapping Results for Age effect on Intentional mediated by Attitude

	a-path IV to Mediator	b-path Direct Effect of Mediator on DV	c'-path Direct Effect of IV on DV	c-path Total Effect of IV on DV	Bootstrap (95% CI)
TrustMed > ATT	0.38***	0.27***	-0.40***	-0.51***	-0.19 to -0.05
TrustDoc > ATT	-0.26***	0.38***	-0.19***	-0.28***	-0.16 to -0.05
Knowledge > ATT	-0.10	0.43***	-0.05	-0.01	-0.12 to 0.01

Results showed that indirect effect of Belief on Intentional is mediated by Attitude. Partial indirect effect of Trust in Medication and Trust in Doctor is found, as direct effect of Trust in Medication and Trust in Doctor on intentional is also significant.

7.3 Age-Belief-Attitude

Multiple regression mediation analysis is performed to test Age effects on Attitude mediated by Belief (see Table 90). Table 91 shows the mediation and bootstrapping results.

Table 90: Independent, Mediating and Dependent Variables for Age-Belief-Attitude

Independent Variable	Mediating Variable (Belief)	Dependent Variable
Age	Trust in Medicine	Attitude
	Trust in Doctor	
	Knowledge	

Table 91: Mediation Analysis and Bootstrapping Results for Age effect on Attitude mediated by Belief

	a-path IV to Mediator	b-path Direct Effect of Mediator on DV	c'-path Direct Effect of IV on DV	c-path Total Effect of IV on DV	Bootstrap (95% CI)
Age>TrustMed	0.18**	-0.34***	-0.23***	-0.29***	-0.11 to -0.03
Age> TrustDoc	0.14*	-0.22***	-0.26***	-0.29***	-0.07 to -0.01
Age>Knowledge	-0.14*	-0.15*	-0.31***	-0.29***	0.003 to 0.06

Figure 51 shows the relationship between Age, Belief and Attitude variables and constructs as well as regression results.

Figure 51: Multiple regression analysis of Age-Belief-Attitude

Results showed that significant indirect effect of Age on Attitude is mediated by Belief. Partial effect is found when mediated by Trust in Medication, Trust in Doctor and Knowledge, as direct effect of Age on Attitude is also significant.

7.4 Age-Belief-Intentional

Multiple regression mediation analysis is performed to test Age effects on Intentional Nonadherence mediated by Belief (see Table 92).

Table 92: Independent, Mediating and Dependent Variables for Age-Belief-Intentional

Independent Variable	Mediating Variable (Belief)	Dependent Variable
Age	Trust in Medicine	Intentional
	Trust in Doctor	
	Knowledge	

Figure 52 shows the relationship between Age, Belief and Intentional variables and constructs as well as regression results.

Figure 52: Multiple regression analysis of Age-Belief-Intentional

Table 93: Mediation Analysis and Bootstrapping Results for Age effect Intentional mediated by Belief

	a-path IV to Mediator	b-path Direct Effect of Mediator on DV	c'-path Direct Effect of IV on DV	c-path Total Effect of IV on DV	Bootstrap (95% CI)
Age>TrustMed	-0.18**	-0.48***	-0.12*	-0.21***	-0.150 to -0.03
Age> TrustDoc	0.14***	-0.26***	-0.17**	-0.21***	-0.08 to -0.1
Age>Knowledge	-0.14***	-0.30	-0.21***	-0.21***	-0.01 to 0.03

Results showed that indirect effect of Age on Intentional is mediated by Belief (see Table 93). Partial effect is found when mediated by Trust in Medication and Trust in Doctor, as direct effect of Age on Intentional is also significant.

7.5 Age-Context-Unintentional

Multiple regression mediation analysis is performed to test Age effects on Unintentional mediated by Context (see Table 94).

Table 94: Independent, Mediating and Dependent Variables for Age-Context-Unintentional

Independent Variable	Mediating Variable (Context)	Dependent Variable
Age	Social Support	Unintentional
	External Cue	

Figure 53 shows the relationship between Age, Context and Unintentional variables and constructs as well as regression results.

Figure 53: Multiple regression analysis of Age-Context-Unintentional

Table 95: Mediation Analysis and Bootstrapping Results for Age effect Unintentional mediated by Context

	a-path IV to Mediator	b-path Direct Effect of Mediator on DV	c'-path Direct Effect of IV on DV	c-path Total Effect of IV on DV	Bootstrap (95% CI)
Age>Social Sup	-0.003	0.35*	-0.20***	-0.20***	-0.02 to 0.02
Age>External Cue	-0.03	0.18	-0.21***	-0.20***	-0.003 to 0.03

Results showed that indirect effect of Age on Unintentional is not mediated by Context (see Table 95). Direct effect of Age on Unintentional is significant. Social Support has a direct effect on Unintentional.

7.6 Ability-Belief-Context Framework

Based on our multiple regression mediation results, we have sufficient evidence to support the following revised framework (see Figure 54).

Figure 54: Revised ABC Framework for Intentional and Unintentional Medication Nonadherence.

7.6.1 Age

Age effect on Unintentional and Intentional nonadherence, is found to be mediated by Ability (Prospective Memory, Busyness), Belief (Trust in Medication, Trust in Doctor and Knowledge) as show in section 7.1 and section 7.3. However, no significant relationship can be found with the contextual factors studies (Social Support and External Cue) (see section 7.5).

7.6.2 Ability

As show in section 6.2.2.4, there is no direct effect of Perceived Ability (to self-manage medication) on Nonadherence nor is there significant relationship with Age as shown in section 6.2.1.4. However, there is indirect effect of Perceived Ability (to manage self-medication) on Nonadherence when mediated by Intentional and Unintentional factors (see section 6.2.2.4. Perceived Ability direct effect on Unintentional is also significant (see section 7.1). Age effect on Unintentional nonadherence is not found to be mediated by Perceived Ability (see section 7.1). Age effect on Unintentional is found to be significantly mediated by both Perceived Prospective Memory and Busyness (see section 7.1).

7.6.3 Belief

As show in section 6.2.2.1, Trust in Medication has both direct and indirect effects on nonadherence mediated by both intentional and unintentional factors. Trust in Doctor does not have direct effect on nonadherence when mediated by intentional and unintentional, but a significant indirect effect is found (see section 6.2.2.2). Both constructs have significant relationships with Age (see section 6.2.1.2.1, 6.2.1.2.2, 7.3, 7.4). Knowledge is also found to have a significant relationship with Age in Study 2 (see

section 5.2.4.5.2) and the indirect effect of Age on Attitude mediated by Knowledge is also significant (see section 7.3).

7.6.4 Context

Although, no significant relationship is found with contextual factors and many of the variables, as shown in section 6.2.2.5, indirect effect of Social Support on Nonadherence is found to be fully mediated by Unintentional. With reference to section 7.5, Social Support is also found to have a direct effect on Unintentional.

7.7 Summary of Findings

Table 96, Table 97, Table 98 and Table 99 summarizes the results of the mediation analysis for the proposed ABC Framework.

Table 96: Age effect on Unintentional mediated by Ability and Context

Independent Variable	Mediated Variable	Indirect Effect	Direct Effect on Unintentional
Age	A: Perceived Prospective Memory	Significant	Significant
	A: Busyness	Significant	Not significant
	A: Perceived Ability	Not significant	Significant
Age	C: Social Support	Not significant	Significant
	C: External Cue	Not significant	Significant

Table 97: Belief effect on Intentional mediated by Attitude

Independent Variable	Mediated Variable	Indirect Effect	Direct Effect on Intentional
B: Trust in Medication	Attitude	Significant	Significant
B: Trust in Doctor		Significant	Significant
B: Knowledge		Not significant	Not significant

Table 98: Age effect on Intentional mediated by Belief

Independent Variable	Mediated Variable	Indirect Effect	Direct Effect on Intentional
Age	B: Trust in Medication	Significant	Significant
	B: Trust in Doctor	Significant	Significant
	B: Knowledge	Not significant	Significant

Table 99: Age effect on Attitude mediated by Belief

Independent Variable	Mediated Variable	Indirect Effect	Direct Effect on Attitude
Age	B: Trust in Medication	Significant	Significant
	B: Trust in Doctor	Significant	Significant
	B: Knowledge	Significant	Significant

From the mediation analysis, Age effect on Unintentional nonadherence is found to be mediated by Ability (Perceived Ability and Busyness), while its effect on Intentional nonadherence is mediated by Belief (Trust in Medication and Trust in Doctor). Age effect on Attitude is also significantly mediated by Belief (Trust in Medication, Trust in Doctor and Knowledge). Belief (Trust in Medication and Trust in Doctor) effect on Intentional nonadherence is also significantly mediated by Attitude. Although Age effect on Unintentional is not mediated by Context (Social Support and External Cue), Context (Social Support) direct effect on Unintentional is found to be significant.

Chapter 8   Conclusions and Future Research

This chapter presents the summary, contribution of the research, limitation, and suggests directions for future research.

8.1 Summary

An extensive literature review covering predictors of adherence, behavioral and belief models of medication adherence was discussed. A framework on intentional and unintentional was proposed and data was collected to test the hypotheses. Two studies were conducted to understand attitude of medication adherence in Singapore. The first study resulted in a dataset of 347 responses for analysis, while the second study resulted in a dataset of 267 responses for analysis. A total of 10 variables and constructs: (i) Age, (ii) Lifestyle Busyness, (iii) Knowledge, (iv) Attitude (v) External cue (vi) Trust in Medication (vii) Trust in Doctor (viii) Perceived Ability (ix) Perceived Prospective Memory and (x) Social Support were analyzed for their relationships with nonadherence and their mediating effects of intentional and unintentional, through mediation analysis (Baron and Kenny, 1986), on the proposed Ability- Belief- Context (ABC) framework.

The variables and constructs were modeled into Ability, Beliefs and Context to investigate their influence on intentional and unintentional nonadherence: Ability includes: Perceived Prospective Memory, Perceived Ability (to self-manage medication) and Lifestyle Busyness; Belief includes: Trust in Medication, Trust in Doctor and Knowledge; while Context includes: Social Support and External Cues (e.g. pillbox use). With reference to Azjen's (1991) Theory of Planned Behavior and Park (1997)'s conceptual model of Medication Adherence, the proposed ABC framework to study intentional and unintentional nonadherence was developed and validated as shown in Figure 55.

Figure 55: Final ABC Framework for Intentional and Unintentional Medication Nonadherence.

Through two data collection, the results revealed a pervasiveness of the medication nonadherence in Singapore, with about 70%-75% of respondent considered below medium adherent to their medication based on MMAS-8 (Morisky et al., 2008) scale, with between 33-37% in the low adherence group. This is consistent to the report by Osterberg et al. (2005) that medication nonadherence is between 43% to 78% among chronic disease patients. Forgetfulness is a common reason cited for nonadherence. “Forgetting” (or unintentional nonadherence) is cited by more than 40-55% respondents for not taking their medication, whereas intentional nonadherence made up about 20-25% of the reasons. This figure is different from the survey by BCG (2003), where patient’s active reasons not to comply (intentional) made up more than 50% of the reasons for nonadherence and forgetfulness (unintentional) made up 24% of the reasons (see section 1.2.1). Nevertheless, in both studies, forgetfulness is cited as the top reason for nonadherence.

As explained in Section 2.5, differences in medication adherence in developed and developing countries, is influenced by social and economic factors, health care team and systems, cultural and lay beliefs about illness and treatment (WHO, 2003). Although it may be argued that past research outcome may be generalized to other countries, we believe the pervasiveness of medication nonadherence should still be validated when applied to a different country.

Our investigation revealed that medication adherence is an extremely complex behavior. Although “forgetfulness” is more commonly associated with diminishing cognitive decline and old age, our findings reveal that younger adults are less adherent than older adults. This finding is consistent with studies by Mehta et al. (1997), where adherence is found to increase with age. Younger adults doubled the proportion of older adults in citing “forgetfulness” as the reason for nonadherence. In addition, younger adults also have more intentional nonadherence tendency than older adults. Age-related difference is found towards medication adherence attitude across many variables. Consistent with the report by Park et al. (1998), self-rated busyness is found to contribute more to unintentional nonadherence than age. This suggests that cognitive decline has less to do with unintentional nonadherence compared to busyness and other factors.

