

INVESTIGATING PERSONALITY FACTORS IN PATIENTS WITH ASTHMA

APPROVED BY SUPERVISORY COMMITTEE

First Name Last Name, Credentials

DEDICATION

I would like to express my sincere thanks to the members of my committee for lending me their time and expertise throughout this project. They pushed me to persevere, seek autonomy, consider alternate perspectives, and had a positive impact on my development as a student and professional. I would specifically like to express my gratitude for my committee chair for introducing me to the world of asthma research. I owe a special thanks to my statistician, Jayme Palka, for guiding me through complicated statistical processes, providing unwavering moral support, and being a bright light in the dark. I would also like to acknowledge the encouragement and support of my family and friends during this process.

INVESTIGATING PERSONALITY FACTORS IN PATIENTS WITH ASTHMA

by

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DISSERTATION

Presented to the Faculty of the Graduate School of Biomedical Sciences

The University of Texas Southwestern Medical Center at Dallas

In Partial Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

The University of Texas Southwestern Medical Center at Dallas

Dallas, Texas

August, 2020

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Publication No. _____

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The University of Texas Southwestern Medical Center at Dallas, 2020

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Traits defined by the Five-Factor Model (FFM) of personality have been linked to physical health, leading to treatment implications and psychophysiological conceptualizations. Previous studies have reported a consistent association between neuroticism and asthma. This study aims to reinforce this finding and further its scope by looking at all five personality traits and lifetime asthma diagnosis. The current study examined associations between personality traits and lifetime asthma diagnosis in a sample of 3,993 participants and, for the purposes of replication, a second sample of

1,692 participant siblings. Personality was measured at a single time point in adulthood (mean age: 53 years), while asthma diagnosis by a medical professional was self-reported across three time points over a range of 54 years. A binary logistic regression was performed to examine the association between FFM personality traits and the likelihood of having endorsed asthma at any time point. Higher scores in the traits of neuroticism ($\beta = 0.024, p = .03, OR = 1.025$) and openness ($\beta = 0.041, p < .001, OR = 1.042$) were associated with increased risk of lifetime asthma diagnosis, while the trait of conscientiousness ($\beta = -0.034, p = .009, OR = 0.967$) was associated with decreased risk of lifetime asthma diagnosis. The associations with neuroticism and openness were replicated in the sibling sample. These findings suggest that research into certain personality traits might help us better understand psychophysiological connections. Neuroticism, openness, and conscientiousness might be salient factors in developing asthma education and treatment.

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LIST OF ABBREVIATIONS

ALA: American Lung Association

BFI-54: 54-item Big Five Inventory

BMI: Body Mass Index

CAPI: Computer-Assisted Personal Interviewing

CATI: Computer-Assisted Telephone Interviewing

CDC: Centers for Disease Control and Prevention

CI: Confidence Interval

COPD: Chronic Obstructive Pulmonary Disease

FFM: Five Factor Model

GIA: Global Initiative for Asthma

NHLBI: National Heart Lung and Blood Institute

NIH: National Institutes of Health

SAQ: Self-Administered Questionnaire

SD: Standard Deviation

SPSS: Statistical Package for the Social Sciences

WHO: World Health Organization

WLS: Wisconsin Longitudinal Study

SECTION ONE

Journal Ready Manuscript

1.0 INTRODUCTION

The prevalence of asthma has been rising in most parts of the world since the second half of the 20th century (Eder, Ege, & Von Mutius, 2006). Asthma affects more than 25.9 million people in the United States (Centers for Disease Control and Prevention, n.d.) and was cited as the primary cause of death for 383,000 individuals worldwide in 2015 (World Health Organization, 2017). Despite its high incidence and prevalence, the fundamental causes of asthma remain unknown (World Health Organization, 2017).

Prior research has linked personality traits to physical health, including longevity and the occurrence and course of cardiovascular disease (T. W. Smith & MacKenzie, 2006). The development of the fields of behavioral medicine and health psychology imply that the link between psychological factors and physical health need to be addressed (T. W. Smith & MacKenzie, 2006).

While several models to describe personality characteristics have been introduced and defended over the years, the Five-Factor Model (FFM) has remained the most widely accepted (Peabody & De Raad, 2002). The FFM of personality was developed to help categorize patterns of human behavior into universal, measurable traits that remain stable over time (McCrae & Costa, 2003). These five traits are defined as agreeableness, conscientiousness, extraversion, neuroticism, and openness.

Agreeableness is exemplified by individuals who are friendly, cooperative, and compassionate. Conscientiousness is demonstrated in individuals who are organized, methodical, and thorough. Individuals high in extraversion are defined as being talkative, energetic and assertive. Neuroticism, sometimes also referred to as “emotional instability”, is modeled by individuals who experience a high degree of negative affect. Openness is exemplified by individuals who seek out novel experiences and enjoy learning new skills.

Prior research suggests personality characteristics can be predictors of health behaviors, such as smoking and activity level, and can even lead to the development of chronic illness (Bogg & Roberts, 2004; Munafo, Zetteler, & Clark, 2007). Specifically, a 2004 meta-analysis by Bogg and Roberts found that conscientious traits were positively related to beneficial health behaviors and negatively related to risky health behaviors. There is evidence that individuals with a combination of low conscientiousness and high neuroticism are more vulnerable to poor health outcomes, such as chronic illness and lower subjective physical health ratings (Goodwin & Friedman, 2006; Löckenhoff, Sutin, Ferrucci, & Costa Jr, 2008). The association between high neuroticism, low conscientiousness, and poor health outcomes might be partially explained by engagement in risky health behaviors: these individuals are more likely to smoke, eat impulsively, and maintain an elevated Body Mass Index (BMI) (Terracciano, Löckenhoff, Crum, Bienvenu, & Costa, 2008; Terracciano et al., 2009). A 2015 meta-analysis of personality and physical activity found that conscientiousness, openness, and extraversion were positively correlated with physical activity, while

neuroticism was negatively correlated with physical activity (Wilson & Dishman, 2015). Additionally, high neuroticism and low extraversion, openness, agreeableness, and conscientiousness were associated with poorer lung function, and higher likelihood of chronic obstructive pulmonary disease (Terracciano et al., 2016).

BMI and health behaviors, such as smoking and physical activity, have been associated with asthma diagnosis and symptom severity. A 2012 meta-analysis found physical activity to be a possible protective factor against asthma development (Eijkemans, Mommers, Jos, Thijs, & Prins, 2012). Obesity (as measured by BMI) is linked with a higher risk for developing adult-onset asthma and worse asthma-specific quality of life (Nystad, Meyer, Nafstad, Tverdal, & Engeland, 2004; Vortmann & Eisner, 2008). The risk of developing asthma is significantly higher among current smokers, and active cigarette use has been shown to cause more severe asthma symptoms in those already diagnosed (Piipari, Jaakkola, Jaakkola, & Jaakkola, 2004; Thomson, Chaudhuri, & Livingston, 2004)

Treatment adherence is another important health behavior to consider in the study of asthma. In patients with asthma, low rates of adherence to preventative medications are associated with higher rates of hospitalization and death (Horne, 2006). Despite these risks, encouraging medication-compliance in patients with asthma has long been a challenge for providers, with adherence rates often falling below 50% (Bender & Rand, 2004; Gillissen, 2007; Rand & Wise, 1994). Previous research suggested that impulsivity (the opposite pole of conscientiousness) is negatively correlated with medication adherence in asthmatic patients (Axelsson et al., 2009).

Neuroticism has also been linked to worse patient adherence to prescribed medical regimens (Brickman, Yount, Blaney, Rothberg, & De-Nour, 1996; Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002).

Previous studies have theorized that physiological stress response is involved in the etiology of asthma through the influence of inflammation (Chen & Miller, 2007; A. Loerbroks, J. Li, J. A. Bosch, R. M. Herr, & P. Angerer, 2015b; Rod, Kristensen, Lange, Prescott, & Diderichsen, 2012). Stress exacerbates airway inflammatory response to irritants, allergens, and infections, thereby increasing the frequency, duration, and severity of asthma symptoms (Chen & Miller, 2007). Personality influences the way psychological stress is processed (Carver & Connor-Smith, 2010; T. W. Smith & MacKenzie, 2006; Swickert, Rosentreter, Hittner, & Mushrush, 2002). A 2010 meta-analysis linked optimism, extraversion, conscientiousness, and openness to more engagement coping; neuroticism to more disengagement coping; and optimism, conscientiousness, and agreeableness to less disengagement coping (Carver & Connor-Smith, 2010), indicating that strategies of handling stress could be related to personality traits.

Stress and health behaviors are implicated in the etiology of asthma (Loerbroks, Gadinger, Bosch, Sturmer, & Amelang, 2010; Rod et al., 2012; Subbarao, Mandhane, & Sears, 2009). Therefore, specific personality traits might be associated with asthma through the shared influence of health behaviors and stress response.

Previous studies have shown some evidence of a link between FFM personality traits and asthma. Huovinen, Kaprio, and Koskenvuo (2001) investigated only

neuroticism and extraversion in association with asthma, finding that while high neuroticism scores were associated with prevalent asthma, they were not predictive of future asthma diagnosis. These researchers further found that high extraversion scores were predictive of future asthma diagnosis only in women (Huovinen, Kaprio, & Koskenvuo, 2001). Another study, looking only at neuroticism and extraversion, found that neuroticism but not extraversion was predictive of asthma (Loerbroks, Apfelbacher, Thayer, Debling, & Sturmer, 2009). Goodwin & Friedman (2006) found that neuroticism scores were significantly higher in participants with asthma. A study examining all five personality traits found that only neuroticism was predictive of new asthma diagnosis over a two-year period (Loerbroks et al., 2015b). Yet another study found that participants with asthma scored significantly different from a healthy control group in all personality traits, with asthma being related to higher scores in neuroticism and lower scores in all other traits (Fernandes et al., 2005). These studies seem to indicate that only neuroticism has been consistently associated with asthma. This study aims to reinforce the link between neuroticism and asthma while also exploring associations with the other four personality traits.

2.0 METHODS

2.1 Sample

The present study is a secondary analysis of the Wisconsin Longitudinal Study (WLS). WLS is a publicly available, de-identified dataset collected by researchers at the University of Wisconsin-Madison (Hauser, Sewell, & Herd, 1957-2019; Herd, Carr, & Roan, 2014). The study followed a random sample of 10,317 men and women who

graduated from Wisconsin high schools in 1957 over the course of 54 years. The original survey was funded by state-government to assess the state of Wisconsin's ability to provide adequate resources to students who endorsed a desire to attend college. Data were collected from the graduate respondents in 1957 (in school), 1975 (phone), 1992 (phone and mail), 2004 (phone and mail) and 2011 (phone and mail). At each time point, surviving WLS respondents who had at least responded to the 1975 (graduate) or 1993 (sibling) survey were asked to participate by means of telephone and consented for research. WLS graduates were also mailed a paper mail-back survey.

A random one-third sample was chosen from a pool of Wisconsin high school graduates to participate in the WLS study. In 1977 the WLS researchers expanded their study by adding a 1/3 random sample of one randomly chosen sibling for each graduate with a sibling, except when the graduate was a twin, in which case the twin was selected. Roughly 2000 siblings were interviewed in 1977 (phone), and the full sibling sample was implemented in 1993. The full sibling sample includes one randomly selected sibling per graduate with a sibling, except in the cases where a graduate or sibling had previously declined participation. The WLS sample is broadly representative of a middle aged, white population of the American Midwest. When personality was first measured in 1992, a majority of the participants were 53 years old and more than two-thirds of the participants still lived in Wisconsin (both graduate and sibling cohorts). Additionally, in 1992, respondents had received an average of 13 years of education and over 80% were currently married. Average reported household income

among the graduates in 1992 was \$45,565. When race was measured in 2004, less than 1% of the respondents classified themselves as non-white.

2.2 Measures

2.2.1 Demographic Information

In 1992, participants provided demographic information, including sex, education level (measured in years), household income (graduate sample only), marital status, smoking habits (i.e., “Have you ever smoked regularly in the past?” and “Do you smoke regularly currently?”), BMI, and average level of physical exercise. Physical exercise was measured as a categorical variable, with options for “ ≥ 3 times per week,” “1 or 2 times per week,” “1 to 3 times per month,” and “ < 1 time per month.” Finally, minorities are not well-represented in the WLS; in 2004 less than 1% of the respondents classified themselves as non-white. As such, ethnicity is not included as a factor in the present study.

2.2.2 Big Five Factors of Personality

Personality was assessed via a paper survey sent to participants through the mail in 1992 (i.e., time point 3) using a subset of the 54-item Big Five Inventory (BFI-54) (McCrae & Costa, 2003). Personality was also measured at two later time points, however only the first assessment (time point 3) was used for the present study as personality traits have been found to remain stable over time (McCrae & Costa, 1987). The subset of the BFI-54 represents a FFM of personality, consisting of 29 items. The FFM of personality has been well validated in the literature across instruments and observers (McCrae & Costa, 1987). The five factors include: extraversion (six items),

agreeableness, (six items), conscientiousness (six items), neuroticism (five items), and openness (six items). Participants were asked to rate whether or not certain personality descriptions fitted themselves (ex: “To what extent do you see yourself as someone who has a forgiving nature?”). Items are measured on a six-point Likert scale ranging from 1 (agree strongly) to 6 (disagree strongly) and were reversed scored where appropriate. Subscale total scores were calculated by summing individual item responses. As such, extraversion, agreeableness, conscientiousness, and openness scores can range from 1 to 36, while neuroticism scores range from 1 to 30. The traits are measured on continuums such that a higher extraversion score is more likely to indicate extroverted personality traits and a lower extraversion score indicates tendencies on the opposite pole of the trait (i.e. introversion). WLS researchers performed mean imputation (within each subscale) on missing item scores so long as the participant had a valid response to three or more subscale items. In the case of insufficient valid item responses, mean imputation was not performed and the score was left as missing. After accounting for the aforementioned mean imputation, there were $n = 4018$ valid responses for extraversion, $n = 4032$ for agreeableness, $n = 4032$ for conscientiousness, $n = 4008$ for neuroticism, and $n = 4010$ for openness in the graduate sample. In the sibling sample, there were $n = 2003$ valid responses for extraversion, agreeableness, conscientiousness, and neuroticism and $n = 2000$ valid responses for openness. As such, missingness on the personality subscales for the sample used in the present study was no greater than 2% and deemed negligible (Schafer, 1999).