External cues (e.g. pillboxes) is often prescribed for improving medication adherence (Bosworth et al., 2011, Osterberg et al., 2005), but our findings revealed that this does not contribute to either intentional or unintentional nonadherence, and is not related to adherence levels nor age. We also found no relationship between “feeling hassled by medication taking” and “pillbox use”. However, a small but significant correlation is found between subjects who find their pillbox use troublesome and

medication taking a hassle. Simoni et al (2006)'s found that social support, in the form of reminders by family, friends and caregivers improves medication adherence. Social Support (to remind to take medication) is found to be significantly related to adherence and attitude. Social support effect on nonadherence is also found to be mediated by unintentional factors.

We found that Attitude, Beliefs, Trust in Medication and Trust in Doctor consistently have an effect on intentional medication nonadherence. As highlighted by Schneider et al. (2004), good physician-patient relationship improves medication adherence. In our studies, our findings suggest that good physician-patient relationship has the potential to improve trust and beliefs in medication, leading to better adherence. Hassled by medication made up substantial reasons for nonadherence and this is however not often reported in the literature. About 28%-40% of the respondents reported finding medication taking a hassle, and this contributed to both intentional and unintentional nonadherence. Lee et al. (2007) found that patients with higher disease knowledge adhere better to their medication. Here, we found that Knowledge (e.g. desire to know more about their medication) is associated with intentional nonadherence. This suggests that subjects who are more involved in their own healthcare decision are less likely to rely entirely on their doctor's decision on the medication necessity, and may intentionally alter their medication without informing their doctors. A χ^2 analysis found a significant difference between Knowledge and subjects who believe that they make their own decisions when it comes to their medication needs (See Appendix E Q26 and Table 100) (χ^2 (2,265) = 5.296, $p < 0.05$). Pearson correlation revealed a significant positive weak relationship ($r = 0.141$, $p < 0.05$).

Table 100: Cross Tabulation of Knowledge vs. Make own Decision on Medication

Q26 Make Own Decision when it comes to Medication	Knowledge		Total
	0	1	
0	18 (34.6%)	34 (65.4%)	52 (100.0%)
1	10 (19.7%)	171 (80.35%)	213 (100.0%)
Total	60 (22.6%)	205 (77.4%)	265 (100.0%)

Perceived Prospective Memory construct is adapted from Smith et. al. (2000)'s Prospective and Retrospective Memory Questionnaire. Perceived Prospective Memory is found to be significantly associated with both adherence and attitude. Its effect on nonadherence is also found to be significantly mediated by both intentional and unintentional factors. Ability to self-manage medication is also significantly associated with adherence and attitude (see sections 6.2.1.3.1 and 6.2.1.3.3). Ability to self-manage medication effect on nonadherence is found to be significantly mediated by both intentional and unintentional factors. As shown by Currie et al. (2008), ability to manage medication impacts medication adherence. It is found that younger adults (61.2%) have lower perceived prospective memory (see Table 64). However, no significance χ^2 relationship between Age groups with Perceived Prospective Memory or Perceived Ability (see sections 6.2.1.3.2 and 6.2.1.4.2) is found.

In Gadkari et al. (2012)'s study, patients beliefs effect on intentional nonadherence is mediated by unintentional nonadherence. In study 1, unintentional medication nonadherence was found to be mediated by intentional nonadherence, and vice versa. However, in study 2, we only found significant intentional effect on nonadherence when mediated unintentional. This finding is consistent with Gadkari et al. (2012)'s finding. Since there is conflicting results for the intentional mediator, we can

only conclude that when unintentional mediator is present, intentional has an indirect effect on nonadherence. One possible explanation as suggested by Unni et al. (2011) is that patients may report forgetfulness as a reason for nonadherence because they perceived it to be a socially acceptable response. Another possible explanation is that, patients who has intentional nonadherence tendency are doubtful about the importance of their medication, and hence may sometimes forget to take their medication due to busyness of other priorities.

8.2 Contributions of Research

This research made several contributions in the understanding of medication nonadherence. First, a comprehensive study on reasons for medication nonadherence in Singapore is studied and validated through subsequently studies. Second, ten factors contributing to intentional and unintentional nonadherence are analyzed, looking into both intentional and unintentional direct and indirect effects. Third, age-related differences and attitudes towards medication nonadherence are analyzed. Fourth, a combination of psychosocial and human factors approaches is adopted to understand medication nonadherence. And last but not least, a framework is proposed to identify the relationships between predictors, intentional and unintentional mediators, nonadherence, as well as Abilities, Beliefs, Context and Age.

8.3 Implication and Insights

As Becker and Mainman (1975) said “patient compliance has become the best documented but least understood health behavior.” As discussed in Chapters 1 and 2, there are over 200 variables predicting medication nonadherence. Although there are about 2,000 publications a year found on this topic in PubMed, we found that many

research focused on main effects of predictors on nonadherence, with very few research looking into mediating effects of intentional and unintentional on nonadherence. From this research, we found that intentional nonadherence is not the reverse of unintentional nonadherence, neither is the reverse true. Intentional nonadherence involves trust, as well as beliefs in the necessity of the medication. Unintentional nonadherence involves the patients' environment and ability to take his medication. Healthcare professional should not assume that when a patient is nonadherent, it is due to either intentional or unintentional factors, as it can potentially be both. In addition, simply by handing out educational materials or encouraging the use of pillbox may have little effect to improve the medication nonadherent behavior. Healthcare professionals who are involved in the medication dispensing chain are encouraged to take a more holistic approach to medication adherence by consider the patients' ability, belief and context, as well as intentional and unintentional factors.

8.4 Limitations of Research and Directions for Future Research

This study has its limitations. Some variables are single item measures instead of multiple-items constructs. Although attempt is done to use multiple-items constructs as much as possible, some constructs led to low Cronbach's alpha and hence are not used. Further improvements on the questionnaires and constructs development can improve the data analysis and findings. Future research can focus on developing constructs for all the variables, validating them and further expanding on the list of the constructs for the proposed Ability, Belief and Context framework.

The initial plan for the study is to use stratified sampling, however due to challenges in recruiting subjects who are on long-term medication, convenient sampling is used instead. In addition, interest to understand various variables and constructs with

relationship to nonadherence resulted in a 66-items questionnaire in studies 2 and 3, which many respondents found too lengthy. Although 293 responses are collected, only 267 are complete and reliable enough for analysis. In addition, using self-report questionnaires to assess medication adherence has its limitations. Due to the subjective nature of self-report questionnaires, if a patients report forgetfulness as a reason for nonadherence due them perceiving it as a socially acceptable response (Unni et al., 2011), this could have influenced the proportion of subject found to be unintentionally nonadherence. There is also no way of telling if the respondent was telling the truth or had misinterpreted the questions. Further, surveys are collected at a single point in time and do not measure population changes over time. Despite its limitations, it has its advantages as well, as it allows the collection of large amount of information in a relatively cost effective way. Due to its simplicity to administer, self-report questionnaires is still the most popular methodology for assessing medication adherence (Velligan et al., 2009).

In developed countries like Singapore, where the city lifestyle tends to be fast-paced, it is not surprising that middle-age and younger adults lead a busy lifestyle. They are hence more likely to unintentionally miss their medication. Further investigations on how medication adherence programme can be tailored to changing demographics and busy lifestyle are hence important. Younger generation and older adult may require different solutions due to their differences in lifestyle, attitudes and ability. As shown, simply by recommending the use of pillboxes or education, may have limited effect on improving medication nonadherence, as the behavior is influenced by both unintentional and intentional factors. Looking into design of information and tool to improve the understanding of medication necessity, will aid in reducing intentional medication nonadherence. Further understanding of Age factors, individual's Ability, Belief and

Context has the potential to help healthcare professionals understand this complex health behavior better.

Healthcare professionals and systems design engineers can use the ABC framework as a guide to design medication adherence applications and systems. For example, if the intent is to design a mobile phone application to remind the patient to take his medications. The designer may think of designing reminders for the patient to take his medication at lunch time and dinner time by sounding an alarm. This will address the “unintentional” aspect of nonadherence by providing “context cue”. If the patient is still nonadherent to his medication, the designer may consider designing for the “intentional” aspect by providing more medication necessity information to increase the patient’s “belief” and “knowledge” of the treatment. If the patient often fails to respond to the alarms or delay taking his medication, the patient’s “lifestyle busyness” may be assessed to determine if the patient may have been limited by his personal “ability” to take his medication as planned. It should be noted that the framework takes into consideration of the time-domain through the variables in Ability, Belief and Context. For example, if the model was used thirty years ago, when lifestyle busyness was less of an issue in Singapore, “busyness” may not have been found to have a significant effect on unintentional nonadherence. Instead, other variables in “Ability” may have resulted in a higher weightage. As the internet was not pervasively available at that time, the access to medical information is hence limited. Patients hence may have higher trust in their doctors instead of relying on information that they found on the internet, and may hence be less influenced by “knowledge”.

8.5 Conclusion

This research sets out to develop a framework to explain intentional and unintentional medication nonadherence, with the aim to further contribute to the

understanding of this complex behavior through a combination of human factors (human limitation or unintentional factors) and psychosocial (beliefs or intentional factors) approaches. A survey of earlier research on medication nonadherence was carried out, the research gaps were identified, two data collections on medication adherence in Singapore were implemented, and the extent of medication nonadherence in Singapore has been investigated. A framework combining human factors and psychosocial approaches was developed to further explain unintentional and intentional medication nonadherence behavior. In conclusion, the objectives set out for this research have been achieved.

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Appendix A: Medication Adherence Survey Questionnaire 1

Subject ID:	
Survey site:	

MEDICATION ADHERENCE & MANAGEMENT SURVEY 2012 SURVEY QUESTIONNAIRE

1. Medication Characteristics

- a. Are you required to take prescribed medications regularly? 1) Yes 2) No
- b. Have you been taking these medications for at least 2 months? 1) Yes 2) No
- c. How long have you been taking these medications for? 1) Less than 1 year 2) 1-5 years 3) 5-10 years 4) More than 10 years

- d. How many types of prescribed medications are you taking daily?

- e. For each medication, how many times do you need to take it? (e.g. 3 times a day, once every 2 days, etc)

2. Medication Adherence

a.	Do you sometimes forget to take your medications?	1) Yes	2) No			
b.	Over the past 2 weeks, were there any days when you did not take your medications?	1) Yes	2) No			
c.	Have you ever cut back or stopped taking your medication without telling your doctor because you felt worse when you took it?	1) Yes	2) No			
d.	When you travel or leave home, do you sometimes forget to bring along your medications?	1) Yes	2) No			
e.	Did you take your medications yesterday?	1) Yes	2) No			
f.	When you feel like your condition is under control, do you sometimes stop taking your medications?	1) Yes	2) No			
g.	Taking medication everyday is a real inconvenience for some people. Do you ever feel hassled about sticking to your treatment plan?	1) Yes	2) No			
h.	How often do you have difficulty remembering to take all your medication?	1) Never/ Rarely	2) Once in a while	3) Sometimes	4) Usually	5) All the time
i.	Are these some of the reasons for your non-adherence? (Tick > 1 if applicable)	1) Simply forgot	2) Too many pills to take	3) Worry about side effects	4) Lack of information of medicine and management of side effects	5) Unclear about the instructions to use it
j.	Other reasons					
k.	Would you want to know more about your medications	1) Yes, why? 2) No, why?				

3. Medication Management

a.	Are you using any specific method to manage your medications	1) Yes	1) No (Go to 3d)
b.	How do you currently manage your medications? (tick > 1 of applicable; Picture Guide 1)	1) Pillbox	2) Blister Medication Packing Service
		3) Calendar	4) Using of symbols/ color coding
		5) Digital Pillbox/ Alarm clock	6) Automated Medication Dispenser
c.	What is most troublesome about this current way of medicine management?		
d.	Have you used any existing technology/ social media to manage your medication? (Picture Guide 2)	1) Yes, which one(s)?	
		2) No	
e.	Are you interested in using technology/social media to help in medicine management?	1) Yes, why?	
		2) No, why?	
f.	Describe/Draw an impression of the device that you would like to use to manage your medication (optional question)		

4. Demographics

- a. Gender   1) Male   2) Female
- b. Age   1) 21-29   2) 30-39   3) 40-49   4) 50-59   5) >60
- c. Ethnic Group   1) Chinese   2) Malay   3) Indian   4) Others
- d. Educational Experience   1) None   2) Primary   3) Secondary   4) JC/Polytechnic
5) Undergrad   6) Post Grad
- e. Language   1) English   2) Mandarin   3) Malay   4) Tamil   ☐ 5) Others

5. Technographics

- a. Computer literacy   1) Do not use   2) Limited   3) Good   4) Very good   5) Excellent
- b. How often do you use the Internet?   1) Daily   2) 2-3 times a week   3) Weekly   4) Monthly   5) Never
- c. Do you carry a mobile phone?   1) Yes
- d. Do you use your mobile phone for these functions?   1) SMS   2) Camera/Video   3) Internet   4) Others
(Tick > 1 if applicable)   _____

END OF SURVEY

Picture Guide 1

Picture Guide 2

Appendix B: Data Generated for Survey 1

1. Medication Characteristics		
	Yes	No
a) Are you required to take prescribed medications regularly?	347	0
b) Have you been taking these medications for at least 2 months?	347	0
c) How long have you been taking these medications for?	Response	
<1 year	27 (7.8%)	
1-5 years	104 (30.0%)	
5-10 years	52 (15.0%)	
>10 years	164 (47.3%)	
d) How many types of prescribed medications are you taking daily?		
1	135 (38.9%)	
2	101 (29.1%)	
3	66 (19.0%)	
>4	45 (13.0%)	
2. Medication Adherence		
	Yes	No
a) Do you sometimes forget to take your medications?	142 (40.9%)	205(59.1%)
b) Over the past 2 weeks, were there any days when you did not take your medications	93 (26.8%)	253(73.2%)
c) Have you ever cut back or stopped taking your medication without telling your doctor because you felt worse when you took it?	38 (11.0%)	309 (89.0%)
d) When you travel or leave home, do you sometimes forget to bring along your medications	76 (21.9%)	271 (78.1%)
e) Did you take your medications yesterday?	318 (91.6%)	29 (8.4%)
f) When you feel like your condition is under control, do you sometimes stop taking your medications?	55 (15.9%)	292 (84.1%)
g) Taking medication everyday is a real inconvenience for some people. Do you ever feel hassled about sticking to your treatment plan?	135 (38.9%)	212 (61.1%)
h) How often do you have difficulty remembering to take all your medication?		
Never/Rarely	213 (61.4%)	
Once in a while	95 (27.4%)	
Sometimes	28 (8.1%)	
Usually	9 (2.6%)	
All the time	2 (0.6%)	
i) Are these some of the reasons for your nonadherence		
Simply Forget	157 (45.2%)	
Too Many pills to take	14 (4.0%)	
Worry about side effects	11 (3.2%)	
Lack of information	0 (0.0%)	
	1 (0.3%)	
j) Other reasons for nonadherence		
Busy	35 (10.1%)	
Feeling	12 (3.5%)	
Cost	2 (0.6%)	
k) Would you like to know more about the medication?	69 (19.9%)	278 (80.1%)
3. Medicine Management		
	Yes	No
a) Are you using any specific method to manage your medication?	117 (33.7%)	
b) How do you currently manage your medications		
Pillbox	95 (27.4%)	
Blister Medication Packing	2 (0.6%)	
Calendar	0 (0.0%)	
Using symbols/color code	6 (1.7%)	
Digital Pillbox/Alarm	2 (0.6%)	
Automated Medication Dispenser	0 (0.0%)	

c) Is the current way of medicine management troublesome?		
Yes	21 (6.1%)	
No	62 (17.9%)	
d) Have you used any technology/social media to manage your medication	1 (0.3%)	
e) Are you interested in using technology/social media to help in medicine management?	39 (11.2%)	308 (88.8%)

4. Demographics

	Morisky Adherence Score			
	High	Medium	Low	Total
a) Gender				
Male	53 (15.0%)	59 (17.0%)	66 (19.0%)	178 (51.3%)
Female	49 (18.0%)	58 (17.0%)	62 (14.0%)	169 (48.7%)
Overall	102 (29.4%)	117 (33.7%)	128 (36.9%)	347 (100%)
b) Age Range (Years)				
21-29	1 (0.3%)	3 (0.9%)	13 (3.7%)	17 (4.9%)
30-39	1 (0.3%)	4 (1.2%)	3 (0.9%)	8 (2.3%)
40-49	2 (0.6%)	5 (1.4%)	18 (5.2%)	25 (7.2%)
50-59	23 (6.6%)	19 (5.5%)	30 (8.6%)	72 (20.7%)
>60	75 (21.6%)	86 (24.8%)	64 (18.4%)	225 (64.8%)
c) Ethnic Group				
Chinese	92 (26.5%)	104 (30.0%)	102(29.4%)	298 (85.9%)
Malay	8 (2.3%)	4 (1.2%)	19 (5.5%)	31 (8.9%)
Indian	1 (0.3%)	8 (2.3%)	4 (1.2%)	13 (3.7%)
Others	1 (0.3%)	1 (0.3%)	3 (0.9%)	5 (1.4%)
d) Educational Experience				
None	23 (6.6%)	29(8.4%)	14(4%)	66(19%)
Primary	27 (7.8%)	33(9.5%)	30(8.6%)	90(25.9%)
Secondary	32 (9.2%)	25(7.2%)	42(12.1%)	99(28.5%)
JC/Polytechnic	10 (2.9%)	17(4.9%)	22(6.3%)	49(14.1%)
Undergrad	6 (1.7%)	7(2%)	10(2.9%)	23(6.6%)
Post Grad	2 (0.6%)	4(1.2%)	7(2%)	13(3.7%)
Others	2(0.6%)	2(0.6%)	3(0.9%)	7(2%)

5. Technographics

	High	Medium	Low	Total
a) Computer Literacy				
Do not use	62 (17.9%)	78 (22.5%)	57(16.4%)	197(56.8%)
Limited	24 (6.9%)	10(2.9%)	27(7.8%)	61(17.6%)
Good	9 (2.6%)	23(6.6%)	20(5.8%)	52(15.0%)
Very good	4 (1.2%)	4(1.2%)	15(4.3%)	23(6.6%)
Excellent	3 (0.9%)	2(0.6%)	9(2.6%)	14(4.4%)
b) How often do you use the internet				
Daily	75 (21.6%)	83(23.9%)	65(18.7%)	223(64.3%)
2-3 times a week	15(4.3%)	23(6.6%)	43(12.4%)	81(23.3%)
Weekly	6(1.7%)	7(2.0%)	10(2.9%)	23(6.6%)
Monthly	4(1.2%)	1(0.3%)	4(1.2%)	9(2.6%)
Never	2(0.6%)	3(0.9%)	6(1.7%)	11(3.2%)
c) Do you carry a mobile phone				
Yes	77 (22.2%)	87(25.1%)	106(30.5%)	270(77.8%)
No	25 (7.2%)	30 (8.6%)	22 (6.3%)	77 (22.2%)

Appendix C: Mediation Analysis Results from SPSS

Mediation Analysis and Bootstrapping Results

Independent Variable	Mediating Variable	a-path IV to Mediator	b-path Direct Effect of Mediator on DV	c'-path Direct Effect of IV on DV	c-path Total Effect of IV on DV	Bootstrap (95% CI)
Age	> Unintentional	-0.28***	0.35***	-0.02	-0.17*	-0.16 to -0.05
Age	> Intentional	-0.22***	0.20***	-0.02	-0.17*	-0.09 to -0.02
Busyness	> Unintentional	0.70***	0.36***	-0.06	0.21	0.15 to 0.40
Busyness	> Intentional	0.09	0.21***	-0.06	0.21	-0.05 to 0.12
Pillbox	> Unintentional	0.11	0.36***	-0.18	-0.14	-0.04 to 0.14
Pillbox	> Intentional	0.01	0.20***	-0.18	-0.14	-0.04 to 0.05
Attitude	> Unintentional	0.74***	0.39***	-0.18	0.19	0.19 to 0.42
Attitude	> Intentional	0.40**	0.21***	-0.19	0.19	0.03 to 0.17
Knowledge	> Unintentional	0.17	0.36***	0.14	0.28*	-0.03 to 0.17
Knowledge	> Intentional	0.43*	0.20**	0.14	0.28*	0.02 to 0.20
Intentional	> Unintentional	0.34***	0.26***	0.34***	0.43***	0.04 to 0.15
Unintentional	> Intentional	0.38***	0.36***	0.21***	0.34	0.08 to 0.21

*** Multiple regression is significant at the 0.001 level

** Multiple regression is significant at the 0.01 level

* Multiple regression is significant at the 0.05 level

1) Age effect on Nonadherence

```

Run MATRIX procedure:
*****
Preacher and Hayes (2008) SPSS Macro for Multiple Mediation
Written by Andrew F. Hayes, The Ohio State University
http://www.comm.ohio-state.edu/ahayes/
For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic
and resampling strategies for assessing and comparing indirect effects
in multiple mediator models. Behavior Research Methods, 40, 879-891.
*****
Dependent, Independent, and Proposed Mediator Variables:
DV = Nonadherence
IV = Age
MEDS = Intentio
      Unintent
Sample size
      347
IV to Mediators (a paths)
      Coeff      se      t      p
Intentio  -.2201    .0525   -4.1894   .0000
Unintent  -.2804    .0517   -5.4231   .0000
Direct Effects of Mediators on DV (b paths)
      Coeff      se      t      p
Intentio  .2029    .0518    3.9175   .0001
Unintent  .3497    .0526    6.6439   .0000
Total Effect of IV on DV (c path)
      Coeff      se      t      p
Age       -.1665    .0531   -3.1357   .0019
Direct Effect of IV on DV (c' path)
      Coeff      se      t      p
Age       -.0238    .0500   -.4767    .6339
Model Summary for DV Model
      R-sq  Adj R-sq      F      df1      df2      p
      .2245   .2177   33.1032    3.0000   343.0000   .0000
*****
          BOOTSTRAP RESULTS FOR INDIRECT EFFECTS
Indirect Effects of IV on DV through Proposed Mediators (ab paths)
      Data      Boot      Bias      SE
TOTAL      -.1427    -.1420    .0007    .0325
Intentio    -.0447    -.0438    .0008    .0188
Unintent    -.0981    -.0982   -.0001    .0263
Bias Corrected Confidence Intervals
      Lower      Upper
TOTAL      -.2132    -.0841
Intentio    -.0941    -.0160
Unintent    -.1576    -.0542
*****
Level of Confidence for Confidence Intervals:
95
Number of Bootstrap Resamples:
5000
***** NOTES *****
----- END MATRIX -----