2.2.3 Lifetime Asthma Diagnosis.

Asthma was assessed using a self-report questionnaire during 1992, 2003, and 2011 (i.e., time points 3, 4, and 5, respectively). Participants were asked to respond to the question, “Has a medical professional ever said you have asthma?” by marking either yes or no on a paper survey form. The responses were coded as either 0 = no asthma diagnosis or 1 = asthma diagnosis. In 1992, 6875 of WLS participants (67%) answered this question. In 2003, 6655 participants (65%) answered and in 2011, 5047 participants (49%) answered. The present study uses a subsample of the WLS data that includes only those participants who answered the asthma diagnosis question on at least one occasion ($n = 4,082$ for the graduate sample and $n = 2029$ for the sibling sample). An additional binary variable was created to capture whether the participant responded with “yes” during any of the three time points (0 = no at all three time points, 1 = yes at one or more time points) and is referred to as lifetime asthma diagnosis.

2.3 Inclusion Criteria

To be included in the present study, participants had to respond to the question on asthma diagnosis during one or more of the three time points when it was assessed. Additionally, participants had to respond to three or more of the component items for each BFI subscale for a personality trait score to be created and included in the analysis

2.4 Statistical Analysis

The present research includes two parallel studies. The analytic sample for study 1 includes only the WLS graduate participants ($n = 4082$) and was conducted to elucidate the effects of personality traits on the likelihood of being diagnosed with asthma. The analytic sample for study 2 contains only siblings of the original WLS

graduate sample ($n = 2029$). The analysis of the study 2 sample was conducted using the same model as was analyzed in study 1 and was done to determine whether study 1 findings could be replicated in the sibling sample.

In both study 1 and study 2, preliminary analyses included a series of independent samples *t*-tests and chi-squared tests to determine whether there were statistically significant differences between those with no lifetime asthma diagnosis and those with a lifetime asthma diagnosis on both the demographic and personality variables. For the primary analysis, a binary logistic regression analysis was performed to determine the predictive ability of the five personality traits on the likelihood of having been diagnosed with asthma (i.e., lifetime asthma diagnosis). Demographic variables (i.e., sex, education level, household income, marital status, past smoking habit, BMI, and physical exercise) were included in the analysis as covariates in study 1. Study 2 excluded household income as a covariate as siblings were not asked for this information in the 1992-1993 wave of data collection. Prior to conducting the analysis, continuous variables (i.e., BFI subscale scores, education level, household income, and BMI) were checked for the presence of outliers and multicollinearity among independent predictors. Both skew and kurtosis were within acceptable ranges for both analytic samples (a value of ± 2 for skewness and a value of ± 7 for kurtosis) (West, Finch, & Curran, 1995) and bivariate correlations indicated only small to moderate correlations among the independent variables. Additionally, continuous measures were standardized to a mean = 0 and standard deviation = 1 to aid in interpretation. Categorical variables (i.e., sex, marital status, past smoking habit, and physical

exercise) were dummy coded with the following reference categories: female (sex), married (marital status), “no” (past smoking habit), and “ ≥ 3 times per week” (physical exercise). All analyses were conducted using IBM SPSS Statistics version 25.0 (Armonk, NY: IBM Corp.) Results with $p < .05$ were deemed statistically significant.

3.0 RESULTS

3.1 Study 1: Graduate Sample

3.1.1 Descriptive Statistics

The study sample, as measured in 1992 (time-point 3), consisted of the $n = 4,082$ individuals who responded to the question on asthma diagnosis during one or more of the three time points when it was assessed. The mean age of the sample was 53.18 (SD = 0.61) and was nearly evenly distributed by sex (54.4% female). The average level of education was 13.5 years and approximately 85% of the sample reported being married.

The same demographic information was examined by lifetime asthma diagnosis. Approximately 12% of the sample had a lifetime asthma diagnosis, congruent with the 13.1% asthma prevalence rate for American men and women aged 35 to 65 (Centers for Disease Control and Prevention, 2017). Because the participants graduated high school in the same year, the mean age for both groups was 53 years. In those with no lifetime asthma diagnosis, males and females were nearly evenly distributed (52.9% female), while those in the lifetime asthma group were predominantly female (65.6%). This group difference was statistically significant ($\chi^2(1) = 28.15, p < .001$). In both groups, the average education level was 13.5 years with the

lifetime asthma group earning less income on average (\$43,000 compared to \$46,000). However, the difference in income was statistically non-significant. Additionally, the lifetime asthma group reported a statistically significantly higher rate of past smoking habits ($\chi^2(1) = 7.41, p = .006$). Both the asthma and non-asthma groups showed similar levels of the FFM traits, with higher scores on extraversion, agreeableness, conscientiousness, and openness compared to neuroticism. Complete demographic information, including group comparisons, is presented in Table 1.

3.1.2 Binary Logistic Regression

Table 2 presents results from the binary logistic regression in which the likelihood of a lifetime asthma diagnosis was predicted by five personality traits (i.e., extraversion, agreeableness, conscientiousness, neuroticism, and openness) while controlling for demographic covariates. After excluding cases with missing data on one or more variables included in the analysis (i.e., listwise deletion) a total of $n = 3,490$ participants remained and were included in the analysis. However, no single variable had more than 10% missing data suggesting that bias was likely not introduced into our sample due to missingness (Bennett, 2001). Omnibus results showed good model fit ($\chi^2(8) = 7.983, p = .435$, Nagelkerke $R^2 = .050$). Three personality traits were found to be statistically significant predictors of reported asthma diagnosis. An increase in the traits of neuroticism ($\beta = 0.149, p = .012, OR = 1.161$) and openness ($\beta = 0.194, p = .001, OR = 1.214$) were associated with an increased likelihood of asthma diagnosis. That is, for each one-standard deviation increase in neuroticism there is an associated 16.1% increase in the odds of having a lifetime asthma diagnosis. Similarly, for each

one-standard deviation increase in openness, the odds of having a lifetime asthma diagnosis increases by 21.4%. Conversely, the trait of conscientiousness was associated with a decreased likelihood of asthma diagnosis ($\beta = -0.131$, $p = .023$, OR = 0.877), such that for each one-standard deviation increase in conscientiousness, the odds of having a lifetime asthma diagnosis decreases by 12.3%. Finally, BMI ($\beta = 0.167$, $p = .001$, OR = 1.182), sex (male: $\beta = -0.735$, $p < .001$, OR = 0.480), and smoking history (yes: $\beta = 0.330$, $p = .003$, OR = 1.392) were statistically significant predictors of reported asthma diagnosis.

3.2 Study 2: Sibling Sample

3.2.1 Descriptive Statistics

The sibling sample, as measured in 1992 (time-point 3), consisted of the $n = 2029$ individuals who responded to the question on asthma diagnosis during one or more of the three time points when it was assessed. The mean age of the sample was 53.23 (SD = 7.40) and was nearly evenly distributed by sex (54.0% female). The average level of education was about 14 years and approximately 82% of the sample reported being married. The same demographic information was examined by lifetime asthma diagnosis. As was the case in the graduate sample, approximately 12% of the sibling sample had a lifetime asthma diagnosis. In those with no lifetime asthma diagnosis, males and females were nearly evenly distributed (52.9% female), while those in the lifetime asthma group were predominantly female (62.6%). This group difference was statistically significant ($\chi^2(1) = 7.797$, $p = .005$). Unlike the graduate sample, there was not a statistically significant difference in past smoking habits

between the two groups. Both the asthma and non-asthma groups showed similar levels of the FFM traits, with higher scores on extraversion, agreeableness, conscientiousness, and openness compared to neuroticism. However for both neuroticism and openness, the group difference was statistically significant [$t(2001) = -2.190, p = .029$ and $t(1998) = -3.130, p = .002$, respectively]. Complete demographic information for the sibling sample, including group comparisons, is presented in Table 3.

3.2.2 Binary Logistic Regression

Table 4 presents results from the binary logistic regression in which the likelihood of a lifetime asthma diagnosis in the sibling sample was predicted by five personality traits (i.e., extraversion, agreeableness, conscientiousness, neuroticism, and openness) while controlling for demographic covariates (not including household income). After listwise deletion, a total of $n = 1682$ participants remained and were included in the analysis. Omnibus results showed good model fit ($\chi^2(8) = 9.820, p = .278$, Nagelkerke $R^2 = .038$). Contrary to the results found in the original sample, only two personality traits were found to be statistically significant predictors of reported asthma diagnosis. An increase in the trait of openness ($\beta = 0.274, p = .003, OR = 1.315$) was associated with an increased likelihood of asthma diagnosis. That is, for each one-standard deviation increase in openness there is an associated 31.5% increase in the odds of having a lifetime asthma diagnosis. Additionally, an increase in the trait of neuroticism ($\beta = 0.192, p = .034, OR = 1.211$) was associated with an increased likelihood of asthma diagnosis such that a one-standard deviation increase in neuroticism was associated with a 21.1% increase in the odds of having a lifetime

asthma diagnosis. Finally, BMI ($\beta = 0.217$, $p = .005$, OR = 1.242) and sex (male: $\beta = -0.394$, $p = .023$, OR = 0.674) were statistically significant predictors of reported asthma diagnosis. Contrary to the findings in the graduate sample, smoking history was not a statistically significant predictor.

4.0 DISCUSSION

We used logistic regression to examine the relationship between personality scores and asthma diagnosis. The findings from the graduate sample appear to support our hypothesis that there is a connection between personality and asthma. This conclusion is further strengthened by the results in the sibling sample. In the graduate sample, for every additional one standard deviation increase on the neuroticism subscale the participant is 16% more likely to have received an asthma diagnosis over his or her lifetime. In the same fashion, every additional one standard deviation increase on the openness scale translates to 21.4% increased likelihood of lifetime asthma diagnosis, while a one standard deviation increase on the conscientiousness scale decreases the associated likelihood of lifetime asthma diagnosis by 12.3%. These results were partially replicated in the sibling sample. As with the graduate sample, neuroticism and openness were statistically significant predictors of lifetime asthma diagnosis. In the sibling sample, a one standard deviation increase in the neuroticism subscale translates to a 21.1% increased likelihood of lifetime asthma diagnosis. A one standard deviation decrease in the conscientiousness subscale translates to a 31.5% increase in likelihood of lifetime asthma diagnosis. However, in the sibling sample, conscientiousness was not

statistically significantly predictive of asthma. Although, the current study does not attempt to establish direct causal links these findings provide important clues for future research into the pathways that link personality and asthma. Specifically, the data are consistent with previous findings by documenting an association between neuroticism and the increased likelihood of asthma diagnosis, while extending the research by finding new associations between conscientiousness and openness with asthma diagnosis.

In those with no lifetime asthma diagnosis, males and females were nearly evenly distributed (52.9% female), while those in the lifetime asthma group were predominantly female (65.6%). Sex was a statistically significant predictor of the likelihood of having a lifetime asthma diagnosis, which is consistent with the higher lifetime asthma prevalence rate in women aged 35 to 64 reported by the CDC (Centers for Disease Control and Prevention, 2017).

Our study is consistent with previous literature that found the trait of neuroticism to be associated with diagnosis of asthma (Huovinen et al., 2001; Loerbroks, Apfelbacher, Thayer, Debling, & Sturmer, 2009; Loerbroks et al., 2015b). This finding further strengthens the theory that neuroticism is linked to poor physical health (Charles, Gatz, Pedersen, & Dahlberg, 1999; Goodwin & Friedman, 2006). Previous literature has suggested that perceived psychological stress might mediate the incidence of asthma through immunological and inflammatory pathways (Miller, Chen, & Cole, 2009). Neurotic individuals report high negative emotions and psychological stress (Ebstrup, Eplov, Pisinger, & Jørgensen, 2011) possibly leading to greater

vulnerability to asthma and other stress-related health outcomes. In a clinical setting, it could be helpful for practitioners to recognize neuroticism in asthma patients.

Individuals high in neuroticism are more likely to attend to negative stimuli and report greater concern over adverse side effects from medications (Costa & McCrae, 1987; Emilsson et al., 2011). Practitioners could individualize their care of these patients by spending more time assessing for negative side effects in patients and ensuring that this does not prevent the patients from adhering to their treatment.

Previous to the current study, conscientiousness had not been found to predict lifetime diagnosis of asthma. However, the literature indicates that conscientiousness is a significant predictor of health and mortality (Christensen et al., 2002; Friedman et al., 1993). Conscientiousness is associated with engagement in healthy lifestyle behaviors and choices that affect health, such as adherence to prescribed medical treatment, which is an important factor in asthma care (Axelsson, Cliffordson, Lundbäck, & Lötval, 2013; Axelsson et al., 2009; Bogg & Roberts, 2004; Friedman & Kern, 2014; Jokela, Elovainio, et al., 2014). Additionally, conscientiousness is associated with better coping (Connor-Smith & Flachsbar, 2007) and lower levels of perceived stress (Lee-Baggley, Preece, & Delongis, 2005; Vollrath, 2001). Due to their goal-oriented and organized nature, conscientious individuals are less likely to exhibit impulsive behavior, consequently avoiding stress related to reckless decisions in social, financial, and health-related domains of life (Carver & Connor-Smith, 2010). The findings in our study indicated conscientiousness might have played a role in reducing the chance of lifetime asthma diagnosis in the graduate sample but not the sibling sample, possibly

through increased coping ability and healthy behavior choices. Conscientiousness may not be as reliably associated with asthma diagnosis as neuroticism and openness. Low-conscientiousness might be a factor to consider in asthma education and treatment, but more research is needed.

Previous studies have already linked individuals low in conscientiousness and high in neuroticism with greater risk of negative health outcomes (Goodwin & Friedman, 2006; Löckenhoff et al., 2008). Our findings indicate increased risk of asthma diagnosis might be appropriate to add to the list of possible negative health outcomes associated with lower conscientiousness and higher neuroticism scores. Additionally, our analysis indicated that elevated BMI and a history of regular smoking behavior were statistically significant predictors of reported asthma diagnosis. Based on the established link between low conscientiousness, high neuroticism, and risky health factors (i.e. smoking and elevated BMI), and the link between these same health factors and asthma, it appears possible that BMI and smoking could act as mediators in the relationship between personality and asthma. However, our analyses did not consider a mediational relationship and can only indicate how these factors individually influence risk of reported asthma diagnosis. Future studies could examine a possible relationship between personality and asthma through the mechanisms of smoking and health behaviors.