```

2) Busyness effect on Nonadherence

```

Run MATRIX procedure:
*****
Preacher and Hayes (2008) SPSS Macro for Multiple Mediation
Written by Andrew F. Hayes, The Ohio State University
http://www.comm.ohio-state.edu/ahayes/
For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic
and resampling strategies for assessing and comparing indirect effects
in multiple mediator models. Behavior Research Methods, 40, 879-891.
*****
Dependent, Independent, and Proposed Mediator Variables:
DV = Nonadherence
IV = Busy
MEDS = Intentio
      Unintent
Sample size
      347
IV to Mediators (a paths)
      Coeff      se      t      p
Intentio      .0904      .1785      .5067      .6127
Unintent      .6972      .1745      3.9951      .0001
Direct Effects of Mediators on DV (b paths)
      Coeff      se      t      p
Intentio      .2050      .0515      3.9838      .0001
Unintent      .3593      .0526      6.8278      .0000
Total Effect of IV on DV (c path)
      Coeff      se      t      p
Busy      .2110      .1782      1.1844      .2371
Direct Effect of IV on DV (c' path)
      Coeff      se      t      p
Busy      -.0580      .1616      -.3592      .7197
Model Summary for DV Model
      R-sq Adj R-sq      F      df1      df2      p
      .2243      .2175      33.0611      3.0000      343.0000      .0000
*****
      BOOTSTRAP RESULTS FOR INDIRECT EFFECTS
Indirect Effects of IV on DV through Proposed Mediators (ab paths)
      Data      Boot      Bias      SE
TOTAL      .2690      .2690      .0000      .0795
Intentio      .0185      .0183      -.0002      .0428
Unintent      .2505      .2507      .0002      .0631
Bias Corrected Confidence Intervals
      Lower      Upper
TOTAL      .1217      .4370
Intentio      -.0516      .1245
Unintent      .1478      .3980
*****
Level of Confidence for Confidence Intervals:
95
Number of Bootstrap Resamples:
5000
***** NOTES *****
----- END MATRIX -----

```


3) Pillbox effect on Nonadherence

```

Run MATRIX procedure:
*****
Preacher and Hayes (2008) SPSS Macro for Multiple Mediation
Written by Andrew F. Hayes, The Ohio State University
http://www.comm.ohio-state.edu/ahayes/
For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic
and resampling strategies for assessing and comparing indirect effects
in multiple mediator models. Behavior Research Methods, 40, 879-891.
*****
Dependent, Independent, and Proposed Mediator Variables:
DV = Nonadherence
IV = Pillbox
MEDS = Intentio
      Unintent
Sample size
      347
IV to Mediators (a paths)
      Coeff      se      t      p
Intentio      .0137      .1206      .1138      .9094
Unintent      .1093      .1204      .9075      .3648
Direct Effects of Mediators on DV (b paths)
      Coeff      se      t      p
Intentio      .2049      .0512      4.0044      .0001
Unintent      .3596      .0512      7.0197      .0000
Total Effect of IV on DV (c path)
      Coeff      se      t      p
Pillbox      -.1407      .1203      -1.1692      .2431
Direct Effect of IV on DV (c' path)
      Coeff      se      t      p
Pillbox      -.1828      .1062      -1.7214      .0861
Model Summary for DV Model
      R-sq      Adj R-sq      F      df1      df2      p
      .2307      .2239      34.2785      3.0000      343.0000      .0000
*****
      BOOTSTRAP RESULTS FOR INDIRECT EFFECTS
Indirect Effects of IV on DV through Proposed Mediators (ab paths)
      Data      Boot      Bias      SE
TOTAL      .0421      .0403      -.0018      .0580
Intentio      .0028      .0021      -.0007      .0239
Unintent      .0393      .0382      -.0011      .0448
Bias Corrected Confidence Intervals
      Lower      Upper
TOTAL      -.0632      .1661
Intentio      -.0427      .0548
Unintent      -.0402      .1389
*****
Level of Confidence for Confidence Intervals:
95
Number of Bootstrap Resamples:
5000
***** NOTES *****
----- END MATRIX -----

```

4) Hassle effect on Nonadherence

```

Run MATRIX procedure:
*****
Preacher and Hayes (2008) SPSS Macro for Multiple Mediation
Written by Andrew F. Hayes, The Ohio State University
http://www.comm.ohio-state.edu/ahayes/
For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic
and resampling strategies for assessing and comparing indirect effects
in multiple mediator models. Behavior Research Methods, 40, 879-891.
*****
Dependent, Independent, and Proposed Mediator Variables:
DV = Nonadherence
IV = Hassle
MEDS = Intentio
      Unintent
Sample size
      347
IV to Mediators (a paths)
      Coeff      se      t      p
Intentio      .4009      .1081      3.7072      .0002
Unintent      .7372      .1029      7.1654      .0000
Direct Effects of Mediators on DV (b paths)
      Coeff      se      t      p
Intentio      .2123      .0513      4.1399      .0000
Unintent      .3850      .0539      7.1426      .0000
Total Effect of IV on DV (c path)
      Coeff      se      t      p
Hassle      .1860      .1098      1.6939      .0912
Direct Effect of IV on DV (c' path)
      Coeff      se      t      p
Hassle      -.1829      .1042      -1.7551      .0801
Model Summary for DV Model
      R-sq      Adj R-sq      F      df1      df2      p
      .2309      .2242      34.3288      3.0000      343.0000      .0000
*****
      BOOTSTRAP RESULTS FOR INDIRECT EFFECTS
Indirect Effects of IV on DV through Proposed Mediators (ab paths)
      Data      Boot      Bias      SE
TOTAL      .3689      .3670      -.0019      .0695
Intentio      .0851      .0848      -.0003      .0355
Unintent      .2838      .2823      -.0015      .0593
Bias Corrected Confidence Intervals
      Lower      Upper
TOTAL      .2505      .5262
Intentio      .0307      .1744
Unintent      .1857      .4208
*****
Level of Confidence for Confidence Intervals:
95
Number of Bootstrap Resamples:
5000
***** NOTES *****
----- END MATRIX -----

```

5) Knowledge effect on Nonadherence

```

Run MATRIX procedure:
*****
Preacher and Hayes (2008) SPSS Macro for Multiple Mediation
Written by Andrew F. Hayes, The Ohio State University
http://www.comm.ohio-state.edu/ahayes/
For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic
and resampling strategies for assessing and comparing indirect effects
in multiple mediator models. Behavior Research Methods, 40, 879-891.
*****
Dependent, Independent, and Proposed Mediator Variables:
DV = Nonadherence
IV = Knowledge
MEDS = Intentio
      Unintent
Sample size
      347
IV to Mediators (a paths)
      Coeff      se      t      p
Intentio      .4293      .1327      3.2354      .0013
Unintent      .1662      .1344      1.2366      .2171
Direct Effects of Mediators on DV (b paths)
      Coeff      se      t      p
Intentio      .1965      .0519      3.7823      .0002
Unintent      .3551      .0513      6.9240      .0000
Total Effect of IV on DV (c path)
      Coeff      se      t      p
Knowledge      .2842      .1338      2.1236      .0344
Direct Effect of IV on DV (c' path)
      Coeff      se      t      p
Knowledge      .1408      .1205      1.1683      .2435
Model Summary for DV Model
      R-sq Adj R-sq      F      df1      df2      p
      .2271      .2203      33.5919      3.0000      343.0000      .0000
*****
      BOOTSTRAP RESULTS FOR INDIRECT EFFECTS
Indirect Effects of IV on DV through Proposed Mediators (ab paths)
      Data      Boot      Bias      SE
TOTAL      .1434      .1442      .0008      .0761
Intentio      .0843      .0857      .0013      .0450
Unintent      .0590      .0585      -.0005      .0500
Bias Corrected Confidence Intervals
      Lower      Upper
TOTAL      .0097      .3077
Intentio      .0195      .1975
Unintent      -.0310      .1674
*****
Level of Confidence for Confidence Intervals:
95
Number of Bootstrap Resamples:
5000
***** NOTES *****
----- END MATRIX -----

```

6a) Unintentional effect on Nonadherence

```

Run MATRIX procedure:
*****
Preacher and Hayes (2008) SPSS Macro for Multiple Mediation
Written by Andrew F. Hayes, The Ohio State University
http://www.comm.ohio-state.edu/ahayes/
For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic
and resampling strategies for assessing and comparing indirect effects
in multiple mediator models. Behavior Research Methods, 40, 879-891.
*****
Dependent, Independent, and Proposed Mediator Variables:
DV = Nonadherence
IV = Intentio
MEDS = Unintent
Sample size
347
IV to Mediators (a paths)
      Coeff      se      t      p
Unintent      .3784      .0498      7.5925      .0000
Direct Effects of Mediators on DV (b paths)
      Coeff      se      t      p
Unintent      .3552      .0513      6.9223      .0000
Total Effect of IV on DV (c path)
      Coeff      se      t      p
Intentio      .3405      .0506      6.7257      .0000
Direct Effect of IV on DV (c' path)
      Coeff      se      t      p
Intentio      .2061      .0513      4.0163      .0001
Model Summary for DV Model
      R-sq  Adj R-sq      F      df1      df2      p
      .2240      .2195      49.6528      2.0000      344.0000      .0000
*****
      BOOTSTRAP RESULTS FOR INDIRECT EFFECTS
Indirect Effects of IV on DV through Proposed Mediators (ab paths)
      Data      Boot      Bias      SE
TOTAL      .1344      .1352      .0008      .0336
Unintent      .1344      .1352      .0008      .0336
Bias Corrected Confidence Intervals
      Lower      Upper
TOTAL      .0784      .2099
Unintent      .0784      .2099
*****
Level of Confidence for Confidence Intervals:
95
Number of Bootstrap Resamples:
5000
***** NOTES *****
----- END MATRIX -----

```

6b) Intentional effect on Nonadherence

```

Run MATRIX procedure:
*****
Preacher and Hayes (2008) SPSS Macro for Multiple Mediation
Written by Andrew F. Hayes, The Ohio State University
http://www.comm.ohio-state.edu/ahayes/
For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic
and resampling strategies for assessing and comparing indirect effects
in multiple mediator models. Behavior Research Methods, 40, 879-891.
*****
Dependent, Independent, and Proposed Mediator Variables:
DV =   Unintent
IV =   Miss
MEDS = Intention
Sample size
      347
IV to Mediators (a paths)
      Coeff      se      t      p
Intention .3405    .0506   6.7257 .0000
Direct Effects of Mediators on DV (b paths)
      Coeff      se      t      p
Intention .2612    .0497   5.2520 .0000
Total Effect of IV on DV (c path)
      Coeff      se      t      p
Miss      .4332    .0485   8.9264 .0000
Direct Effect of IV on DV (c' path)
      Coeff      se      t      p
Miss      .3442    .0497   6.9223 .0000
Model Summary for DV Model
      R-sq  Adj R-sq      F      df1      df2      p
      .2479   .2436   56.7017   2.0000  344.0000 .0000
*****
      BOOTSTRAP RESULTS FOR INDIRECT EFFECTS
Indirect Effects of IV on DV through Proposed Mediators (ab paths)
      Data      Boot      Bias      SE
TOTAL      .0889      .0892      .0003      .0279
Intention  .0889      .0892      .0003      .0279
Bias Corrected Confidence Intervals
      Lower      Upper
TOTAL      .0422      .1536
Intention  .0422      .1536
*****
Level of Confidence for Confidence Intervals:
95
Number of Bootstrap Resamples:
5000
***** NOTES *****
----- END MATRIX -----

```

Appendix D: Medication Adherence Questionnaire for Study 2 and 3

Interviewer ID:	
Subject ID:	
Survey site:	

MEDICATION ADHERENCE & MANAGEMENT SURVEY 2014 SURVEY QUESTIONNAIRE

Demographics

- a) Are you a Singaporean Citizen? ☐ Yes ☐ No
- b) Are you at least 18 years old? ☐ Yes ☐ No
- c) Are you currently required to take prescribed medication regularly? ☐ Yes ☐ No
- d) Have you been taking these medications for at least 2 months? ☐ Yes ☐ No

Instructions

- For items with a scale (1-5), please **circle** the response that is most true for you.
- For items with multiple boxes, please **check** the box(es) that are most true for you.
- If you wish to cancel a response, please **cross out** the previous response and circle/check the desired response.
- Please answer all questions to the best of your ability, unless the question is optional.
- **Optional questions need not be answered if you do not wish answer them.**

Medication Complexity

The questions in this section will concern your medical routines, to examine the impact that the number of medication prescribed might have on your medication habits.

Question 4 is **optional** and you may choose not to answer it.

1a. How many types of medication do you need to take?

_____ (please specify)

b. If you **take more than one medication**, is taking **all** your medication regularly equally important to you? If you take **one** type of medication, proceed to Question 2.

☐ Yes ☐ No

If you indicated **“Yes”**, please proceed to Question 2. If you indicated **“No”**, please answer the following questions.

i. How regularly do you take your most important medication?

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

ii. How regularly do you take your least important medication?

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

2. How long have you been taking medication on a regular basis?

_____ (please specify)

3. Taking into account all the medication you are taking, approximately how many times a day do you take your medication?

_____ (please specify)

4. What condition(s) are your medication for? (**Optional**)

☐ High Blood Pressure (Hypertension) ☐ Diabetes

☐ High Blood Cholesterol

☐ Others: _____ (please specify)

Medication Prescription

The questions in this section will concern the relationship between you and your doctor(s), and any effects it might have on your medication habits.

5. Do you see different doctors for different conditions?

☐ Yes ☐ No

If you indicated “Yes”, please answer the following question based on the doctor that you have been seeing the longest.

6. How long have you been seeing your current doctor for?

_____ (please specify)

7. When you see a doctor for a medical condition, you will seek a second opinion.

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

8. When you see a doctor for a medical condition, you will stick to the same doctor for the following consultations.

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

9. Your doctor(s) only think about what is best for you.

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

10. How much do you trust your doctor(s) when it comes to your medication needs?

Strongly Mistrust	Mistrust	Neutral	Trust	Strongly Trust
1	2	3	4	5

Medication Adherence
The questions in this section will concern how regularly you take your medication. Please use your medication habits (i.e. all the medication that you are taking) for the past 2 months as a guideline.

11. Did you take your medication yesterday?

☐ Yes ☐ No

12. Over the past 2 weeks, were there any days when you did not take your medication?

☐ Yes ☐ No

13a. Do you sometimes forget to take your medication?

☐ Yes ☐ No

If you indicated “Yes”, please answer the following question. If you indicated “No”, please proceed to Question 14.

b. Please indicate the reason(s) for not taking your medication sometimes.

☐ Concerned about side effects

☐ Hassle

☐ Busy

☐ Save money

☐ Don't feel like taking

☐ Simply forget

☐ Others: _____ (please specify)

14. How often do you forget to bring your medication when you travel or leave your house?

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

15. How often do you reduce or stop taking the prescribed dose of medication without telling your doctor because you felt worse after taking it?

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

16. How often do you stop taking your medication because you feel that your condition is under control?

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

17. How often do you feel hassled about taking your prescribed dose of medication?

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

18. How often do you have difficulty remembering to take all your medication?

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

19. You check with your doctor(s) before reducing or stopping your prescribed dose of medication.

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

20. You inform your doctor(s) after you stop or reduce your prescribed dose of medication at your next appointment.

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

21. It is not necessary to take all the medication prescribed by your doctor(s).

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

22. You will only take your medication when the symptoms of your condition show.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

23. Your general health depends on how regularly you take your medication.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

24. You sometimes worry about becoming too dependent on your medication.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

25. Taking your medication as prescribed is important to you.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

26. You make the decision when it comes to taking your medication.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

27. It is rude to tell doctors that you did not follow his/her prescriptions.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

28. Doctors sometimes prescribe too much medication.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

29. Your doctor(s) do not mind you reducing or stopping your prescribed dose of medication.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

30. It is okay to take supplementary medication for your condition.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

31. Your doctor(s) do not mind you taking supplementary medication for your condition (e.g. herbs, tonics, teas, chiropractic, etc.).

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

32. It is not necessary to discuss with your doctor(s) about the supplementary medication that you take.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

33. Your doctor(s) care to know about the supplementary medication that you take.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

34. You trust your doctor(s) when it comes to your medication needs.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

35. Your doctor(s) only prescribe medication that you need.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

36. Your family and friends believe that it is important for you to take all your medication.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

Medication Management

The questions in this segment will concern how you take your medication, help received when you take your medication, and the possible impact on your medication habits.

37a. Is there somebody who helps you when you take your medication?

☐ Yes ☐ No

If you indicated “Yes”, please answer the following questions. If you indicated “No”, please proceed to Question 38.

b. Who helps you when you take your medication?

☐ Spouse ☐ Children ☐ Helper

☐ Others _____ (please specify)

c. Does this person live in the same household as you?

☐ Yes ☐ No

38. Who reminds you to take your medication?

☐ Myself ☐ Spouse ☐ Children ☐ Helper

☐ Others _____ (please specify)

39. Which of these strategies do you use to remember to take your medication?

☐ Alarm reminder

☐ Place in prominent location (e.g. dinner table, kitchen table)

☐ Routine (e.g. after meal, brushing teeth)

☐ When I feel pain

☐ Others _____ (please specify)

40a. What method do you use to store and manage your medication?

☐ Pillbox

☐ Others _____ (please specify)

If you indicated “**Pillbox**”, please answer the following question. If you indicated “**Others**”, please proceed to Question 41.

b. Who sorts the medication into your pillbox?

_____ (please specify)

41a. Do you find the medication management method you are currently using troublesome?

☐ Yes ☐ No

If you indicated “**Yes**”, please answer the following question. If you indicated “**No**”, please proceed to Question 42.

b. Why do you find the current method troublesome?

_____ (please specify)

42. You have difficulty managing your medication by yourself.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

43. You follow all the instructions given by your doctor for taking your medication.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

44. You are unable to find time to take your medication because you are too busy.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

45. You are unable to remember to take your medication because you are too busy.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

Medical Information
The questions in this section will concern how much you know about your medication, your attitude regarding medical knowledge, as well as the effects on your medication habits

46. You know enough about your medication.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

47. You would like to know more about your medication.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

48. You need to know more about your medication to decide if you need to take it.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

49. You always have discussions with your doctor about your medication.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

Lifestyle

This section will concern how busy you usually are, and how it might affect your medication schedules.

50. You are busy on an average day.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

51. You often have to rush from place to place to get things done.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

52. You are usually too busy to have breaks.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

53. You often follow a daily routine.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

54. You have a specific time for doing things (i.e. watch a particular television) at home.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

Prospective Memory

The questions in this section will concern how good your memory is, and if it might affect your medication habits.

55. You decide to do something later but forget to do it.

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

56. You forget about appointments unless you are reminded (e.g. by somebody or via a calendar).

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

57. You usually forget to buy something that you planned to, even after seeing the shop.

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

58. You usually leave things behind even though they were right in front of you.

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

59. You usually take a second look at something without realising that you have seen it before.

Never	Rarely	Sometimes	Often	Always
1	2	3	4	5

Demographics

This section identifies your personal particulars.

Questions 64, 65 and 66 are **optional** and you may choose not to answer any of them.

60. Gender :

☐ Female ☐ Male

61. Age: _____ (please specify)

62. Race:

☐ Chinese ☐ Malay ☐ Indian ☐ Others _____ (please specify)

63. Highest Educational Certification:

☐ PSLE or below ☐ GCE 'N' / 'O' Level ☐ GCE 'A' Level
☐ Diploma and/or Professional Qualification ☐ Degree or above

64. Occupation (**Optional**): _____ (please specify)

65. Type of Housing (**Optional**):

☐ Rented ☐ 1-2-Room Flat ☐ 3-4-Room Flat ☐ 5-Room/ Executive Flat
☐ Condominium ☐ Landed Property
☐ Other Housing Types _____ (please specify)

66. Monthly Salary (**Optional**):

☐ Below \$1,000 ☐ \$1,000 - \$1,999 ☐ \$2,000 - \$2,999 ☐ \$3,000 - \$3,999
☐ \$4,000 - \$4,999 ☐ \$5,000 - \$5,999 ☐ \$6,000 - \$6,999 ☐ \$7,000 - \$9,999
☐ More than \$10,000

Appendix E: Data Generated for Survey 2

Medication Complexity (N=267)

1a. How many types of medication do you need to take	Response	
1-3	193 (72.3%)	
4-6	52 (19.5%)	
7-10	17 (6.4%)	
>11	5 (1.9%)	
1b. If you take more than one medication, is taking all your medication regularly equally important to you?	Yes 104 (39.0%)	No 161 (60.3%)
2. How long have you been taking medication on a regular basis?		
1-3 months	21 (7.9%)	
4-6 months	15 (5.6%)	
7-12 months	19 (7.1%)	
>13	212 (79.4%)	
3. Taking into account all the medication you are taking, approximately how many times a day do you take your medication?		
1-2 times a day	222 (83.1%)	
3-4 times a day	40 (15.0%)	
>5 times a day	5 (1.9%)	

Medication Prescription

5. Do you see different doctors for different conditions?	Yes 189 (70.8%)	No 78 (29.2%)			
7. When you see a doctor for a medical condition, you will seek a second opinion.	Never 119(44.6%)	Rarely 63(23.6%)	Sometimes 61(22.8%)	Often 15(5.6%)	Always 8(3.0%)
8. When you see a doctor for a medical condition, you will stick to the same doctor for the following consultations.	16(6.0%)	24(9.0%)	30(11.2%)	77(28.8%)	119(44.6%)
9. Your doctor(s) only think about what is best for you.	2(0.7%)	4(1.5%)	33(12.4%)	101(37.8%)	126(47.2%)
10. How much do you trust your doctor(s) when it comes to your medication needs?	1(0.4%)	3(1.1%)	42(15.7%)	113(42.3%)	107(40.1%)

Medication Prescription

11. Did you take your medication yesterday?	Yes 249 (6.7%)	No 18(6.7%)			
12. Over the past 2 weeks, were there any days when you did not take your medication?	61(22.8%)	206(77.2%)			
13. Do you sometimes forget to take your medication?	150(56.2%)	117(43.8%)			
14. How often do you forget to bring your medication when you travel or leave your house?	Never 132(49.4%)	Rarely 69(25.8%)	Sometimes 35(13.1%)	Often 12(4.5%)	Always 19(17.1%)
15. How often do you reduce or stop taking the prescribed dose of medication without telling your doctor because you felt worse after taking it?	117(66.3%)	47(17.6%)	24(9.0%)	8(3.0%)	11(4.1%)
16. How often do you stop taking your medication because you feel that your condition is under control?	165(61.8%)	45(16.9%)	34(12.7%)	15(5.6%)	8(3.0%)
17. How often do you feel hassled about taking your prescribed dose of medication?	138(51.7%)	54(20.2%)	55(20.6%)	11(4.1%)	9(3.4%)