Openness was the third personality trait that we found to statistically significantly predict lifetime asthma diagnosis. Previous studies have not found any association between openness and respiratory health outcomes (Goodwin & Friedman,

2006). Additionally, openness to experience has not been shown to increase risky health behaviors that might lead to the development of asthma (i.e. smoking) (Vollrath, Knoch, & Cassano, 1999). Openness has been linked to physical health through increased engagement in physical activity (Wilson & Dishman, 2015). However, our analyses did not show a statistically significant association between reported physical exercise and risk of asthma diagnosis. If openness does in fact affect health outcomes by way of physical activity, we would expect that with increased levels of openness, and the corresponding high levels of physical activity, the risk of an asthma diagnosis would decrease. It is possible that asthma and openness might be linked through stress rather than health behaviors but research on openness and stress has yielded mixed findings (Schneider, Rench, Lyons, & Riffle, 2012). In particular, one study found that individuals high in openness reported greater stress-exposure during childhood but exhibited fewer physical symptoms of stress as adults when exposed to a stressor in lab (Williams, Rau, Cribbet, & Gunn, 2009). Our findings indicate that the personality trait of openness is worth exploring as it might hold clues to the pathogenesis of asthma. Further research is necessary to better understand the possible pathways that link asthma and openness and how this information might be used to improve clinical care of asthma patients.

There could be multiple explanations for why our study found significant associations between conscientiousness and openness and asthma while previous studies have not. Specifically, the study by Loerbroks and colleagues did not find an association between asthma diagnosis and conscientiousness (Loerbroks et al., 2015b),

and in our study we failed to find a statistically significant connection between conscientiousness and asthma diagnosis in the sibling sample. This might be explained by the differences in BFI items used to assess conscientiousness; the items in Loerbroks's study almost exclusively measured the achievement-striving facet of the trait while the items used by the WLS relate more to the discipline facet of conscientiousness. Additionally, when Loerbroks et al. (2015) examined the relationship between asthma and personality, they only included new cases of adult asthma within a two-year period, in contrast our analysis included lifetime asthma diagnosis, analyzing a larger asthma group. The relative homogeneity of our sample might have impacted the analyses as well. The sibling sample was smaller than the graduate sample, meaning that it had less power. This might explain why conscientiousness was a significant predictor for the graduate sample but not for the siblings.

4.1 Limitations

The WLS sample is largely homogenous in terms of race and ethnicity. In 2004 less than 1% of the participants classified themselves as non-white. Thus, the findings may not be generalizable to other racial or ethnic groups. Participants were randomly chosen from a pool of high school graduates, failing to represent an estimated 25% of Wisconsin youth who did not graduate high school in the late 1950's (Sewell & Hauser, 1975). Future studies should focus on replicating these results in a more heterogeneous sample.

Our study used self-reported physician diagnosis of asthma, a widely accepted measurement approach for epidemiological studies that has been shown to exhibit 99% specificity when compared to clinical diagnosis (Toren, Brisman, & Järholm, 1993). However, additional data collection might have been useful to improve inclusion criteria for the asthma group (i.e. use of asthma medications, respiratory symptoms, etc.). Additionally, measurement of physical illness by self-report may be vulnerable to self-report bias in the case of neuroticism in particular as these individuals might be more likely to attend to and report adverse physical symptoms (Costa & McCrae, 1987).

In this study, personality was first measured in 1992 (i.e. time-point 3) when participants were in their 50s. Participants could have been diagnosed with asthma either before or after assessment of their personality in 1992. There has been disagreement in the field about the stability of personality traits throughout the lifetime, one study argues personality traits are vulnerable to a number of contextual influences throughout the lifetime (Srivastava, John, Gosling, & Potter, 2003). However, the overwhelming majority of researchers in the field have found that personality traits remain stable over time, through multiple assessments, with modest normative age-related changes in adolescence (Costa & McCrae, 1988; McCrae & Costa, 2003; Terracciano, McCrae, Brant, Costa Jr, & aging, 2005). As with all theoretical causal links, there is also the possibility of a third factor that drives changes in both asthma and personality that we have not considered. Future studies could expand on these ideas by measuring personality throughout the lifetime and whether those scores were predictive of future asthma diagnosis.

Personality was measured using a subset of the BFI-54. While this subset personality measure has been utilized in multiple published studies (Ha & Pai, 2012; Jokela, Batty, et al., 2014; Jokela, Pulkki-Råback, Elovainio, & Kivimäki, 2014), it is not as lengthy as other FFM personality measures, such as the NEO-PI-R 240, and thus might not provide as nuanced of results. The current study was limited to the measures used in the original WLS study. It is also important to consider that the differences in personality traits between the asthma and non-asthma groups, while highly statistically significant, were not large in magnitude. There is great variability in personality traits in both groups.

4.2 Conclusions

Our study further indicates the importance of understanding the relationship between personality and physical health, particularly asthma. While our findings do not suggest a particular plan of action in the prevention of asthma, they do offer clues for avenues of future research. Asthma likely represents only one health condition of many associated with specific five-factor personality traits. It has been suggested that identification of health conditions associated with these traits and examination of hypotheses to explain these connections are likely to advance our understanding of both personality traits and asthma. Through personality research we might better understand a prevalent disease with problematic treatment adherence and unknown pathogenesis.

5.0 TABLES

Table 1
Descriptive Statistics by Asthma Diagnosis (Graduate Sample)

	Whole Sample		No Lifetime Asthma		Lifetime Asthma		Group Comparisons		
	Mean	SD	Mean	SD	Mean	SD	df	t	p
Extraversion	23.09	5.41	23.11	5.43	22.95	5.28	4016	0.63	.52
Agreeableness	28.63	4.40	28.63	4.41	28.57	4.34	4030	0.32	.74
Conscientiousness	29.31	4.06	29.38	4.05	28.79	4.09	4030	3.02	.003
Neuroticism	15.86	4.93	15.78	4.92	16.43	4.98	4006	-2.73	.006
Openness	21.91	4.80	21.84	4.74	22.44	5.15	597.74	-2.44	.015
BMI	26.57	4.35	26.51	4.26	26.99	4.91	577.88	-2.04	.042
Household income	45565	48096	45926	48190	42917	47367	3713	1.24	.21
Education (years)	13.61	2.44	13.59	2.43	13.74	2.51	4073	-1.29	.19
	Frequency	%	Frequency	%	Frequency	%	df	χ^2	p
Sex									
Female	2222	54.4	1901	52.9	321	65.6	1	28.15	< .001
Male	1860	45.6	1692	47.1	168	34.4			
Missing	0	0.0	0	0.0	0	0.0			
Ever smoked regularly									
No	1935	47.4	1733	48.2	202	41.3	1	7.41	.006
Yes	2088	51.2	1812	50.4	276	56.4			
Missing	59	1.4	48	1.3	11	2.2			
Smoke regularly now*									
No	1472	36.1	1267	35.3	205	41.9	1	2.46	.11
Yes	615	15.1	545	15.2	70	14.3			
Missing	1995	48.9	1781	49.6	214	43.8			
Physical exercise									
≥ 3 times / week	643	15.8	561	15.6	82	16.8	3	1.35	.71
1 or 2 times / week	648	15.9	578	16.1	70	14.3			
1 – 3 times / month	740	18.1	654	18.2	86	17.6			
< 1 time / month	1951	47.8	1714	47.7	237	48.5			
Missing	100	2.4	86	2.4	14	2.9			
Marital status									
Married	3473	85.1	3070	85.4	403	82.4	4	8.55	.07
Separated	29	0.7	21	0.6	8	1.6			
Divorced	363	8.9	315	8.8	48	9.8			
Widowed	81	2.0	69	1.9	12	2.5			
Never married	135	3.3	117	3.3	18	3.7			
Missing	1	< .01	1	< .01	0	0.0			

Note. Valid listwise $n = 3490$. * “Smoke regularly now” was only assessed in participants who responded affirmatively to the question “Ever smoked regularly”

Table 2
Binomial Logistic Regression Results for Lifetime Asthma Diagnosis (Graduate Sample)

	B	SE	<i>p</i>	OR	95% CI for OR	
					Lower	Upper
Extraversion	-0.081	0.057	.15	0.922	0.824	1.031
Agreeableness	0.062	0.060	.30	1.064	0.945	1.198
Conscientiousness	-0.131	0.058	.023	0.877	0.783	0.982
Neuroticism	0.149	0.060	.012	1.161	1.033	1.305
Openness	0.194	0.061	.001	1.214	1.078	1.367
BMI	0.167	0.052	.001	1.182	1.067	1.310
Income	0.014	0.059	.81	1.014	0.903	1.139
Education (years)	0.099	0.055	.07	1.104	0.991	1.229
Sex						
Male	-0.735	0.125	< .001	0.480	0.375	0.613
Smoking history						
Yes	0.330	0.110	.003	1.392	1.122	1.726
Physical exercise						
1 or 2 times / week	-0.301	0.188	.10	0.740	0.513	1.069
1 – 3 times / month	-0.204	0.179	.25	0.815	0.574	1.159
< 1 time / month	-0.231	0.154	.13	0.794	0.586	1.074
Marital status						
Separated	1.020	0.437	.020	2.772	1.177	6.529
Divorced	-0.021	0.178	.90	0.979	0.690	1.390
Widowed	0.035	0.340	.91	1.035	0.532	2.014
Never married	0.215	0.268	.42	1.240	0.733	2.098

Note. $\chi^2(8) = 7.983$, $p = .435$. Nagelkerke $R^2 = .050$. Reference groups are: female (sex), married (marital status), “no” (past smoking habit), and “ ≥ 3 times per week” (physical exercise).

Table 3
Descriptive Statistics by Asthma Diagnosis (Sibling Sample)

	Whole Sample		No Lifetime Asthma		Lifetime Asthma		Group Comparisons		
	Mean	SD	Mean	SD	Mean	SD	df	t	p
Extraversion	22.57	5.46	22.55	5.44	22.71	5.65	2001	-0.410	.68
Agreeableness	28.24	4.39	28.29	4.39	27.83	4.38	2001	1.496	.13
Conscientiousness	28.75	4.23	28.80	4.24	28.36	4.14	2001	1.508	.13
Neuroticism	15.99	4.75	15.90	4.71	16.63	5.01	2001	-2.190	.029
Openness	21.77	4.49	21.66	4.50	22.64	4.32	1998	-3.130	.002
Age	52.77	6.60	52.77	6.62	52.79	6.41	2006	-1.125	.26
BMI	26.64	4.52	26.55	4.42	27.32	5.21	271.14	-2.126	.034
Education (years)	13.90	2.52	13.89	2.50	13.99	2.65	2015	-0.594	.55
	Frequency	%	Frequency	%	Frequency	%	df	χ^2	p
Sex									
Female	1096	54.0	949	52.9	147	62.6	1	7.797	.005
Male	933	46.0	845	47.1	88	37.4			
Missing	0	0.0	0	0.0	0	0.0			
Ever smoked regularly									
No	944	46.5	845	47.1	99	42.1	1	1.864	.17
Yes	1053	51.9	922	51.4	131	55.7			
Missing	32	1.6	27	1.5	5	2.1			
Smoke regularly now*									
No	1717	84.6	1521	84.8	196	83.4	1	0.125	.72
Yes	280	13.8	246	13.7	34	14.5			
Missing	32	1.6	27	1.5	5	2.1			
Physical exercise									
≥ 3 times / week	328	16.2	296	16.5	32	13.6	3	1.637	.65
1 or 2 times / week	365	18.0	324	18.1	41	17.4			
1 – 3 times / month	417	20.6	364	20.3	53	22.6			
< 1 time / month	881	43.4	778	43.4	103	43.8			
Missing	38	1.9	32	1.8	6	2.6			
Marital status									
Married	1670	82.3	1485	82.8	185	78.7	4	3.147	.53
Separated	9	0.4	7	0.4	2	0.9			
Divorced	187	9.2	160	8.9	27	11.5			
Widowed	59	2.9	51	2.8	8	3.4			
Never married	83	4.1	73	4.1	10	4.3			
Missing	21	1.0	18	1.0	3	1.3			

Note. Valid listwise $n = 1682$. * “Smoke regularly now” was only assessed in participants who responded affirmatively to the question “Ever smoked regularly”

Table 4

Binomial Logistic Regression Results for Lifetime Asthma Diagnosis (Sibling Sample)

	95% CI for OR					
	B	SE	p	OR	Lower	Upper
Extraversion	-0.012	0.083	.88	0.988	0.839	1.162
Agreeableness	-0.038	0.092	.68	0.963	0.805	1.152
Conscientiousness	-0.058	0.088	.51	0.943	0.794	1.121
Neuroticism	0.192	0.090	.034	1.211	1.015	1.446
Openness	0.274	0.094	.003	1.315	1.095	1.580
Age	0.009	0.012	.48	1.009	0.985	1.034
BMI	0.217	0.078	.005	1.242	1.067	1.447
Education (years)	0.023	0.080	.78	1.023	0.875	1.196
Sex						
Male	-0.394	0.174	.023	0.674	0.479	0.948
Smoking history						
Yes	0.216	0.162	.18	1.241	0.904	1.703
Physical exercise						
1 or 2 times / week	0.107	0.269	.69	1.113	0.657	1.887
1 – 3 times / month	0.090	0.263	.73	1.094	0.653	1.832
< 1 time / month	-0.085	0.243	.73	0.918	0.570	1.479
Marital status						
Separated	0.856	0.834	.31	2.353	0.459	12.061
Divorced	0.102	0.258	.69	1.107	0.668	1.836
Widowed	-0.434	0.546	.43	0.648	0.222	1.889
Never married	0.087	0.361	.81	1.091	0.538	2.215

Note. $\chi^2(8) = 9.820$, $p = .278$. Nagelkerke $R^2 = .038$. Reference groups are: female (sex), married (marital status), “no” (past smoking habit), and “ ≥ 3 times per week” (physical exercise).

SECTION TWO

Appendices

APPENDIX A

Additional Background

Asthma is a chronic condition characterized by inflammation of the air passages in the lungs that leads to constricted airflow through these passages. It is a disease characterized by recurrent exacerbations (i.e. asthma attacks) of wheezing and difficulty breathing, which vary in severity and frequency between individuals (GSK, 2017). Although peak incidence rates occur in childhood, asthma may occur at any point in a person's life (Nunes, Pereira, & Morais-Almeida, 2017). Over time, effects of uncontrolled asthma, such as increased inflammation and asthma attacks, may have long-term effects on a person's breathing leading to permanent damage to the lining of airways (GSK, 2017).

The prevalence of asthma has been rising in most parts of the world since the second half of the 20th century (Eder et al., 2006). Asthma currently affects more than 25.9 million people in the United States - about 8% of the population (Centers for Disease Control and Prevention, 2017). The Global Initiative for Asthma (GIA) estimated that in 2014 over 300 million people had asthma (Bateman et al., 2008) and asthma was cited as the primary cause of death for 383,000 individuals worldwide in 2015 (World Health Organization, 2017). The GIA further indicated that by 2025 there might be closer to 400 million asthma patients (Masoli, Fabian, Holt, Beasley, & Program, 2004).

Asthma can be deemed a significant public health problem, which often requires the use of emergency care, sometimes including hospital admission, and is responsible for a high number of missed school and/or work days; moreover, it can cause early permanent disability and premature death (Asher & Pearce, 2014; Masoli, Fabian, Holt, Beasley, & Allergy, 2004). In fact, asthma can be associated with substantial impairments on physical, social and professional aspects of the life for patients who suffer from this disease, especially when it is uncontrolled (Asher & Pearce, 2014; Masoli, Fabian, Holt, Beasley, & Allergy, 2004). In children, asthma is a leading cause of healthcare utilization and school absences (Currie, 2009).

Overall, asthma-related costs are very high (Bousquet, Bousquet, Godard, & Daures, 2005). The socioeconomic cost of asthma can be considered in terms of direct costs (i.e. hospital admissions and the cost of medications) and indirect costs (i.e. time away from work, impaired functioning, and premature death) (Bousquet et. al., 2005). A study conducted by CDC researchers estimated that during the 5-year span between 2008 and 2013, the total cost of asthma on the United States economy was over \$80 billion (Nurmagambetov, Kuwahara, & Garbe, 2018). They further estimated that 61% of this cost was attributable medical costs, while approximately 39% was attributable to absenteeism and mortality. Of note, there are also intangible costs that result from poor quality of life. It might not be possible to measure the effect these intangible costs have on the economy, but we might assume that they are not insignificant.

Despite its high incidence and prevalence, the fundamental causes of asthma remain unknown (World Health Organization, 2017). Treatment adherence is another

important health behavior to consider in the study of asthma. In patients with asthma, low rates of adherence to preventative medications are associated with higher rates of hospitalization and death (Horne, 2006). Despite these risks, encouraging medication-adherence in patients with asthma has long been a challenge for providers (Bender & Rand, 2004; Rand & Wise, 1994). The development of the fields of behavioral medicine and health psychology imply that the link between psychological factors and physical health need to be addressed (T. W. Smith & MacKenzie, 2006).

History of Asthma

There is evidence to suggest that humans have displayed symptoms of asthma since ancient times. An ancient Egyptian record of medical knowledge, known as the Ebers Papyrus and dated from approximately 1550 B.C., describes an herbal remedy to treat difficulty breathing, now accepted by historians as the first recorded description of asthma (Cohen, 1992). The Greek physician Hippocrates (460-357 B.C.) is believed to be the first to link asthma to psychological factors; Hippocrates theorized that patients with asthma could prevent exacerbations by avoiding or “guarding against” anger (Adams, 1886). In fact, asthma was considered to be a psychosomatic disorder well into the second half of the 20th century. Its classification as an illness caused solely by emotional disturbance is reflected in its title: *asthma nervosa*. This belief is exemplified in Henry Hyde Salter’s 1860 treatise on the pathology of asthma wherein he wrote “asthma is essentially, and with perhaps the exception of a single class of cases, exclusively a nervous disease; the nervous system is the seat of the essential

pathological condition” (Salter, 1868). However, as asthma research progressed, new external risk factors were recognized and observed, such as airborne allergens. These developments, combined with growing understanding of the inflammatory mechanisms involved in asthma, caused popular opinion to shift as asthma was no longer regarded solely as a psychosomatic disorder.

Currently, asthma is defined as a chronic condition that intermittently inflames the airways in the lungs causing them to become narrow, making breathing more difficult. Symptoms of asthma include periods of chest tightness, occur on a daily or monthly basis. While the pathogenesis of asthma remains unknown, risk factors and influencing gene-environment interactions have been identified. It is widely accepted that asthma includes a genetic component. Asthma heritability appears to range from 35% and 95% (Ober & Yao, 2011) and specific genetic markers have been associated with an increased risk of asthma (Holloway, Yang, & Holgate, 2010). Other proposed risk factors for developing asthma include respiratory infections and airborne environmental exposures (i.e. tobacco smoke, pollutants, and ozone) (Jackson, Gangnon, Evans, Roberg, Anderson, Pappas, & Carlson-Dakes, 2008). Additional factors that have been theorized to influence asthma diagnosis include factors such as vitamin intake, prenatal chemical exposures, and dietary changes (Raby, Lazarus, Silverman, Lake, Lange, & Weiss, 2004; Smit, Lenters, Høyer, Lindh, Pedersen, Liermontova, & Vermeulen, 2015; DeChristopher, Uribarri, & Tucker, 2016).

The National Institute of Health (NIH) suggests that asthma control depends on two factors: (1) reducing impairment—reduce the frequency and intensity of chronic

symptoms and return to normal (or near normal) lung function and activity level; and (2) reducing risk—reduce the likelihood of future exacerbations, progressive decline in lung function, need for hospitalization, or medication side effects” (NIH, 2012). The goals of asthma treatment therefore involve not just the temporarily relief from, but the maintained control of symptoms through managing medication, addressing environmental risk factors, teaching self-management skills, and long-term monitoring. Despite the importance placed on preventative care to reduce exacerbations and worsening function, treatment adherence among asthma patients remains low compared to patients with other chronic conditions (Bender & Rand, 2004; Rand & Wise, 1994).

Due to the unknown pathogenesis of asthma, theories into associated risk factors have considerable potential to guide the development of future primary (and secondary) prevention tactics. Given the diverse presentation and myriad of idiosyncratic risk factors between patients, any one intervention appears unlikely to prevent all asthma cases (Douwes, Brooks, & Pearce, 2010). Exploring asthma’s association with psychological factors provides further candidates for possible future primary (and secondary) prevention options.

Asthma and Personality

Prior research has linked personality traits to physical health, including longevity and the occurrence and course of cardiovascular disease (T. W. Smith & MacKenzie, 2006). The development of the fields of behavioral medicine and health psychology imply that the link between psychological factors and physical health need

to be addressed (T. W. Smith & MacKenzie, 2006). While several models to describe personality characteristics have been introduced and defended over the years, the Five-Factor Model (FFM) has remained the most widely accepted (Peabody & De Raad, 2002). The FFM of personality was developed to help categorize patterns of human behavior into universal, measurable traits that remain stable over time (McCrae & Costa, 2003). These five traits are defined as agreeableness, conscientiousness, extraversion, neuroticism, and openness. Agreeableness is exemplified by individuals who are friendly, cooperative, and compassionate. Conscientiousness is demonstrated in individuals who are organized, methodical, and thorough. Individuals high in extraversion are defined as being talkative, energetic and assertive. Neuroticism, sometimes also referred to as “emotional instability”, is modeled by individuals who experience a high degree of negative affect. Openness is exemplified by individuals who seek out novel experiences and enjoy learning new skills.

Prior research suggests personality characteristics can be predictors of health behaviors, such as smoking and activity level, and can even lead to the development of chronic illness (Bogg & Roberts, 2004; Munafo et al., 2007). Specifically, a 2004 meta-analysis by Bogg and Roberts found that conscientious traits were positively related to beneficial health behaviors and negatively related to risky health behaviors. Individuals with a combination of low conscientiousness and high neuroticism are more vulnerable to poor health outcomes, such as chronic illness and lower subjective physical health ratings (Goodwin & Friedman, 2006; Löckenhoff et al., 2008). The association between high neuroticism, low conscientiousness, and poor health outcomes might be partially

explained by engagement in risky health behaviors: these individuals are more likely to smoke, eat impulsively, and maintain an elevated Body Mass Index (BMI) (Terracciano et al., 2008; Terracciano et al., 2009). A 2015 meta-analysis of personality and physical activity found that conscientiousness, openness, and extraversion were positively associated with physical activity, while neuroticism was negatively associated with physical activity (Wilson & Dishman, 2015). Additionally, high neuroticism and low extraversion, openness, agreeableness, and conscientiousness were associated with poorer lung function, and higher likelihood of chronic obstructive pulmonary disease (Terracciano et al., 2016).

BMI and health behaviors, such as smoking and physical activity, are associated with asthma diagnosis and symptom severity. A 2012 meta-analysis found physical activity to be a possible protective factor against asthma development (Eijkemans et al., 2012). Obesity (as measured by BMI) has been linked with a higher risk for developing adult-onset asthma and worse asthma-specific quality of life (Nystad et al., 2004; Vortmann & Eisner, 2008). The risk of developing asthma is significantly higher among current smokers, and active cigarette use causes more severe asthma symptoms in those already diagnosed (Piipari et al., 2004; Thomson et al., 2004).

Previous research suggests that impulsivity (the opposite pole of conscientiousness) is negatively associated with medication adherence in asthma patients (Axelsson et al., 2009). Neuroticism has also been linked to worse patient adherence to prescribed medical regimens (Brickman et al., 1996; Kiecolt-Glaser et al.,

2002). These findings are important to note because treatment adherence has historically been poor in asthma patients.

Previous studies theorize that physiological stress response is involved in the etiology of asthma through the influence of inflammation (Chen & Miller, 2007; A. Loerbroks, J. Li, J. Bosch, R. Herr, & P. Angerer, 2015a; Rod et al., 2012). Stress exacerbates airway inflammatory response to irritants, allergens, and infections, thereby increasing the frequency, duration, and severity of asthma symptoms (Chen & Miller, 2007). Personality influences the way psychological stress is processed (Carver & Connor-Smith, 2010; T. W. Smith & MacKenzie, 2006; Swickert et al., 2002). A 2010 meta-analysis linked optimism, extraversion, conscientiousness, and openness to more engagement coping; neuroticism to more disengagement coping; and optimism, conscientiousness, and agreeableness to less disengagement coping (Carver & Connor-Smith, 2010), indicating that strategies of handling stress could be related to personality traits. Stress and health behaviors have been implicated in the etiology of asthma (Loerbroks, Gadinger, et al., 2010; Rod et al., 2012; Subbarao et al., 2009). Therefore, specific personality traits might be associated with asthma through the shared influence of health behaviors and stress response.

Previous studies have demonstrated a link between FFM personality traits and asthma. Huovinen, Kaprio, and Koskenvuo (2001) investigated only neuroticism and extraversion in association with asthma, finding that while high neuroticism scores were associated with prevalent asthma, they were not predictive of future asthma diagnosis. These researchers further found that high extraversion scores were predictive of future

asthma diagnosis only in women (Huovinen et al., 2001). Another study, looking only at neuroticism and extraversion, found that neuroticism but not extraversion was predictive of asthma (Loerbroks, Apfelbacher, Thayer, Debling, & Sturmer, 2009). Goodwin & Friedman (2006) found that neuroticism scores were significantly higher in participants with asthma. A study examining all five personality traits found that only neuroticism was predictive of new asthma diagnosis over a two-year period (Loerbroks et al., 2015a). Yet another study found that participants with asthma scored significantly differently from a healthy control group in all personality traits, with asthma being related to higher scores in neuroticism and lower scores in all other traits (Fernandes et al., 2005). These studies seem to indicate that only neuroticism is consistently associated with asthma.

Discussion of Homogeneity of Sample

The WLS sample is unusual in its homogeneity. Due to the method of collection, the entirety of the participants in the graduate sample are within one year of each other in age and have completed at least a high school education. Additionally, less than 1% of participants classified themselves as non-white. Due to these factors, the homogeneity of the sample must be considered in relation to the generalizability of the results. The sample available for this study is limited by its homogeneity in some ways and strengthened in others. Due to the homogeneity the sample lacks some generalizability to other more diverse populations. The sample might have poor external

validity, the degree to which the conclusions of this study can be held to be true for other samples. In this way it may have greater internal validity than external validity.

In this study it was important to consider what effect a racially homogeneous population might have on the results. A 2008 meta-analysis comparing the extent to which racial groups differ across the FFM found that differences between groups were negligible (Foldes, Duehr, & Ones, 2008), indicating that the racial homogeneity of the sample might not have significantly affected the personality scores. Asthma has been found to disproportionately affect black and Hispanic children; however, this effect decreases significantly with increases in family SES (Litonjua, Carey, Weiss, & Gold, 1999), indicating that this effect is driven in part by factors related to income. Future studies need to explore personality traits and asthma in a more racially diverse population to be able to make generalizations about the communities most affected by asthma.

All of the participants in the graduate sample graduated from high school. This is a limiting factor because the graduate sample is self-selected for a certain level of educational attainment. Openness to experience has been linked to higher levels of educational attainment (Goldberg, Sweeney, Merenda, & Hughes Jr, 1998) and conscientiousness has been linked to increased GPA in college students (Komarraju, Karau, & Schmeck, 2009; Wolfe & Johnson, 1995). However, no previous studies have assessed whether individuals high in certain FFM personality traits are more likely to graduate high school.

Treatment Planning and Adherence

Harkness and Lilienfeld (1997) stated that the fundamental rule of treatment planning requires that the plan should be predicated on the best science available. This thinking dictates that practitioners should be held responsible for staying up to date on relevant research and scientific findings, even if those scientific findings were not emphasized in their training (Harkness & Lilienfeld, 1997). The study of individual differences and personality represents an entire branch of psychology and spans several decades worth of research and findings. However, attempts to integrate key findings from personality literature into modern treatment planning for specific issues are few and far between (Staiger, Kambouropoulos, & Dawe, 2007).

In the treatment of asthma, planning is crucial. Asthma requires multiple stages of intervention to both control current symptoms and prevent future attacks (NIH, 2012). According to the National Heart Lung and Blood Institute's (NHLBI, 2018) National Asthma Education and Prevention Program, there are four major components of care when planning asthma treatment: (1) Assessment and monitoring: assess asthma severity to initiate therapy, assess asthma control to monitor and adjust therapy, and schedule follow-up care; (2) Education: provide self-management education, develop a written asthma action plan in partnership with the patient, and integrate education into all points of care where health professionals interact with patients; (3) Control environmental factors and comorbid conditions: recommend measures to control exposures to allergens and pollutants or irritants that make asthma worse and treat comorbid conditions; and (4) Medications: select medication and delivery devices to

meet patient's need and circumstances. The overarching goal of asthma treatment is to attain asthma control, defined here as living without functional limitations, impairment in quality of life, or risk of adverse events (NHLBI, 2018).