18. How often do you have difficulty remembering to take all your medication?	127(47.6%)	74(27.7%)	52(19.5%)	10(3.7%)	4(1.5%)
19. You check with your doctor(s) <u>before</u> reducing or stopping your prescribed dose of medication.	67(25.1%)	23(8.6%)	28(10.5%)	42(15.7%)	75(28.1%)
20. You inform your doctor(s) <u>after</u> you stop or reduce your prescribed dose of medication at your next appointment.	87(32.6%)	15(5.6%)	30(11.2%)	36(13.5%)	62(23.2%)
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
21. It is not necessary to take all the medication prescribed by your doctor(s).	88(33.0%)	90(33.7%)	34(12.7%)	41(15.4%)	14(5.2%)
22. You will only take your medication when the symptoms of your condition show.	117(43.8%)	83(31.1%)	17(6.4%)	34(12.7%)	16(6.0%)
23. Your general health depends on how regularly you take your medication.	20(7.5%)	45(16.9%)	47(17.6%)	103(38.6%)	52(19.5%)
24. You sometimes worry about becoming too dependent on your medication.	36(13.5%)	68(25.5%)	38(14.2%)	102(38.2%)	23(8.6%)
25. Taking your medication as prescribed is important to you.	2(0.7%)	10(3.7%)	27(10.1%)	126(47.2%)	102(38.2%)
26. You make the decision when it comes to taking your medication.	16(6.0%)	36(13.5%)	33(12.4%)	113(42.3%)	68(25.5%)
27. It is rude to tell doctors that you did not follow his/her prescriptions.	36(13.5%)	70(26.2%)	62(23.2%)	68(25.5%)	28(10.5%)
28. Doctors sometimes prescribe too much medication.	38(14.2%)	84(31.5%)	54(20.2%)	72(27.0%)	19(7.1%)
29. Your doctor(s) do not mind you reducing or stopping your prescribed dose of medication.	47(17.6%)	94(35.2%)	69(25.8%)	45(16.9%)	9(3.4%)
30. It is okay to take supplementary medication for your condition.	19(7.1%)	43(16.1%)	56(21.0%)	124(46.4%)	23(8.6%)
31. Your doctor(s) do not mind you taking supplementary medication for your condition (e.g. herbs, tonics, teas, chiropractic, etc.).	12(4.5%)	39(14.6%)	97(36.3%)	101(37.8%)	14(5.2%)
32. It is not necessary to discuss with your doctor(s) about the supplementary medication that you take.	45(16.9%)	94(35.2%)	49(18.4%)	66(24.7%)	11(4.1%)
33. Your doctor(s) care to know about the supplementary medication that you take.	9(3.4%)	36(13.5%)	67(25.1%)	119(44.6%)	34(12.7%)
34. You trust your doctor(s) when it comes to your medication needs.	1(0.4%)	4(1.5%)	19(7.1)	155(58.1%)	88(33.0%)
35. Your doctor(s) only prescribe medication that you need.	1(0.4%)	10(3.7%)	29(10.9%)	152(56.9%)	75(28.1%)
36. Your family and friends believe that it is important for you to take all your medication.	1(0.4%)	11(4.1%)	38(14.2%)	114(42.7%)	103(38.6%)
	Yes	No			
37. Is there somebody who helps you when you take your medication?	33(12.4%)	234(87.6%)			
	Self	Others			
38. Who reminds you to take your medication?	224(83.9%)	43(16.1%)			
	Pillbox	Others			
40. What method do you use to store and manage your medication?	112(41.9%)	155(58.1%)			
	Yes	No			
41. Do you find the medication management method you are currently using troublesome?	14(5.2%)	253(94.8%)			

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
42. You have difficulty managing your medication by yourself.	107(40.1%)	132(49.4%)	14(5.2%)	13(4.9%)	1(0.4%)
43. You follow all the instructions given by your doctor for taking your medication.	7(2.6%)	13(4.9%)	14(5.2%)	130(48.7%)	103(38.6%)
44. You are unable to find time to take your medication because you are too busy.	82(30.7%)	116(43.4%)	34(12.7%)	31(11.6%)	4(1.5%)
45. You are unable to remember to take your medication because you are too busy.	88(33.0%)	92(34.5%)	32(12.0%)	52(19.5%)	3(1.1%)
Medical Information					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
46. You know enough about your medication.	6(2.2%)	23(8.6%)	24(9.0%)	158(59.2%)	55(20.6%)
47. You would like to know more about your medication.	13(4.9%)	47(17.6%)	67(25.1%)	106(39.7%)	33(12.4%)
48. You need to know more about your medication to decide if you need to take it.	17(6.4%)	50(18.7%)	52(19.5%)	110(41.2%)	37(13.9%)
49. You always have discussions with your doctor about your medication.	12(4.5%)	51(19.1%)	38(14.2%)	120(44.9%)	45(16.9%)
Lifestyle					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
50. You are busy on an average day.	23(8.6%)	59(22.1%)	40(15.0%)	116(43.4%)	29(10.9%)
51. You often have to rush from place to place to get things done.	29(10.9%)	78(29.2%)	47(17.6%)	89(33.3%)	24(9.0%)
52. You are usually too busy to have breaks.	29(10.9%)	125(46.8%)	47(17.6%)	56(21.0%)	10(3.7%)
53. You often follow a daily routine	6(2.2%)	44(16.5%)	48(18.0%)	140(52.4%)	29(10.9%)
54. You have a specific time for doing things (i.e. watch a particular television) at home.	12(4.5%)	68(25.5%)	56(21.0%)	110(41.2%)	21(7.9%)
Prospective Memory					
	Never	Rarely	Sometimes	Often	Always
55. You decide to do something later but forget to do it.	29(10.9%)	71(26.6%)	117(43.8%)	39(14.6%)	11(4.1%)
56. You forget about appointments unless you are reminded (e.g. by somebody or via a calendar).	71(26.6%)	91(34.1%)	76(28.5%)	23(8.6%)	6(2.2%)
57. You usually forget to buy something that you planned to, even after seeing the shop.	56(21.0%)	94(35.2%)	89(33.3%)	24(9.0%)	4(1.5%)
58. You usually leave things behind even though they were right in front of you.	77(28.8%)	87(32.6%)	77(28.8%)	24(9.0%)	2(0.7%)
59. You usually take a second look at something without realizing that you have seen it before.	65(24.3%)	87(32.6%)	83(31.1%)	25(9.4%)	7(2.6%)
Demographics					
	Morisky Adherence Score (as measured by MMAS-8 Scale)				
60) Gender	High	Medium	Low	Total	
Male	53 (15.0%)	59 (17.0%)	66 (19.0%)	178 (51.3%)	
Female	49 (18.0%)	58 (17.0%)	62 (14.0%)	169 (48.7%)	
Overall	102 (29.4%)	117 (33.7%)	128 (36.9%)	347 (100%)	
61) Age Range (Years)					
21-29	2 (0.8%)	6 (2.3%)	22 (8.3%)	30 (11.4%)	

30-39	4 (1.5%)	8(3.0%)	7 (2.7%)	19 (7.2%)
40-49	6 (2.3%)	16(6.1%)	14 (5.3%)	36 (13.6%)
50-59	17 (6.4%)	32 (12.1%)	22 (8.3%)	71 (26.9%)
60-74	28 (10.6%)	33 (12.5%)	15 (5.7%)	76 (28.8%)
≥75	12 (4.5%)	14 (5.3%)	6 (2.3%)	32 (12.1%)
62) Race				
Chinese	92 (26.5%)	104 (30.0%)	102(29.4%)	298 (85.9%)
Malay	8 (2.3%)	4 (1.2%)	19 (5.5%)	31 (8.9%)
Indian	1 (0.3%)	8 (2.3%)	4 (1.2%)	13 (3.7%)
Others	1 (0.3%)	1 (0.3%)	3 (0.9%)	5 (1.4%)
63) Educational				
Primary and below	23 (8.6%)	35 (13.1%)	24 (9.0%)	82 (30.7%)
Secondary	23 (8.6%)	29 (10.9%)	21 (7.9%)	73 (27.3%)
Junior College	8 (3.0%)	7 (2.6%)	4 (1.5%)	19 (7.1%)
Diploma/Professional	22 (8.20%)	21 (7.9%)	10 (3.7%)	53 (19.9%)
Degree and above	8 (3.0%)	15 (5.6%)	8 (3.0%)	31 (11.6%)
65) Type of Housing (Optional)				
Rented				15(8.3%)
1-2 Room Flat				11(6.1%)
3-4 Room Flat				71(39.2%)
5-Room/Executive Flat				48(26.5%)
Condominium				16(8.8%)
Landed Property				14(7.7%)
Others				0(0%)
66) Monthly Salary (Optional)				
Below \$1,000				53(46.9%)
\$1,000 - \$1,999				17(15.0%)
\$2,000 - \$2,999				9(8.0%)
\$3,000 - \$3,999				8(7.1%)
\$4,000 - \$4,999				5(4.4%)
\$5,000 - \$5,999				4(3.5%)
\$6,000 - \$6,999				1(0.9%)
\$7,000 - \$9,999				0(0.0%)
More than \$10,000				4(3.5%)

Appendix F: Mediation Analysis Results for Study 2 & 3

1a) Age effect on Nonadherence mediated by Unintentional

```
*****
Preacher and Hayes (2008) SPSS Macro for Multiple Mediation
Written by Andrew F. Hayes, The Ohio State University
http://www.comm.ohio-state.edu/ahayes/
For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic
and resampling strategies for assessing and comparing indirect effects
in multiple mediator models. Behavior Research Methods, 40, 879-891.
*****

Dependent, Independent, and Proposed Mediator Variables:
DV = Nonadher
IV = Age
MEDS = Unintent
Sample size
267
IV to Mediators (a paths)
      Coeff    se    t    p
Unintent -.2009   .0571 -3.5192   .0005

Direct Effects of Mediators on DV (b paths)
      Coeff    se    t    p
Unintent .3084   .0594  5.1942   .0000

Total Effect of IV on DV (c path)
      Coeff    se    t    p
Age -.1346   .0578 -2.3272   .0207

Direct Effect of IV on DV (c' path)
      Coeff    se    t    p
Age -.0726   .0565 -1.2860   .1996

Model Summary for DV Model
      R-sq Adj R-sq    F    df1    df2    p
      .1109   .1042 16.4633   2.0000 264.0000   .0000
*****

      BOOTSTRAP RESULTS FOR INDIRECT EFFECTS
Indirect Effects of IV on DV through Proposed Mediators (ab paths)
      Data    Boot    Bias    SE
TOTAL    -.0620   -.0627   -.0008   .0240
Unintent -.0620   -.0627   -.0008   .0240
Bias Corrected Confidence Intervals
      Lower    Upper
TOTAL    -.1191   -.0249
Unintent -.1191   -.0249
*****

Level of Confidence for Confidence Intervals:
95
Number of Bootstrap Resamples:
5000
***** NOTES *****
----- END MATRIX -----
```

1b) Age effect on Nonadherence mediated by Intentional

```
Run MATRIX procedure:
*****
```


Preacher and Hayes (2008) SPSS Macro for Multiple Mediation
Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = Age

MEDS = Intentio

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
Intentio	-.2088	.0570	-3.6646	.0003

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Intentio	.2135	.0611	3.4975	.0006

Total Effect of IV on DV (c path)

	Coeff	se	t	p
Age	-.1346	.0578	-2.3272	.0207

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
Age	-.0900	.0581	-1.5499	.1224

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.0634	.0563	8.9390	2.0000	264.0000	.0002

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	-.0446	-.0436	.0010	.0174
Intentio	-.0446	-.0436	.0010	.0174

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.0878	-.0175
Intentio	-.0878	-.0175

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

2a) Pillbox effect on Nonadherence mediated by Unintentional

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = Pillbox

MEDS = Unintent

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p

Unintent	.1447	.1239	1.1672	.2442

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p

Unintent	.3263	.0583	5.5918	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p

Pillbox	-.0014	.1243	-.0114	.9909

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p

Pillbox	-.0486	.1180	-.4119	.6808

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p

.1059	.0991	15.6339	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE

TOTAL	.0472	.0467	-.0005	.0426

Unintent	.0472	.0467	-.0005	.0426

Bias Corrected Confidence Intervals

	Lower	Upper

TOTAL	-.0324	.1423

Unintent	-.0324	.1423

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

2b) Pillbox effect on Nonadherence mediated by Intentional

```
*****
Preacher and Hayes (2008) SPSS Macro for Multiple Mediation
Written by Andrew F. Hayes, The Ohio State University
http://www.comm.ohio-state.edu/ahayes/
For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic
and resampling strategies for assessing and comparing indirect effects
in multiple mediator models. Behavior Research Methods, 40, 879-891.
*****

Dependent, Independent, and Proposed Mediator Variables:
DV = Nonadher
IV = Pillbox
MEDS = Intention
Sample size
267
IV to Mediators (a paths)
      Coeff    se      t      p
Intention -.1911 .1237 -1.5452 .1235
Direct Effects of Mediators on DV (b paths)
      Coeff    se      t      p
Intention .2364 .0601 3.9336 .0001
Total Effect of IV on DV (c path)
      Coeff    se      t      p
Pillbox  -.0014 .1243 -.0114 .9909
Direct Effect of IV on DV (c' path)
      Coeff    se      t      p
Pillbox   .0438 .1215 .3601 .7191
Model Summary for DV Model
      R-sq Adj R-sq      F      df1      df2      p
.0554 .0482 7.7367 2.0000 264.0000 .0005
*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS
Indirect Effects of IV on DV through Proposed Mediators (ab paths)
      Data Boot Bias      SE
TOTAL  -.0452 -.0446 .0006 .0313
Intention -.0452 -.0446 .0006 .0313
Bias Corrected Confidence Intervals
      Lower Upper
TOTAL  -.1217 .0039
Intention -.1217 .0039
*****

Level of Confidence for Confidence Intervals:
95
Number of Bootstrap Resamples:
5000
***** NOTES *****
----- END MATRIX -----
```