Due in part to the complexity of asthma treatment, continued patient adherence is crucial to attaining control of the symptoms. Treatment nonadherence presents a pervasive issue among patients with asthma and contributes to poor outcomes in asthma treatment (Engelkes, Janssens, de Jongste, Sturkenboom, & Verhamme, 2015).

Adherence rates for patients with asthma have been found to range between 30% and 70% (Bender, Milgrom, & Rand, 1997). For asthma patients taking inhaled medications, fewer than half adhered to their prescribed medication (Belman et al., 1993; Milgrom et al., 1996).

Poor treatment adherence in asthma has been attributed to multiple factors. One such factor might be the prolonged controller therapy necessary to prevent future exacerbations in asthma requires patients to adhere to a daily schedule of medication, even in the total absence of symptoms. In a situation where a patient fails to take their controller medication for a few days they might not notice any change in their symptoms, leading the patient to believe that the daily medications are unnecessary and reinforcing nonadherence. The term *asthma self-efficacy* is often used in the field to refer to the degree of confidence individuals have in successfully executing specific treatment related behaviors (Wigal et al., 1993). Previous studies have found that patients tend to favor treatments with immediate and noticeable results, such as the rapid-onset effects seen with the use of an emergency inhaler (Bender, 2002). Controller

medication, on the other hand, often requires long-term use to substantially decrease and prevent symptoms. Therefore, patients may cease use of their controller medications after their symptoms have dissipated, not realizing that the discontinued use will eventually lead to future exacerbations.

To help address the need for improved patient adherence, Milgrom and Bender (1997) proposed a system of strategies for providers to improve adherence among patients with asthma (Table 5). This system consists of 5 steps: educate, communicate, negotiate, streamline, and individualize. The individualize step is where providers might be able to incorporate findings from personality research to better address the needs of their patients. In a 2008 study, a patient-centered asthma education program led to fewer health care re-attendances than the standardized education program, reinforcing the importance of individualization in asthma treatment (S. Smith, Mitchell, & Bowler, 2008). Different personality traits have also been linked to specific learning styles (Busato, Prins, Elshout, & Hamaker, 1998), indicating that knowing a patient's personality traits might help practitioners craft education materials that are more accessible for the patient and conducive to learning.

The WHO has classified five domains associated with non-adherent-behaviors: socioeconomic factors; therapy-related factors; patient-related factors; condition-related factors; and health care system factors (WHO, 2003). The influence of personality on treatment adherence is considered within the domain of patient-related factors. Personality traits could be used to help guide treatment planning through the connection to health behaviors and treatment adherence. Such knowledge can be used as a basis for

developing specialized treatment plans tailored to patients' personality and their beliefs about medicines. The connection between certain personality traits and specific health behaviors indicates that knowing the personality traits of their patients could help providers anticipate which patients might experience the most difficulty with medication adherence. Both high neuroticism and low conscientiousness have been associated with poor adherence to prescribed medical regimens (Axelsson et al., 2009; Brickman et al., 1996; Kiecolt-Glaser et al., 2002).

In practice, a provider might recognize that a patient scoring high in the trait of neuroticism is more likely to experience barriers to taking medication based on concerns about potential side effects (Emilsson et al., 2011). In this case the provider might spend extra time assuaging the patient's fears about possible adverse effects of medication and highlighting the risks of not taking the medication. On the other hand, a patient scoring high in the trait of conscientiousness and low on the traits of neuroticism may not need the same specific treatment. The importance of treatment planning in asthma and the focus on individualized care imply that assessment of personality traits may prove to be a useful part of care-planning.

APPENDIX B

Hypotheses and Aims

Identification of health conditions associated with certain psychological factors could lead to a better understanding of the health condition through examination of hypotheses used to explain these associations. Through this research we might better understand a prevalent disease with low treatment adherence and unknown cause. This study aims to reinforce the link between neuroticism and asthma while also exploring associations with the other four personality traits. The WHO has classified personality within the domain of patient-related treatment non-adherent factors (WHO, 2003). If asthma can be reliably linked to specific personality traits, then there will be more evidence to encourage the development of individualized personality-based treatment planning.

The trait of neuroticism is associated with diagnosis of asthma (Huovinen et al., 2001; Loerbroks, Apfelbacher, Thayer, Debling, & Sturmer, 2009; Loerbroks et al., 2015a) and linked to poor physical health outcomes (Charles et al., 1999; Goodwin & Friedman, 2006). Previous literature suggested that perceived psychological stress might mediate the incidence of asthma through immunological and inflammatory pathways (Miller et al., 2009). Neurotic individuals report high negative emotions and psychological stress (Ebstrup et al., 2011) possibly leading to greater vulnerability to asthma and other stress-related health outcomes. We hypothesize that neuroticism scores will be linked to higher likelihood of lifetime asthma diagnosis.

Conscientiousness has not been found to predict lifetime diagnosis of asthma. However, the literature indicates that conscientiousness is a significant predictor of health and mortality (Christensen et al., 2002; Friedman et al., 1993). Conscientiousness is associated with engagement in healthy lifestyle behaviors and choices that affect health, such as adherence to prescribed medical treatment (Axelsson et al., 2013; Axelsson et al., 2009; Bogg & Roberts, 2004; Friedman & Kern, 2014; Jokela, Pulkki-Råback, et al., 2014). Additionally, conscientiousness is associated with better coping (Connor-Smith & Flachsbart, 2007) and lower levels of perceived stress (Lee-Baggley et al., 2005; Vollrath, 2001). Due to their goal-oriented and organized nature, conscientious individuals are less likely to exhibit impulsive behavior, consequently avoiding stress related to reckless decisions in social, financial, and health-related domains of life (Carver & Connor-Smith, 2010). Conscientiousness might be linked to asthma diagnosis through the influence of stress and health behaviors. We hypothesize that higher scores of conscientiousness will be associated with a decreased likelihood of lifetime asthma diagnosis.

Previous studies have not found any association between openness and respiratory health outcomes (Goodwin & Friedman, 2006). Additionally, openness to experience does not increase risky health behaviors that might lead to the development of asthma (i.e. smoking) (Vollrath et al., 1999). Openness has been linked to physical health through increased engagement in physical activity (Wilson & Dishman, 2015). If openness affects health outcomes by way of physical activity, we would expect that

with increased levels of openness, and the corresponding high levels of physical activity, the risk of lifetime asthma diagnosis would decrease.

Previous research has yielded mixed results on the association between extraversion and asthma diagnosis. A 1972 study indicated that there was a correlation between women who were high in the trait of extraversion and sensitivity of respiratory response which might indicate an association with asthma (Saunders, Heilpern, & Rebuck, 1972). Substantiating this, a 2001 Finnish study found that high extraversion scores were associated with asthma diagnosis in women, possibly through the influence of increased smoking behaviors (Huovinen et al., 2001). However, Loerbroks et al. failed to find a link between the trait of extraversion and the likelihood of asthma diagnosis (Loerbroks, Apfelbacher, Thayer, Debling, & Stürmer, 2009). Extraversion scores are positively associated with physical activity (Wilson & Dishman, 2015). Additionally, low extraversion scores are associated with poorer lung function and higher likelihood of chronic obstructive pulmonary disease (Terracciano et al., 2016), despite the association between higher extraversion and smoking (Huovinen et al., 2001). Because of these associations, we hypothesize that higher scores of extraversion will be linked to a decreased likelihood of lifetime asthma diagnosis.

Agreeableness has yet to be linked to asthma diagnosis (Loerbroks et al., 2015a). However, several theories have been presented as to why agreeableness could be linked to asthma: individuals who are high in agreeableness tend to experience less interpersonal conflict, report stronger social bonds, and appear to better utilize social support to cope with stress (Asendorpf & Wilpers, 1998; Bowling, Beehr, & Swader,

2005; Carver & Connor-Smith, 2010; Vollrath, 2001). It is possible that these factors could indicate a lowered risk of asthma, as incident asthma has been linked to interpersonal stressors and low social support (Lietzén et al., 2011; Loerbroks, Apfelbacher, Thayer, Debling, & Stürmer, 2009; Loerbroks, Apfelbacher, Bosch, & Stürmer, 2010). We hypothesize that higher scores of agreeableness will be linked to decreased likelihood of lifetime asthma diagnosis.

APPENDIX C

Additional Methods, Analyses and Results

The primary study was a secondary analysis of the Wisconsin Longitudinal Study (WLS). WLS is a publicly available, de-identified dataset collected by researchers at the University of Wisconsin-Madison over the course of 54 years (Hauser et al., 1957-2019; Herd et al., 2014). The WLS originated in 1957 as a survey funded by state-government to assess Wisconsin's ability to provide adequate resources to students who endorsed a desire to attend college. The survey was administered to all Wisconsin high school seniors graduating in the spring of 1957. The government of Wisconsin wanted to assess demand for higher education because they were planning to enhance post-secondary education in the state.

The original questionnaire was expanded upon in 1962 when a Sociology professor at the University of Madison-Wisconsin, William H. Sewell, decided to use the sample for further data collection. Sewell randomly selected one-third of the class of 1957 cohort, resulting in the 10,317 participant cohort known as the “graduate” sample. Since its inception, the WLS has expanded to include new measures and data collected from parents and siblings of the original respondents.

Parents of the graduate sample were mailed a questionnaire in 1964 that assessed the educational attainment, current place of employment, marital status, and mailing address of the graduates. This questionnaire received an 87% response rate, allowing the researchers to locate and contact the original graduates for a continuation of the study. In 1977 the graduates were contacted via telephone for interviews that

covered social background, aspirations, education, military service, family formation, labor-market experiences, and social participation. The 1977 wave additionally utilized information gathered from state records on mental ability, school performance, and characteristics of communities of residence, schools and colleges, employers, and industries.

In 1977 the WLS researchers expanded their study by adding a 1/3 random sample of one randomly chosen sibling for each graduate with a sibling, except when the graduate was a twin, in which case the twin was selected. Roughly 2,000 siblings were interviewed in 1977 (phone), and the full sibling sample was implemented in 1993. The full sibling sample ($n = 4,062$) includes one randomly selected sibling per graduate with a sibling, except in the cases where a graduate or sibling had previously declined participation.

In 1992 the WLS expanded its scope to include occupational histories and job characteristics; income and assets; social and economic characteristics of relatives and descriptions of the respondents' relationships with them; and mental and physical health and well-being. During this wave the WLS implemented a computer program to assist the researchers in collecting information from participants over the phone. The computer-assisted-telephone-interviewing (CATI) software was used to document participant responses and prompt interviewers with the appropriate questions. The CATI software was augmented for use in in-person interviews for the 2011 wave so that researchers could visit respondents in their homes. The in-person software was named computer-assisted-personal interviewing (CAPI) software. As the breadth of measured

variables has increased over the years, researchers have had to augment their phone interviews with self-administered questionnaires (SAQs) mailed to respondents' houses. This system was used to prevent the interviews from becoming too lengthy.

Data were collected from the graduate respondents in 1957 (in school), 1975 (phone), 1992 (phone and mail), 2004 (phone and mail) and 2011 (mail and in-person). Data was collected from sibling respondents in 1977 (phone), 1993 (phone and mail), 2004 (phone and mail), and 2011 (mail and in-person). At each time point, surviving WLS respondents who had at least responded to the 1975 (graduate) or 1993 (sibling) survey were asked to participate by means of telephone and consented for research. WLS graduates were also mailed a paper mail-back survey.

Further Analysis - Ruling out COPD

Chronic Obstructive Pulmonary Disease (COPD) is a group of chronic, progressive lung diseases that cause inflammation and obstruction to airways in the lungs. The two most common diseases that contribute to COPD are emphysema and bronchitis. Symptoms of COPD include shortness of breath, wheezing, and recurrent cough. COPD is primarily caused by prolonged exposure to airway irritants, such as harmful gasses or particulate matter. In developed countries, the primary cause of COPD is smoke from tobacco (MayoClinic, 2020). COPD progresses slowly and can take years of exposure to irritants to develop (BTS, 1997). The prevalence of COPD increases considerably after the ages of 40 to 50, particularly among smokers (Bakke, Baste, Hanao, & Gulsvik, 1991).

Due to the similarity in symptomatology between COPD and asthma, COPD is often misdiagnosed as asthma, especially in patients over the age of 40 (Tinkelman, Price, Nordyke, & Halbert, 2006). We felt that it would be wise to assess for possible cases of COPD misdiagnosed as asthma in our study. The primary cause of COPD is prolonged smoking history. Therefore, we decided to calculate the number of pack-years participants had been smoking. Pack-years is a variable used in the health field to measure a person's smoking history (Bernaards, Twisk, Snel, Van Mechelen, & Kemper, 2001). It is calculated by multiplying the number of cigarette packs smoked per day by the number of years someone has been smoking. The pack-years variable is widely used in epidemiologic studies because of the association between chronic smoking and adverse health conditions (Thomas, 2014). Increasing pack-years has been linked to increasing risk for development of COPD (van Durme et al., 2009), with risk increasing significantly after 40 pack-years (Green, 2019).

We calculated a pack-years variable in our study by multiplying the variable to assess years of regular smoking ("For how many years did/have you smoke/d regularly?") by the variable to assess number of packs smoked per day ("About how many packs did/do you usually smoke per day then/now?"). This information was only available in the graduate sample. Participants who had never smoked were given a pack-years value of zero. We used a cut-off score of >40 pack-years to distinguish participants who were most at risk for developing COPD (Green, 2019). We then ran the analyses again with the pack years variable, first including then excluding participants who endorsed >40 pack-years.

The study sample consisted of $n = 4,082$ individuals. Demographic information and the new pack-years variable were examined by lifetime asthma diagnosis (Table 6). The average number of pack-years reported by the graduate cohort in the 1992 time point was 12.17 pack-years. Approximately 8.7% of the entire sample reported a smoking history of 40 or more pack-years. Within the lifetime asthma group, 9.4% of the participants reported 40 or more pack-years. There were no significant differences in between group comparisons between lifetime and no lifetime asthma with regards to pack-years.

Table 7 presents results from the binary logistic regression in which the likelihood of a lifetime asthma diagnosis was predicted by five personality traits (i.e., extraversion, agreeableness, conscientiousness, neuroticism, and openness) and the newly added pack-years variable, while controlling for demographic covariates. After excluding cases with missing data on one or more variables included in the analysis (i.e., listwise deletion) a total of $n = 3,476$ participants remained and were included in the analysis. No single variable had more than 10% missing data suggesting that bias was likely not introduced into our sample due to missingness (Bennett, 2001). Omnibus results showed good model fit ($\chi^2(8) = 8.633, p = .374$, Nagelkerke $R^2 = .050$). Neuroticism, openness, and conscientiousness were found to be significant predictors. An increase in the traits of neuroticism ($\beta = 0.145, p = .015, OR = 1.156$) and openness ($\beta = 0.213, p < .001, OR = 1.238$) were associated with an increased likelihood of lifetime asthma diagnosis. The trait of conscientiousness was associated with a decreased likelihood of asthma diagnosis ($\beta = -0.123, p = .034, OR = 0.884$).

Additionally, BMI ($\beta = 0.165, p = .002, OR = 1.179$), sex (male: $\beta = -0.748, p < .001, OR = 0.473$), and smoking history (yes: $\beta = 0.284, p = .026, OR = 1.328$) remained statistically significant predictors of reported lifetime asthma diagnosis. Pack-years was not a statistically significant predictor.

Table 8 presents results from the binary logistic regression in which the likelihood of a lifetime asthma diagnosis was predicted by five personality traits, the pack-years variable after removal of any participants who endorsed a smoking history of 40 or more pack-years. After excluding cases with missing data on one or more variables included in the analysis (i.e., listwise deletion) a total of $n = 3,156$ participants remained and were included in the analysis. No single variable had more than 10% missing data. Omnibus results showed good model fit ($\chi^2(8) = 5.887, p = .66$, Nagelkerke $R^2 = .044$). As in the initial analysis of the graduate sample, neuroticism, openness, and conscientiousness were still found to be significant predictors. An increase in the traits of neuroticism ($\beta = 0.124, p = .05, OR = 1.132$) and openness ($\beta = 0.2, p = .002, OR = 1.222$) were associated with an increased likelihood of lifetime asthma diagnosis. The trait of conscientiousness was associated with a decreased likelihood of asthma diagnosis ($\beta = -0.135, p = .026, OR = 0.874$). BMI ($\beta = 0.152, p = .007, OR = 1.164$) and sex (male: $\beta = -0.669, p < .001, OR = 0.512$) were also statistically significant predictors of reported lifetime asthma diagnosis. Smoking history was no longer a statistically significant indicator of lifetime asthma diagnosis. This might indicate that the ≥ 40 pack-years group did include cases of misdiagnosed

COPD because removing them removed smoking history as a significant predictor of lifetime asthma. Pack-years was not a statistically significant predictor.

These results indicate that for each one-standard deviation increase in neuroticism there is an associated 13.2% increase in the odds of having a lifetime asthma diagnosis. A one-standard deviation increase in the trait of openness was associated with an 22.2% increased likelihood of having a lifetime asthma diagnosis and a one-standard deviation increase in the trait of conscientiousness was associated with a 12.6% decrease.

The results from this analysis are in line with findings from the initial analysis. Neuroticism, openness, and conscientiousness remain significant indicators of reported lifetime asthma diagnosis even after the removal of the participants who endorsed ≥ 40 pack-years. This subset of the sample was removed from the analysis to help account for possible cases of COPD misdiagnosed as asthma in the graduate sample. After removing these cases and finding the same personality traits to be significant, the results indicate that misdiagnosed COPD cases were not a likely confounding factor for studying personality.

APPENDIX D

Future Directions and Clinical Implications

While this study does not suggest specific individualized treatment plans for patients with asthma, it does provide evidence that personality might be an important consideration in the treatment conceptualization of asthma patients. Treatment adherence has historically been low in the asthma community, with one study even reporting adherence rates as low as 30% (Bender et al., 1997). There is evidence that individualized and patient-centered treatment planning in the field of asthma could lead to improved treatment adherence (Milgrom & Bender, 1997; S. Smith et al., 2008). The results of our study seem to indicate that personality factors could be the next avenue of exploration in individualizing care for patients with asthma.

Previous research has shown that specific personality traits are associated with different learning styles, implying that asthma education could be tailored to these preferred styles. For example, neuroticism has been linked to the *undirected* learning style (Busato et al., 1998). The undirected learning style is associated with issues in processing material for study and with discriminating what information is important and what is not, especially as the amount of material increases (Vermunt, 1992). This appears to indicate that efforts to improve treatment adherence among high-neuroticism asthma patients by increasing the educational material alone might actually have the opposite effect by overwhelming the patients and making it harder for them to parse out the most important aspects of their care. Future studies could further the field of personality-informed care by researching specific treatment plans for individuals high in

certain traits. The current research implies that future treatment plans might be conceptualized around individuals scoring higher in the traits of neuroticism and openness, and lower in the trait of conscientiousness.

APPENDIX E

Additional Tables and Figures

Table 5

Strategies to improve adherence

1. Educate:	Provide sufficient information about disease and its treatment; involve all members of the treatment team in educating patients
2. Communicate:	Discuss treatment in detail, listen to the patient, provide written instructions, build trust
3. Negotiate:	Establish treatment goals together with the patient, adapt and simplify the dosing regimen to the patient's characteristics
4. Streamline:	Eliminate barriers that prevent patient's contact with the care giver, increase frequency and availability of appointments
5. Individualize:	Be resourceful with more difficult patients, increase telephone contacts, design individualized education and action plans, involve other family members, refer dysfunctional patients for psychological help

From Milgrom H, Bender B. Nonadherence with the asthma regimen. *Pediatr Asthma Allergy Immunol* 1997;11:3-8.

Table 6
Further Descriptive Statistics by Asthma Diagnosis (Graduate Sample)

	Whole Sample		No Lifetime Asthma		Lifetime Asthma		Group Comparisons		
	Mean	SD	Mean	SD	Mean	SD	df	t	p
Extraversion	23.09	5.41	23.11	5.43	22.95	5.28	4016	0.63	.52
Agreeableness	28.63	4.40	28.63	4.41	28.57	4.34	4030	0.32	.74
Conscientiousness	29.31	4.06	29.38	4.05	28.79	4.09	4030	3.02	.003
Neuroticism	15.86	4.93	15.78	4.92	16.43	4.98	4006	-2.73	.006
Openness	21.91	4.80	21.84	4.74	22.44	5.15	597.74	-2.44	.015
BMI	26.57	4.35	26.51	4.26	26.99	4.91	577.88	-2.04	.042
Household income	45565	48096	45926	48190	42917	47367	3713	1.24	.21
Education (years)	13.61	2.44	13.59	2.43	13.74	2.51	4073	-1.29	.19
Pack years	12.17	21.64	12.08	21.83	12.87	20.18	4004	-0.747	.46
	Frequency	%	Frequency	%	Frequency	%	df	χ^2	p
Sex									
Female	2222	54.4	1901	52.9	321	65.6	1	28.15	< .001
Male	1860	45.6	1692	47.1	168	34.4			
Missing	0	0.0	0	0.0	0	0.0			
Ever smoked regularly									
No	1935	47.4	1733	48.2	202	41.3	1	7.41	.006
Yes	2088	51.2	1812	50.4	276	56.4			
Missing	59	1.4	48	1.3	11	2.2			
Smoke regularly now*									
No	1472	36.1	1267	35.3	205	41.9	1	2.46	.11
Yes	615	15.1	545	15.2	70	14.3			
Missing	1995	48.9	1781	49.6	214	43.8			
Pack years									
< 40	3651	89.4	3225	89.8	426	87.1	1	0.52	.47
≥ 40	355	8.7	309	8.6	46	9.4			
Missing	76	1.9	59	1.6	17	3.5			
Physical exercise									
≥ 3 times / week	643	15.8	561	15.6	82	16.8	3	1.35	.71
1 or 2 times / week	648	15.9	578	16.1	70	14.3			
1 – 3 times / month	740	18.1	654	18.2	86	17.6			
< 1 time / month	1951	47.8	1714	47.7	237	48.5			

Missing	100	2.4	86	2.4	14	2.9			
Marital status									
Married	3473	85.1	3070	85.4	403	82.4	4	8.55	.07
Separated	29	0.7	21	0.6	8	1.6			
Divorced	363	8.9	315	8.8	48	9.8			
Widowed	81	2.0	69	1.9	12	2.5			
Never married	135	3.3	117	3.3	18	3.7			
Missing	1	< .01	1	< .01	0	0.0			

Note. Participants with Asthma information is $n = 4082$. * “Smoke regularly now” was only assessed in participants who responded affirmatively to the question “Ever smoked regularly”

Table 7
Binomial Logistic Regression Results for Lifetime Asthma Diagnosis, Including >40 Pack Years (Graduate Sample)

	B	SE	p	OR	95% CI for OR	
					Lower	Upper
Extraversion	-0.102	0.058	.07	0.903	0.806	1.011
Agreeableness	0.063	0.061	.30	1.065	0.945	1.199
Conscientiousness	-0.123	0.058	.034	0.884	0.789	0.991
Neuroticism	0.145	0.060	.015	1.156	1.028	1.300
Openness	0.213	0.061	< .001	1.238	1.098	1.396
BMI	0.165	0.053	.002	1.179	1.063	1.308
Income	0.015	0.060	.80	1.015	0.903	1.141
Education (years)	0.094	0.055	.09	1.098	0.985	1.225
Pack years	0.002	0.003	.59	1.002	0.996	1.007
Smoking history						
Yes	0.284	0.128	.026	1.328	1.034	1.706
Sex						
Male	-0.748	0.128	< .001	0.473	0.368	0.608
Physical exercise						
1 or 2 times / week	-0.267	0.189	.15	0.766	0.529	1.108
1 – 3 times / month	-0.177	0.180	.32	0.838	0.588	1.194
< 1 time / month	-0.222	0.156	.15	0.801	0.589	1.087
Marital status						
Separated	1.034	0.437	.018	2.814	1.195	6.624
Divorced	-0.042	0.181	.81	0.959	0.673	1.365
Widowed	0.037	0.340	.91	1.038	0.533	2.020
Never married	0.206	0.269	.44	1.229	0.726	2.081

Note. Analytic $n = 3476$. $\chi^2(8) = 8.633$, $p = .374$. Nagelkerke $R^2 = .050$. Reference groups are: female (sex), married (marital status), “no” (past smoking habit), and “ ≥ 3 times per week” (physical exercise). Analytic sample *includes* those with pack years ≥ 40 .

Table 8
Binomial Logistic Regression Results for Lifetime Asthma Diagnosis, Excluding ≥ 40 Pack Years (Graduate Sample)

	B	SE	p	OR	95% CI for OR	
					Lower	Upper
Extraversion	-0.102	0.061	.09	0.903	0.801	1.019
Agreeableness	0.037	0.064	.56	1.038	0.915	1.177
Conscientiousness	-0.135	0.061	.026	0.874	0.775	0.984
Neuroticism	0.124	0.063	.050	1.132	1.000	1.281
Openness	0.200	0.065	.002	1.222	1.076	1.387
BMI	0.152	0.056	.007	1.164	1.042	1.299
Income	0.015	0.064	.81	1.015	0.896	1.151
Education (years)	0.082	0.059	.16	1.085	0.967	1.217
Pack years	< .001	0.006	.99	1.000	0.988	1.012
Smoking history						
Yes	0.278	0.143	.051	1.321	0.999	1.747
Sex						
Male	-0.669	0.135	< .001	0.512	0.393	0.667
Physical exercise						
1 or 2 times / week	-0.258	0.197	.19	0.773	0.525	1.137
1 – 3 times / month	-0.264	0.193	.17	0.768	0.526	1.121
< 1 time / month	-0.144	0.164	.37	0.866	0.628	1.193
Marital status						
Separated	1.029	0.465	.027	2.798	1.126	6.957
Divorced	-0.194	0.202	.33	0.824	0.554	1.224
Widowed	-0.012	0.355	.97	0.988	0.492	1.983
Never married	0.043	0.300	.88	1.044	0.580	1.880

Note. Analytic $n = 3156$. $\chi^2(8) = 5.887$, $p = .660$. Nagelkerke $R^2 = .044$. Reference groups are: female (sex), married (marital status), “no” (past smoking habit), and “ ≥ 3 times per week” (physical exercise). Analytic sample *does not include* those with pack years ≥ 40 .

APPENDIX F

WLS Protocols

ORIGINAL WLS SURVEY FOR HIGH SCHOOL SENIORS

HSR _____
HN _____

MY PLANS BEYOND HIGH SCHOOL

Name _____ Age _____ M _____ F _____
School _____ Home address _____
Father's name _____ (or other parent or guardian)

1. I plan: (Place a cross (x) before the statement which describes what you plan to do next year)

☐ To continue going to school	☐ To go into military service
☐ To get a job	☐ To work at my home
☐ To become an apprentice	☐ I have no definite plans
☐ (Other, specify) _____	

If the plan you have checked is not what you would really like to do, place an (L) in front of the statement above which described what you would most like to do, then state what circumstances prevent you from doing what you would most like to do. _____

How sure are you that you will be doing what you plan? _____ certain _____ uncertain

2. If you checked that you plan to go to school next year, what kind of school do you plan to attend?

☐ Vocational school	☐ Liberal arts college
☐ County teachers college	☐ University
☐ State college	☐ Business or trade school
☐ University	☐ Other _____ (Specify)

Do you plan to attend school outside Wisconsin? _____ yes _____ no

I plan to attend school _____ full-time _____ part-time

3. If you plan to continue your schooling or training, answer the items below. If not, go to question 4.

I plan to enter the following courses or fields:

In trade or vocational school _____ Specify field or training _____

Apprenticeship _____ Specify field or trade _____

College or university: (check the field of your interest)

☐ Agriculture	☐ Engineering	☐ Liberal Arts
☐ Architecture	☐ Fine Arts	☐ Medicine
☐ Aeronautics	☐ Forestry	☐ Nursing
☐ Business	☐ Home Economics	☐ Pharmacy
☐ Chemistry	☐ Journalism	☐ Social Work
☐ Dentistry	☐ Law	☐ Teaching
☐ Undecided	☐ (Other) _____	☐ Veterinary

4. If you plan to get a job next year, check the statement below which applies to you.

☐ I have applied, but do not yet have a job
☐ I have applied and have been accepted
☐ I have not applied
☐ I will continue in a job I now have
☐ Other _____

My job will be: (describe) _____

(Name of firm) _____

It will pay about _____ per week

5. To what extent have you discussed your plans with your teachers or school counselors?

☐ not at all	☐ some	☐ very much
-------------------------------------	-------------------------------	------------------------------------

How much did they influence your plans?