3a) Hassle effect on Nonadherence mediated by Unintentional

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = Hassle

MEDS = Unintent

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p

Unintent	.4143	.0559	7.4110	.0000

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p

Unintent	.3089	.0639	4.8331	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p

Hassle	.1656	.0606	2.7342	.0067

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p

Hassle	.0376	.0639	.5887	.5565

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p

.1065	.0997	15.7328	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE

TOTAL	.1280	.1285	.0005	.0356

Unintent	.1280	.1285	.0005	.0356

Bias Corrected Confidence Intervals

	Lower	Upper

TOTAL	.0688	.2082

Unintent	.0688	.2082

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

3b) Hassle effect on Nonadherence mediated by Intentional

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = Hassle

MEDS = Intentio

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p

Intentio	.4252	.0556	7.6481	.0000

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p

Intentio	.2001	.0659	3.0347	.0026

Total Effect of IV on DV (c path)

	Coeff	se	t	p

Hassle	.1656	.0606	2.7342	.0067

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p

Hassle	.0806	.0659	1.2222	.2227

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p

.0602	.0531	8.4584	2.0000	264.0000	.0003

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE

TOTAL	.0851	.0855	.0004	.0342

Intentio	.0851	.0855	.0004	.0342

Bias Corrected Confidence Intervals

	Lower	Upper

TOTAL	.0277	.1633

Intentio	.0277	.1633

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

4a) Busy effect on Nonadherence mediated by Unintentional

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = Busy

MEDS = Unintent

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
Unintent	.3162	.0583	5.4261	.0000

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Unintent	.3031	.0612	4.9514	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p
Busy	.1635	.0606	2.6983	.0074

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
Busy	.0677	.0612	1.1052	.2701

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.1094	.1027	16.2218	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	.0959	.0963	.0005	.0305
Unintent	.0959	.0963	.0005	.0305

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	.0462	.1653
Unintent	.0462	.1653

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

4b) Busy effect on Nonadherence mediated by Intentional

```
*****
Preacher and Hayes (2008) SPSS Macro for Multiple Mediation
Written by Andrew F. Hayes, The Ohio State University
http://www.comm.ohio-state.edu/ahayes/
For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic
and resampling strategies for assessing and comparing indirect effects
in multiple mediator models. Behavior Research Methods, 40, 879-891.
*****

Dependent, Independent, and Proposed Mediator Variables:
DV = Nonadher
IV = Busy
MEDS = Intention
Sample size
267
IV to Mediators (a paths)
      Coeff    se    t    p
Intention .1253 .0609 2.0563 .0407
Direct Effects of Mediators on DV (b paths)
      Coeff    se    t    p
Intention .2172 .0597 3.6374 .0003

Total Effect of IV on DV (c path)
      Coeff    se    t    p
Busy .1635 .0606 2.6983 .0074
Direct Effect of IV on DV (c' path)
      Coeff    se    t    p
Busy .1363 .0597 2.2822 .0233
Model Summary for DV Model
      R-sq Adj R-sq    F    df1    df2    p
.0732 .0662 10.4237 2.0000 264.0000 .0000
*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS
Indirect Effects of IV on DV through Proposed Mediators (ab paths)
      Data    Boot    Bias    SE
TOTAL .0272 .0259 -.0013 .0157
Intention .0272 .0259 -.0013 .0157
Bias Corrected Confidence Intervals
      Lower    Upper
TOTAL .0036 .0698
Intention .0036 .0698
*****

Level of Confidence for Confidence Intervals:
95
Number of Bootstrap Resamples:
5000
***** NOTES *****
----- END MATRIX -----
```

5a) Knowledge effect on Nonadherence mediated by Unintentional

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = Knowledg

MEDS = Unintent

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
Unintent	-.1555	.0607	-2.5617	.0110

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Unintent	.3232	.0589	5.4847	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p
Knowledg	-.0588	.0613	-.9583	.3388

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
Knowledg	-.0085	.0589	-.1446	.8851

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.1054	.0986	15.5508	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	-.0502	-.0503	.0000	.0248
Unintent	-.0502	-.0503	.0000	.0248

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.1088	-.0095
Unintent	-.1088	-.0095

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

5b) Knowledge effect on Nonadherence mediated by Intentional

```

*****
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For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic
and resampling strategies for assessing and comparing indirect effects
in multiple mediator models. Behavior Research Methods, 40, 879-891.
*****

Dependent, Independent, and Proposed Mediator Variables:
DV = Nonadher
IV = Knowledg
MEDS = Intentionio
Sample size
    267
IV to Mediators (a paths)
      Coeff    se    t    p
Intentionio  .0068  .0614  .1108  .9119

Direct Effects of Mediators on DV (b paths)
      Coeff    se    t    p
Intentionio  .2347  .0597  3.9305  .0001
Total Effect of IV on DV (c path)
      Coeff    se    t    p
Knowledg    -.0588  .0613  -.9583  .3388
Direct Effect of IV on DV (c' path)
      Coeff    se    t    p
Knowledg    -.0604  .0597  -1.0108  .3130
Model Summary for DV Model
      R-sq Adj R-sq    F    df1    df2    p
      .0585  .0514  8.2086  2.0000  264.0000  .0003

*****
BOOTSTRAP RESULTS FOR INDIRECT EFFECTS
Indirect Effects of IV on DV through Proposed Mediators (ab paths)
      Data    Boot    Bias    SE
TOTAL    .0016  .0014  -.0002  .0164
Intentionio  .0016  .0014  -.0002  .0164
Bias Corrected Confidence Intervals
      Lower    Upper
TOTAL    -.0314  .0353
Intentionio  -.0314  .0353
*****
Level of Confidence for Confidence Intervals:
    95
Number of Bootstrap Resamples:
    5000
***** NOTES *****
----- END MATRIX -----

```

6a) Unintentional effect on Nonadherence mediated by Intentional

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = Unintent

MEDS = Intentio

Sample size 267

IV to Mediators (a paths)

	Coeff	se	t	p
Intentio	.3942	.0565	6.9833	.0000

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Intentio	.1259	.0629	2.0033	.0462

Total Effect of IV on DV (c path)

	Coeff	se	t	p
Unintent	.3245	.0581	5.5853	.0000

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
Unintent	.2749	.0629	4.3723	.0000

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.1187	.1120	17.7819	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	.0497	.0490	-.0006	.0306
Intentio	.0497	.0490	-.0006	.0306

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.0058	.1164
Intentio	-.0058	.1164

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

6b) Intentional effect on Nonadherence mediated by Unintentional

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = Intentio

MEDS = Unintent

Sample size 267

IV to Mediators (a paths)

	Coeff	se	t	p
Unintent	.3942	.0565	6.9833	.0000

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Unintent	.2749	.0629	4.3723	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p
Intentio	.2343	.0597	3.9236	.0001

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
Intentio	.1259	.0629	2.0033	.0462

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.1187	.1120	17.7819	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	.1084	.1093	.0010	.0351
Unintent	.1084	.1093	.0010	.0351

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	.0507	.1903
Unintent	.0507	.1903

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

7a) Trust in Medicine effect on Nonadherence mediated by Intentional

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = TrustInM

MEDS = Intention

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
Intention	-.5068	.0530	-9.5694	.0000

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Intention	.1573	.0688	2.2873	.0230

Total Effect of IV on DV (c path)

	Coeff	se	t	p
TrustInM	-.2317	.0598	-3.8771	.0001

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
TrustInM	-.1520	.0688	-2.2098	.0280

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.0721	.0650	10.2516	2.0000	264.0000	.0001

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	-.0797	-.0801	-.0004	.0410
Intention	-.0797	-.0801	-.0004	.0410

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.1674	-.0058
Intention	-.1674	-.0058

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

7b) Trust in Medicine effect on Nonadherence mediated by Unintentional

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = TrustInM

MEDS = Unintent

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
Unintent	-.3822	.0568	-6.7322	.0000

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Unintent	.2764	.0625	4.4205	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p
TrustInM	-.2317	.0598	-3.8771	.0001

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
TrustInM	-.1261	.0625	-2.0166	.0447

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.1189	.1122	17.8119	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	-.1056	-.1062	-.0006	.0325
Unintent	-.1056	-.1062	-.0006	.0325

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.1774	-.0492
Unintent	-.1774	-.0492

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

8a) Trust in Doctor effect on Nonadherence mediated by Intentional

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = TrustInD

MEDS = Intention

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
Intention	-.2886	.0588	-4.9066	.0000

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Intention	.2140	.0623	3.4321	.0007

Total Effect of IV on DV (c path)

	Coeff	se	t	p
TrustInD	-.1323	.0609	-2.1723	.0307

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
TrustInD	-.0705	.0623	-1.1313	.2590

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.0595	.0523	8.3452	2.0000	264.0000	.0003

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	-.0617	-.0618	.0000	.0248
Intention	-.0617	-.0618	.0000	.0248

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.1244	-.0237
Intention	-.1244	-.0237

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

8b) Trust in Doctor effect on Nonadherence by Unintentional

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = TrustInD

MEDS = Unintent

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
Unintent	-.2876	.0588	-4.8884	.0000

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Unintent	.3123	.0607	5.1432	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p
TrustInD	-.1323	.0609	-2.1723	.0307

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
TrustInD	-.0424	.0607	-.6989	.4852

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.1070	.1002	15.8121	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	-.0898	-.0908	-.0009	.0299
Unintent	-.0898	-.0908	-.0009	.0299

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.1609	-.0423
Unintent	-.1609	-.0423

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

9a) Prospective Memory effect on Nonadherence by Intentional

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = Prospect

MEDS = Intentio

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
Intentio	-.1891	.0603	-3.1352	.0019

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Intentio	.2049	.0602	3.4049	.0008

Total Effect of IV on DV (c path)

	Coeff	se	t	p
Prospect	-.1943	.0603	-3.2247	.0014

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
Prospect	-.1556	.0602	-2.5853	.0103

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.0782	.0713	11.2041	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	-.0387	-.0389	-.0001	.0193
Intentio	-.0387	-.0389	-.0001	.0193

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.0878	-.0105
Intentio	-.0878	-.0105

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

9b) Prospective Memory effect on Nonadherence by Unintentional

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = Prospect

MEDS = Unintent

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
Unintent	-.4628	.0545	-8.4992	.0000

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Unintent	.2985	.0656	4.5524	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p
Prospect	-.1943	.0603	-3.2247	.0014

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
Prospect	-.0561	.0656	-.8561	.3927

Model Summary for DV Model

	R-sq	Adj R-sq	F	df1	df2	p
	.1078	.1010	15.9487	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	-.1382	-.1386	-.0005	.0370
Unintent	-.1382	-.1386	-.0005	.0370

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.2203	-.0730
Unintent	-.2203	-.0730

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

10a) Ability effect on Nonadherence by Intentional

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = Ability_

MEDS = Intention

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
Intention	-.1780	.0604	-2.9451	.0035

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Intention	.2177	.0605	3.5968	.0004

Total Effect of IV on DV (c path)

	Coeff	se	t	p
Ability_	-.1319	.0609	-2.1666	.0312

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
Ability_	-.0932	.0605	-1.5392	.1250

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.0633	.0562	8.9214	2.0000	264.0000	.0002

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	-.0388	-.0395	-.0008	.0197
Intention	-.0388	-.0395	-.0008	.0197

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.0915	-.0111
Intention	-.0915	-.0111

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

10b) Ability effect on Nonadherence by Unintentional

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = Ability_

MEDS = Unintent

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
Unintent	-.3175	.0583	-5.4500	.0000

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Unintent	.3143	.0614	5.1228	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p
Ability_	-.1319	.0609	-2.1666	.0312

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
Ability_	-.0321	.0614	-.5238	.6009

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.1063	.0995	15.6924	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	-.0998	-.0998	.0000	.0305
Unintent	-.0998	-.0998	.0000	.0305

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.1727	-.0507
Unintent	-.1727	-.0507

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

11a) Social Support effect on Nonadherence by Intentional

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = SocialSu

MEDS = Intentio

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
Intentio	.0112	.1452	.0769	.9388

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Intentio	.2341	.0598	3.9165	.0001

Total Effect of IV on DV (c path)

	Coeff	se	t	p
SocialSu	.1040	.1451	.7168	.4741

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
SocialSu	.1014	.1413	.7174	.4737

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.0567	.0496	7.9404	2.0000	264.0000	.0004

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	.0026	.0028	.0002	.0317
Intentio	.0026	.0028	.0002	.0317

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.0604	.0699
Intentio	-.0604	.0699

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

12b) Social Support effect on Nonadherence by Unintentional

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Nonadher

IV = SocialSu

MEDS = Unintent

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p

Unintent	.3554	.1436	2.4757	.0139

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p

Unintent	.3253	.0589	5.5240	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p

SocialSu	.1040	.1451	.7168	.4741

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p

SocialSu	-.0116	.1392	-.0835	.9335

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p

.1053	.0986	15.5430	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE

TOTAL	.1156	.1157	.0001	.0553

Unintent	.1156	.1157	.0001	.0553

Bias Corrected Confidence Intervals

	Lower	Upper

TOTAL	.0251	.2433

Unintent	.0251	.2433

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

13) Age effect on Unintentional mediated by Prospective Memory

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Unintent

IV = Age

MEDS = Prospect

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p

Prospect	-.1396	.0578	-2.4164	.0164

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p

Prospect	.4413	.0544	8.1103	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p

Age	-.2009	.0571	-3.5192	.0005

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p

Age	-.1393	.0517	-2.6924	.0075

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p

.2352	.2294	40.5943	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE

TOTAL	-.0616	-.0619	-.0003	.0283

Prospect	-.0616	-.0619	-.0003	.0283

Bias Corrected Confidence Intervals

	Lower	Upper

TOTAL	-.1241	-.0117

Prospect	-.1241	-.0117

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

14) Age effect on Unintentional mediated by Busyness

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Unintent

IV = Age

MEDS = Busy

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p

Busy	-.4501	.0515	-8.7473	.0000

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p

Busy	.2786	.0661	4.2151	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p

Age	-.2009	.0571	-3.5192	.0005

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p

Age	-.0755	.0629	-1.2014	.2307

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.1049	.0981	15.4676	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE

TOTAL	-.1254	-.1250	.0004	.0345

Busy	-.1254	-.1250	.0004	.0345

Bias Corrected Confidence Intervals

	Lower	Upper

TOTAL	-.2004	-.0647

Busy	-.2004	-.0647

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

15) Age effect on Unintentional mediated by Ability

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Unintent

IV = Age

MEDS = Ability_

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p

Ability_	-.0093	.0584	-.1596	.8733

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p

Ability_	-.3196	.0569	-5.6211	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p

Age	-.2009	.0571	-3.5192	.0005

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p

Age	-.2039	.0541	-3.7717	.0002

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p

.1468	.1403	22.7057	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE

TOTAL	.0030	.0032	.0003	.0181

Ability_	.0030	.0032	.0003	.0181

Bias Corrected Confidence Intervals

	Lower	Upper

TOTAL	-.0322	.0402

Ability_	-.0322	.0402

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

16) Trust in Medicine effect on Intentional mediated by Attitude (Hassle)

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Intentio

IV = TrustInM

MEDS = Hassle

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
Hassle	-.3843	.0567	-6.7758	.0000

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Hassle	.2704	.0550	4.9161	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p
TrustInM	-.5068	.0530	-9.5694	.0000

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
TrustInM	-.4029	.0550	-7.3236	.0000

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.3191	.3140	61.8732	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	-.1039	-.1038	.0001	.0329
Hassle	-.1039	-.1038	.0001	.0329

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.1788	-.0487
Hassle	-.1788	-.0487

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

17) Trust in Doctor effect on Intentional mediated by Attitude (Hassle)

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Intentio

IV = TrustInD

MEDS = Hassle

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p

Hassle	-.2579	.0594	-4.3449	.0000

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p

Hassle	.3758	.0564	6.6590	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p

TrustInD	-.2886	.0588	-4.9066	.0000

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p

TrustInD	-.1917	.0564	-3.3965	.0008

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p

.2151	.2092	36.1775	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE

TOTAL	-.0969	-.0973	-.0004	.0289

Hassle	-.0969	-.0973	-.0004	.0289

Bias Corrected Confidence Intervals

	Lower	Upper

TOTAL	-.1646	-.0504

Hassle	-.1646	-.0504

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

18) Knowledge effect on Intentional mediated by Attitude (Hassle)

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Intentional

IV = Knowledge

MEDS = Hassle

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p

Hassle	-.1041	.0611	-1.7040	.0896

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p

Hassle	.4306	.0559	7.7006	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p

Knowledge	.0068	.0614	.1108	.9119

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p

Knowledge	.0516	.0559	.9234	.3566

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p

.1835	.1773	29.6568	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE

TOTAL	-.0448	-.0447	.0001	.0327

Hassle	-.0448	-.0447	.0001	.0327

Bias Corrected Confidence Intervals

	Lower	Upper

TOTAL	-.1209	.0099

Hassle	-.1209	.0099

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

19) Age effect on Attitude (Hassle) mediated by Trust in Medicine

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Hassle

IV = Age

MEDS = TrustInM

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
TrustInM	.1837	.0573	3.2058	.0015

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
TrustInM	-.3384	.0560	-6.0390	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p
Age	-.2878	.0557	-5.1701	.0000

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
Age	-.2256	.0533	-4.2346	.0000

Model Summary for DV Model

	R-sq	Adj R-sq	F	df1	df2	p
	.2019	.1958	33.3887	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	-.0622	-.0616	.0006	.0217
TrustInM	-.0622	-.0616	.0006	.0217

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.1124	-.0253
TrustInM	-.1124	-.0253

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

20) Age effect on Attitude (Hassle) mediated by Trust in Doctor

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Hassle

IV = Age

MEDS = TrustInD

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
TrustInD	.1375	.0578	2.3799	.0180

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
TrustInD	-.2187	.0577	-3.7875	.0002

Total Effect of IV on DV (c path)

	Coeff	se	t	p
Age	-.2878	.0557	-5.1701	.0000

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
Age	-.2577	.0549	-4.6950	.0000

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.1384	.1319	21.2106	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	-.0301	-.0298	.0003	.0149
TrustInD	-.0301	-.0298	.0003	.0149

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.0694	-.0083
TrustInD	-.0694	-.0083

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

21) Age effect on Attitude (Hassle) mediated by Knowledge

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Hassle

IV = Age

MEDS = Knowledg

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
Knowledg	-.1423	.0578	-2.4633	.0144

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Knowledg	-.1528	.0586	-2.6088	.0096

Total Effect of IV on DV (c path)

	Coeff	se	t	p
Age	-.2878	.0557	-5.1701	.0000

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
Age	-.3096	.0557	-5.5579	.0000

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.1145	.1077	17.0608	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	.0217	.0217	.0000	.0140
Knowledg	.0217	.0217	.0000	.0140

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	.0027	.0620
Knowledg	.0027	.0620

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX ---

22) Age effect on Intentional mediated by Trust in Medicine

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Intentio

IV = Age

MEDS = TrustInM

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
TrustInM	.1837	.0573	3.2058	.0015

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
TrustInM	-.4823	.0535	-9.0134	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p
Age	-.2088	.0570	-3.6646	.0003

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
Age	-.1202	.0509	-2.3624	.0189

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.2722	.2667	49.3682	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	-.0886	-.0884	.0002	.0299
TrustInM	-.0886	-.0884	.0002	.0299

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.1490	-.0315
TrustInM	-.1490	-.0315

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

23) Age effect on Intentional mediated by Trust in Doctor

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Intentio

IV = Age

MEDS = TrustInD

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
TrustInD	.1375	.0578	2.3799	.0180

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
TrustInD	-.2623	.0585	-4.4843	.0000

Total Effect of IV on DV (c path)

	Coeff	se	t	p
Age	-.2088	.0570	-3.6646	.0003

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
Age	-.1727	.0556	-3.1058	.0021

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.1156	.1089	17.2534	2.0000	264.0000	.0000

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	-.0361	-.0358	.0003	.0168
TrustInD	-.0361	-.0358	.0003	.0168

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.0771	-.0099
TrustInD	-.0771	-.0099

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

24) Age effect on Intentional mediated by Knowledge

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Intentio

IV = Age

MEDS = Knowledg

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
Knowledg	-.1423	.0578	-2.4633	.0144

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Knowledg	-.0266	.0607	-.4390	.6610

Total Effect of IV on DV (c path)

	Coeff	se	t	p
Age	-.2088	.0570	-3.6646	.0003

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
Age	-.2126	.0577	-3.6835	.0003

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.0489	.0417	6.7905	2.0000	264.0000	.0013

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	.0038	.0035	-.0003	.0105
Knowledg	.0038	.0035	-.0003	.0105

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.0124	.0319
Knowledg	-.0124	.0319

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

25) Age effect on Unintentional mediated by Social Support

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Unintent

IV = Age

MEDS = SocialSu

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
SocialSu	-.0034	.0247	-.1393	.8893

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
SocialSu	.3512	.1406	2.4984	.0131

Total Effect of IV on DV (c path)

	Coeff	se	t	p
Age	-.2009	.0571	-3.5192	.0005

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
Age	-.1997	.0565	-3.5323	.0005

Model Summary for DV Model

R-sq	Adj R-sq	F	df1	df2	p
.0667	.0596	9.4359	2.0000	264.0000	.0001

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	-.0012	-.0017	-.0005	.0100
SocialSu	-.0012	-.0017	-.0005	.0100

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.0246	.0182
SocialSu	-.0246	.0182

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----

26) Age effect on Unintentional mediated by External Cue

Run MATRIX procedure:

*****

Preacher and Hayes (2008) SPSS Macro for Multiple Mediation

Written by Andrew F. Hayes, The Ohio State University

<http://www.comm.ohio-state.edu/ahayes/>

For details, see Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior Research Methods, 40, 879-891.

*****

Dependent, Independent, and Proposed Mediator Variables:

DV = Unintent

IV = Age

MEDS = Pillbox

Sample size

267

IV to Mediators (a paths)

	Coeff	se	t	p
Pillbox	.0338	.0288	1.1729	.2419

Direct Effects of Mediators on DV (b paths)

	Coeff	se	t	p
Pillbox	.1763	.1215	1.4507	.1480

Total Effect of IV on DV (c path)

	Coeff	se	t	p
Age	-.2009	.0571	-3.5192	.0005

Direct Effect of IV on DV (c' path)

	Coeff	se	t	p
Age	-.2069	.0571	-3.6217	.0004

Model Summary for DV Model

	R-sq	Adj R-sq	F	df1	df2	p
	.0522	.0450	7.2705	2.0000	264.0000	.0008

*****

BOOTSTRAP RESULTS FOR INDIRECT EFFECTS

Indirect Effects of IV on DV through Proposed Mediators (ab paths)

	Data	Boot	Bias	SE
TOTAL	.0060	.0060	.0000	.0076
Pillbox	.0060	.0060	.0000	.0076

Bias Corrected Confidence Intervals

	Lower	Upper
TOTAL	-.0026	.0322
Pillbox	-.0026	.0322

*****

Level of Confidence for Confidence Intervals:

95

Number of Bootstrap Resamples:

5000

***** NOTES *****

----- END MATRIX -----