☐ not at all	☐ some	☐ very much
-------------------------------------	-------------------------------	------------------------------------

Do not write in this col.
1-6 _____
7-8 _____
9-10 _____
11 _____
12 _____
13 _____
14 _____
15 _____
16 _____
17 _____
18 _____
19 _____
20-21 _____
22-23 _____
24 _____
25 _____

6. To what extent have you discussed your plans with your parents?
☐ not at all ☐ some ☐ very much

How much did they influence your plans?

☐ not at all ☐ some ☐ very much

7. Education of father and mother (check highest level attained)

	Father	Mother
High School		
did not attend	☐	☐
attended	☐	☐
graduated from	☐	☐
Trade or business school:		
attended	☐	☐
College:		
attended	☐	☐
graduated from	☐	☐
has master's or Ph.D. degree	☐	☐
Do not know	☐	☐

8. Education of older brother and sister who have had most schooling. (Check the highest level reached; if more than one, show number at each level.)

	Brother	Sister
Some high school	☐	☐
High school graduate	☐	☐
Some college	☐	☐
Attending college	☐	☐
College graduate	☐	☐
Attending graduate school (or attended)	☐	☐
None older	☐	☐

9. (a) My father is engaged in the type of occupation checked in the left hand column below.

(b) I hope eventually to enter the type of occupation checked in the right hand column below.

Father

Me

☐ Office work (cashier, clerk, secretary, bookkeeper, etc.)	☐
☐ Professional (doctor, lawyer, minister, teacher, etc.)	☐
☐ Executive (manages large business, industry, firm)	☐
☐ Factory worker (laborer, janitor, farm hand, etc.)	☐
☐ Salesman (insurance, real estate, auto, store, etc.)	☐
☐ Owns, rents, manages small business (store, station, newspaper, cafe, etc.)	☐
☐ Owns, rents, manages farm	☐
☐ Other occupation (be specific) _____	☐

(c) If your mother has a job outside the home, place an (M) before the type of occupation in which she works.

10. How much do you think it costs per school year to attend college away from home?

☐ Less than \$1000 ☐ Between \$1500 and \$2000
☐ Between \$1000 and \$1500 ☐ More than \$2000

11. How do you estimate the ability of your parents to help you go to college, if you desire to go?

☐ can easily afford it ☐ cannot afford it
☐ can afford it, but with much sacrifice ☐ I must work to help support the family

12. In terms of income or wealth of families in my community, I think my family is:

☐ considerably above average ☐ average
☐ somewhat above average ☐ somewhat below average
☐ considerably below average

13. (a) Have you ever considered attending college? ☐ yes ☐ no

(b) If no, would you consider it if you had the money ☐ yes ☐ no

(c) Would you borrow money for college expenses if you could pay it back on the installment plan after leaving college ☐ yes ☐ no

(d) About how much could you or your family contribute to your college expenses next year (if you were going)?

☐ none ☐ less than \$500 ☐ Between \$500 and \$1000
☐ between \$1000 and \$1500 ☐ all my expenses

14. Did you apply for admission to a school or college? (Check the statements which apply to you)

- ☐ I have not applied
☐ I have not applied, but plan to
☐ I have applied but was refused because:
☐ I did not rank high enough
☐ I did not take the right subjects
☐ The school could not take more students
- ☐ I have applied, but have not heard
☐ I plan to apply
☐ I have been tentatively admitted, and expect to attend:

(Name of School(s))

(Name of School)

I sent applications to _____ schools
(number)

15. Did you take the National Merit Scholarship Examinations?

_____ yes _____ no

16. Did you take the College Entrance Board Examinations:

_____ yes _____ no

_____ Scholastic Aptitude Test

_____ Subject matter in (fields) _____

17. Have you applied for a scholarship?

- ☐ I did not apply
☐ I have applied, but have not yet heard
☐ I have applied, but was not successful
☐ I have received a scholarship from:

_____ a college

(Name)

_____ company or corporation

(Name)

_____ organization or society

(Name)

_____ other

18. The scholarship or awards I have will pay the following part of my college expenses next year:

_____ tuition, one semester

_____ tuition, plus \$ _____

_____ tuition, both semesters

_____ \$ _____

(cash)

_____ all expenses

19. If you are going to school next year what part of your school or college expenses do you expect to provide from summer earnings or part-time work at school?

_____ Less than \$250

_____ Between \$500 and \$750

_____ Between \$250 and \$500

_____ More than \$750

20. Has marriage or the early prospect of marriage influenced your plan for next year? _____ yes _____ no

21. Place a circle around the number of semesters in which you studied the following subjects?

Algebra 0 1 2 3 4
 Geometry 0 1 2 3 4
 Trigonometry 0 1 2 3 4
 Biology 0 1 2 3 4
 Chemistry 0 1 2 3 4
 Physics 0 1 2 3 4

English 0 2 4 6 8
 History 0 2 4 6 8
 Social Studies 0 2 4 6 8
 Foreign Language 0 2 4 6 8
 Specify Language (s) _____

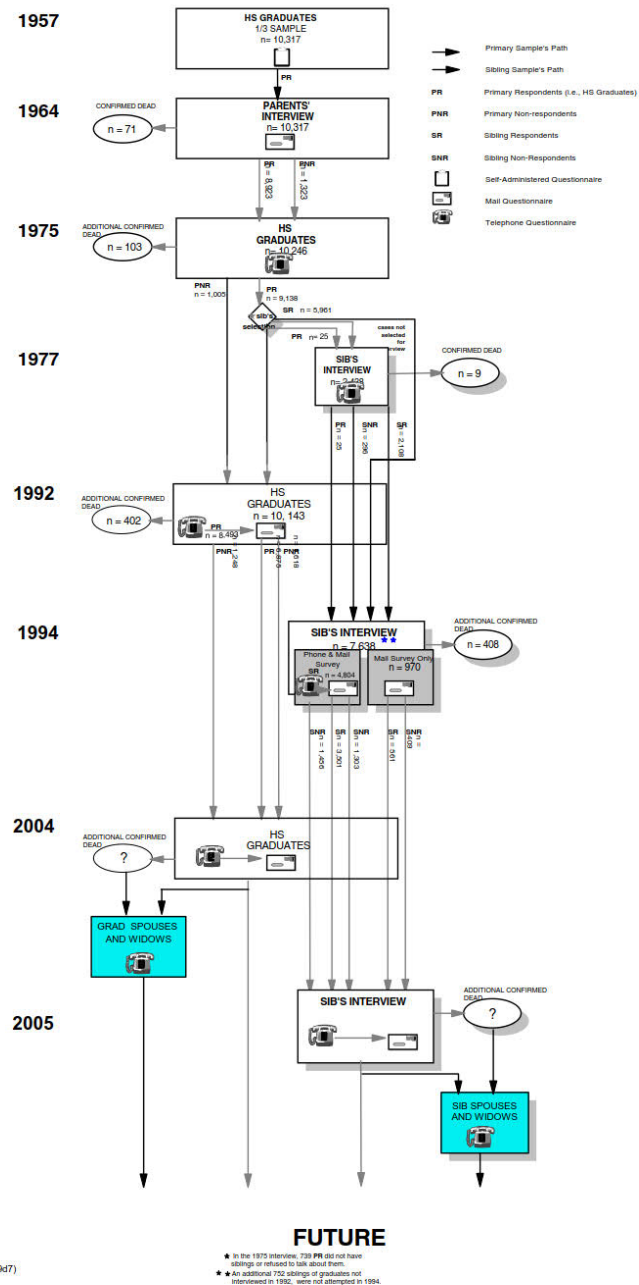
Did you take a college preparatory course? _____ yes _____ no

22. Did your high school give you practice in the following college-type experiences? (Check those in which you had considerable experience)

- ☐ Taking notes from lectures
☐ Writing term reports
☐ Taking final semester examinations during a scheduled period
☐ Making individual studies with oral reports
☐ Long-term assignments
☐ Planning own use of study time rather than required study period
☐ (If other, describe) _____

SAMPLE PARTICIPATION CHART

WLS: Sample Flow for Original 1957 High School Graduates and their Selected Siblings



HOW TO READ CATI & CAPI FLOWCHARTS

HOW TO READ FLOWCHARTS

The flowcharts are visual representations of the survey programming used for the CATI and CAPI interviews (1992/94, 2003, and 2010 rounds of data collection). They allow users to see the phrasing and sequencing of questions asked to respondents. Although we tried to make these flowcharts as representative as possible, some programming language is too complex to display in a concise manner. Additionally, some questions have not been conveyed word for word due to slight variations in phrasing that are dependent on characteristics of each respondent.

Below is a basic key to help you navigate through the flowcharts; some components are not included here due to their rarity and complexity.

Words inside of grey boxes represent what was actually asked to respondents. Often, questions are accompanied by instructions to the interviewer.

Standard Survey Item Box

>y_item< What is/was the name of your [current/ last employer]? (INTERVIEWER: Do not probe.)

Standard Check Box

>y_itemcheck< Is this person married or partnered?

Married

Partnered

>y_item< How long have you been married?

Words inside of blue "check" boxes will not be asked to the respondent; instead, these items will dictate the sequencing of survey questions based on previously collected data OR be directed towards the interviewer.

Words inside of tan "note" boxes will neither be asked to respondents nor directly affect the sequencing of survey questions. They explain complicated programming or provide users with relevant background information.

Standard Note Box

Can help to explain more complex programming that would otherwise take up too much space.

Yellow boxes are called "routing buffers" and indicate a survey path followed by all respondents asked the question above a buffer.

Routing Buffer

>y_item2< Which child is that?

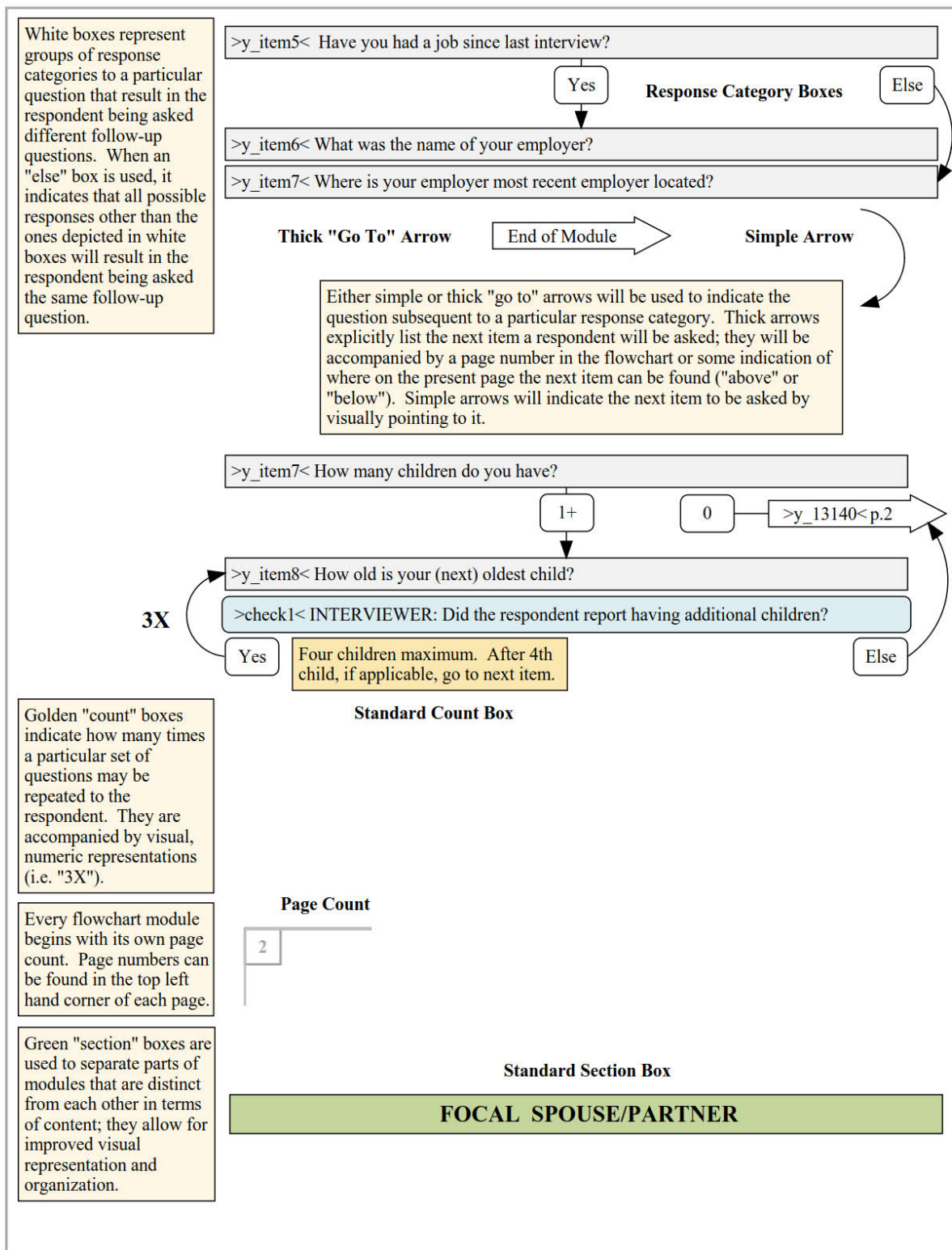
>y_item3< Which spouse is that?

>y_item4< How well does this person understand your needs?

Words inside of purple "guide" boxes will not be asked to the respondent. They function in the same way as blue "check" boxes but may not be attributable to a particular item in the programming code; items on different pages can reference them with "Guide #X".

Standard Guide Box

Guide: #2 Does y_emdflag = 1? (See Guide #1 above for the implications of this value)

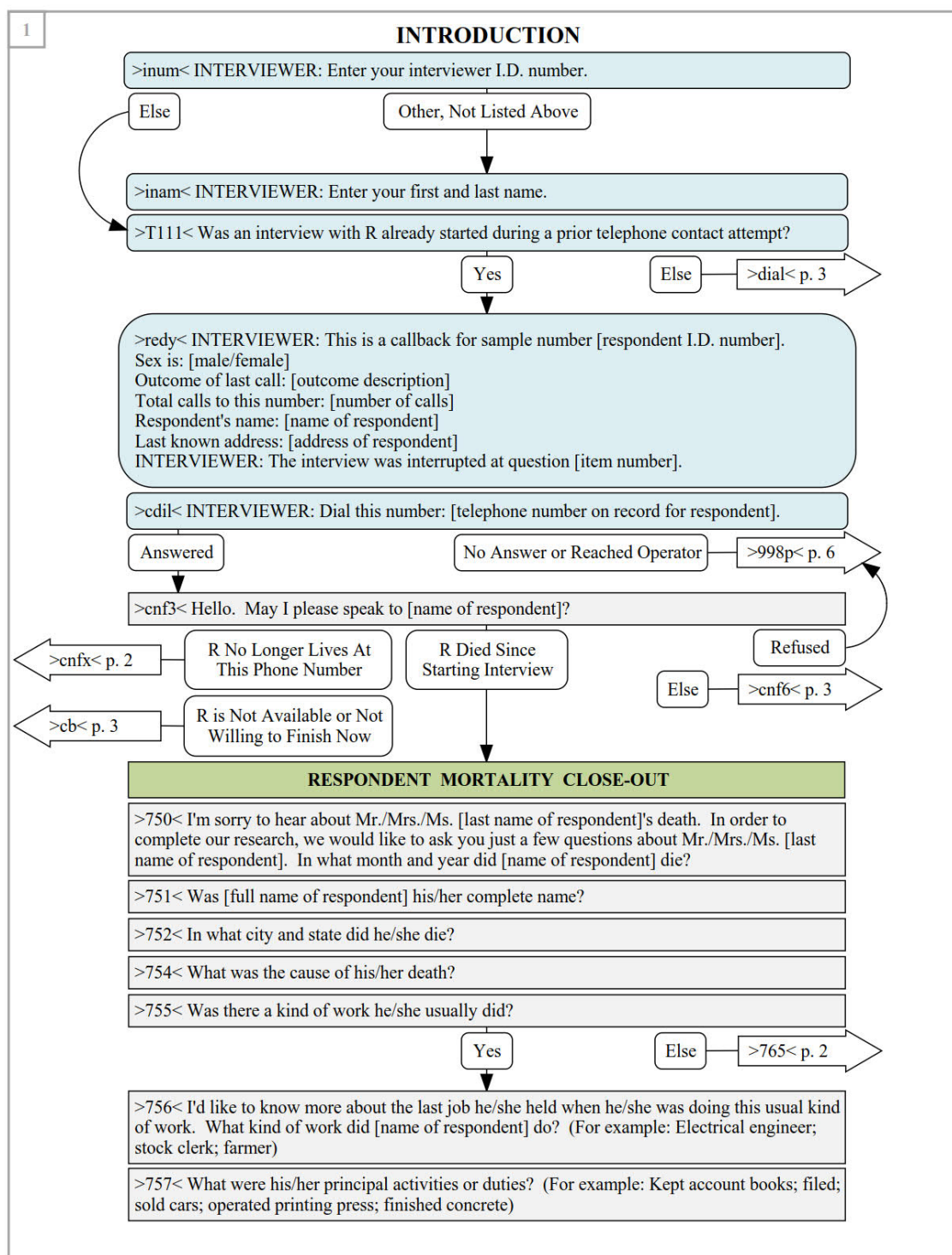


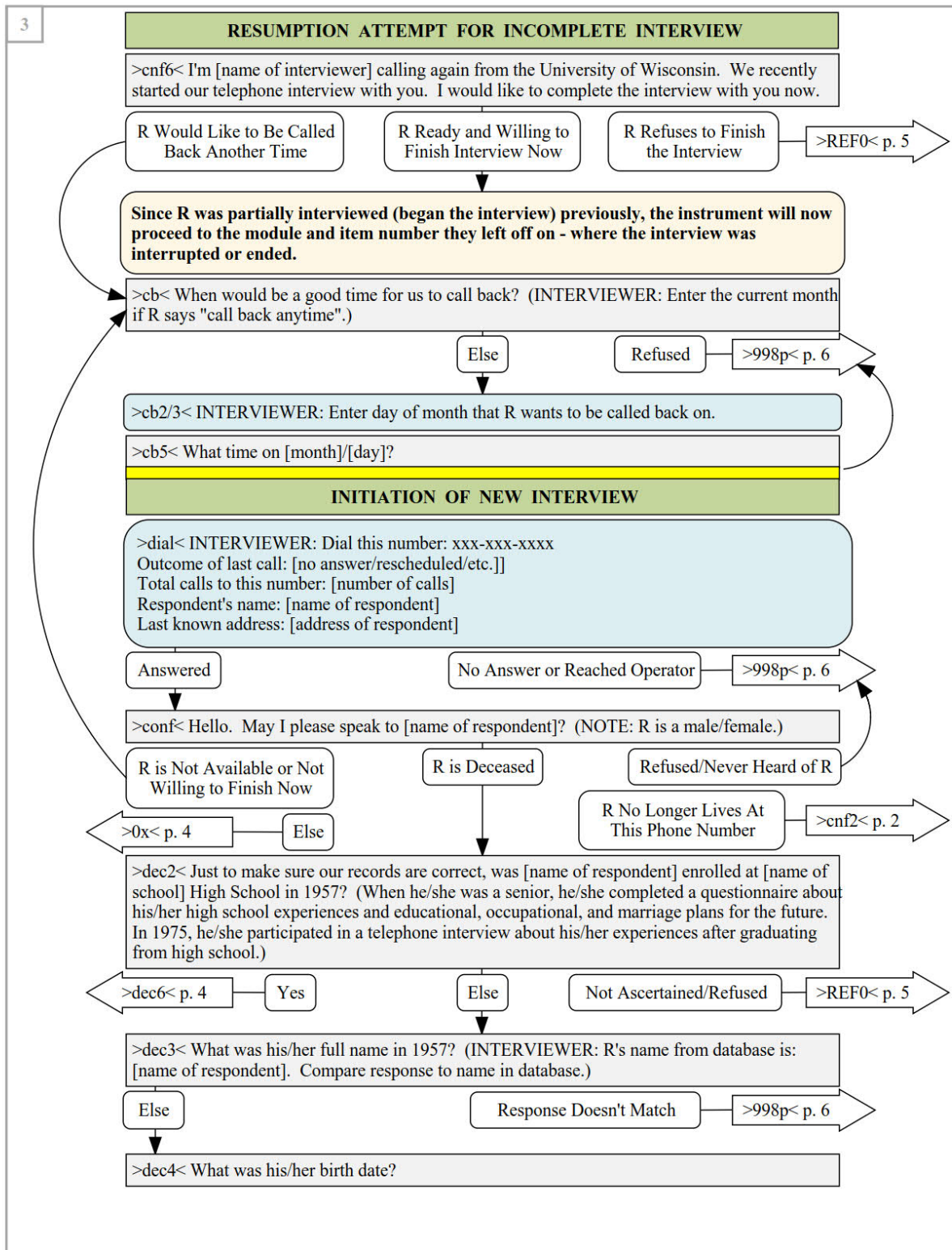
Red "stop" boxes are used to indicate where a given module ends. The text inside of them reading "End Of.....Module" functions as a link and will be surrounded by a blue outline. If clicked, it will transport users back to the "Overview" flowchart for each round of data collection.

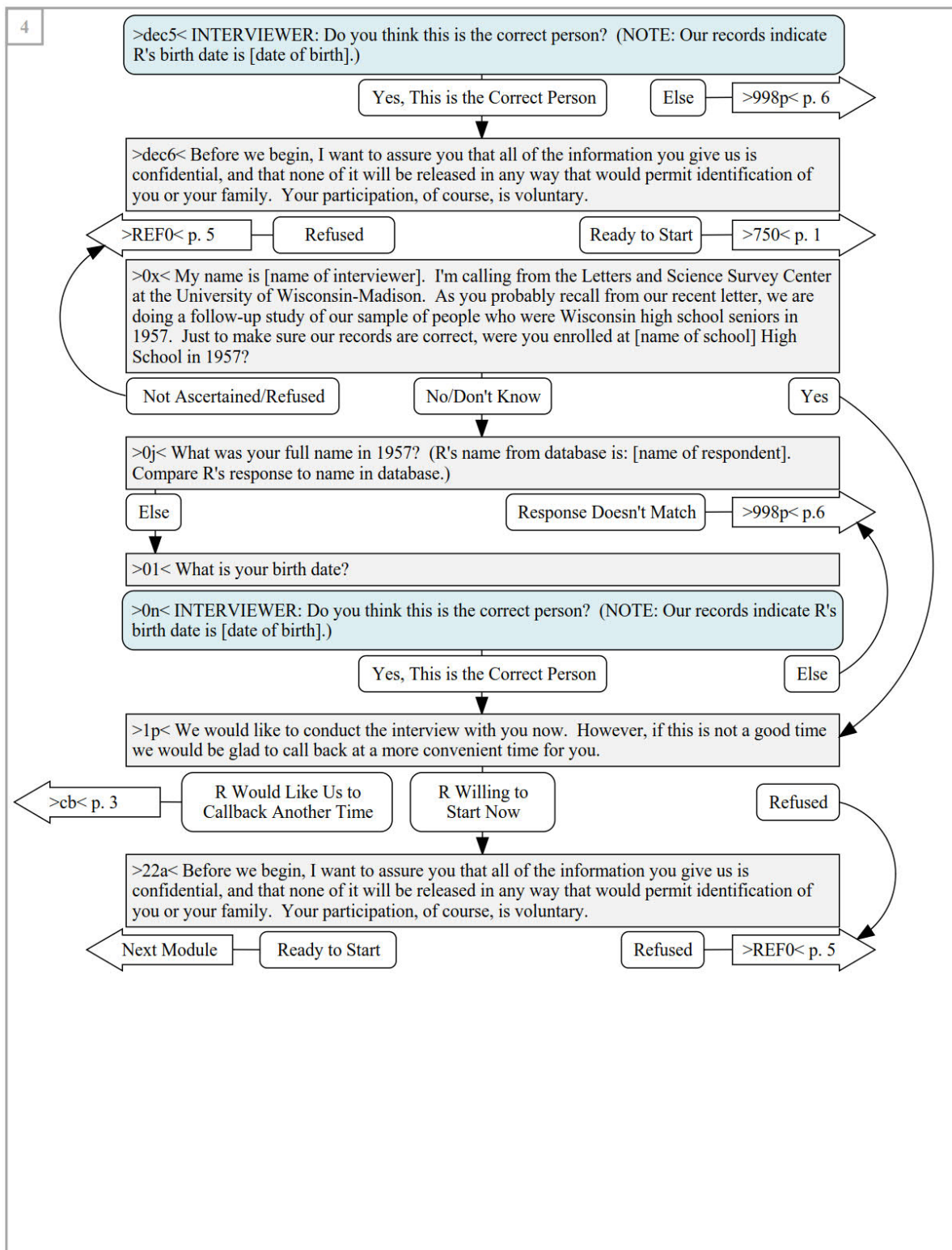
Standard Stop Box

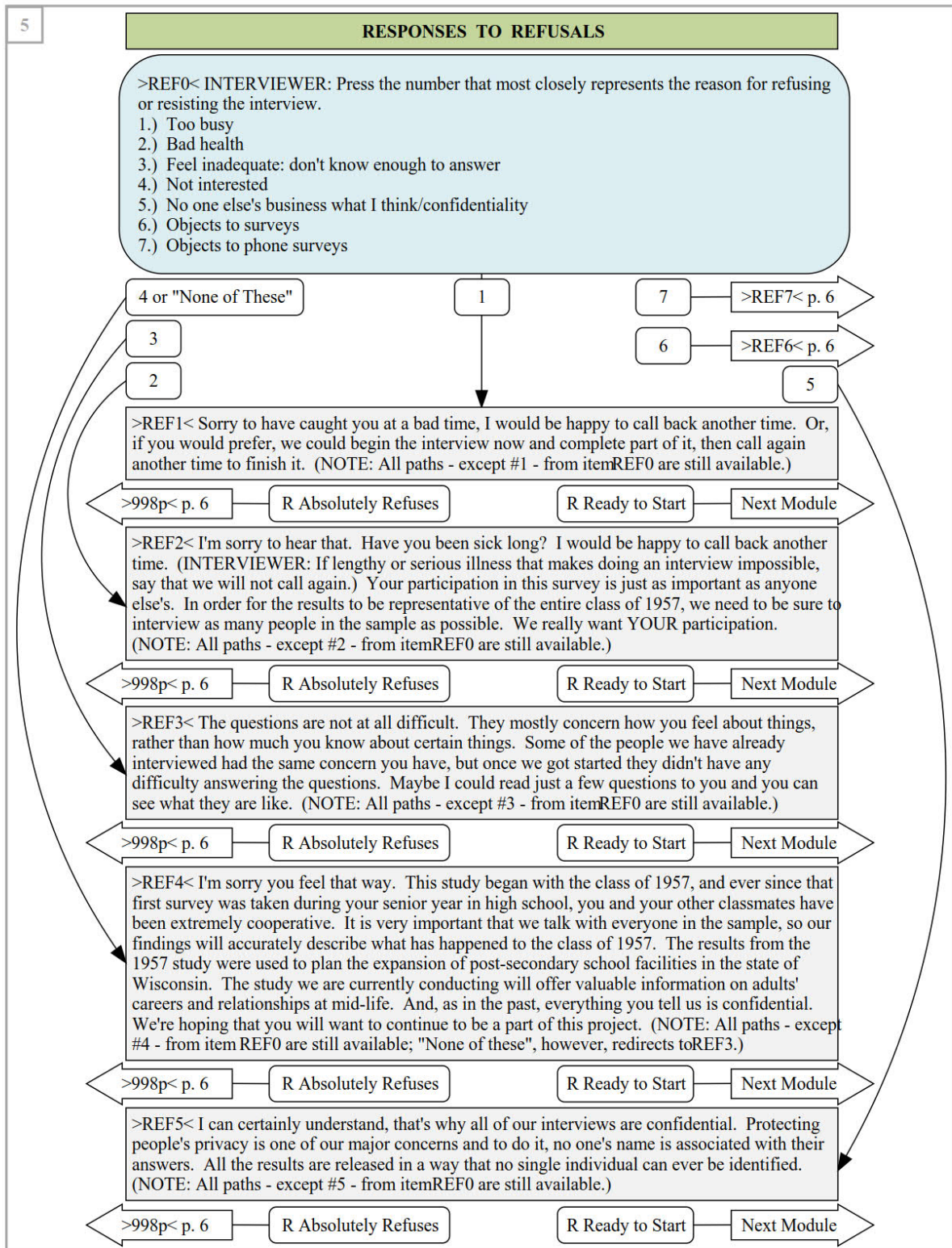
END OF FLOWCHART KEY MODULE

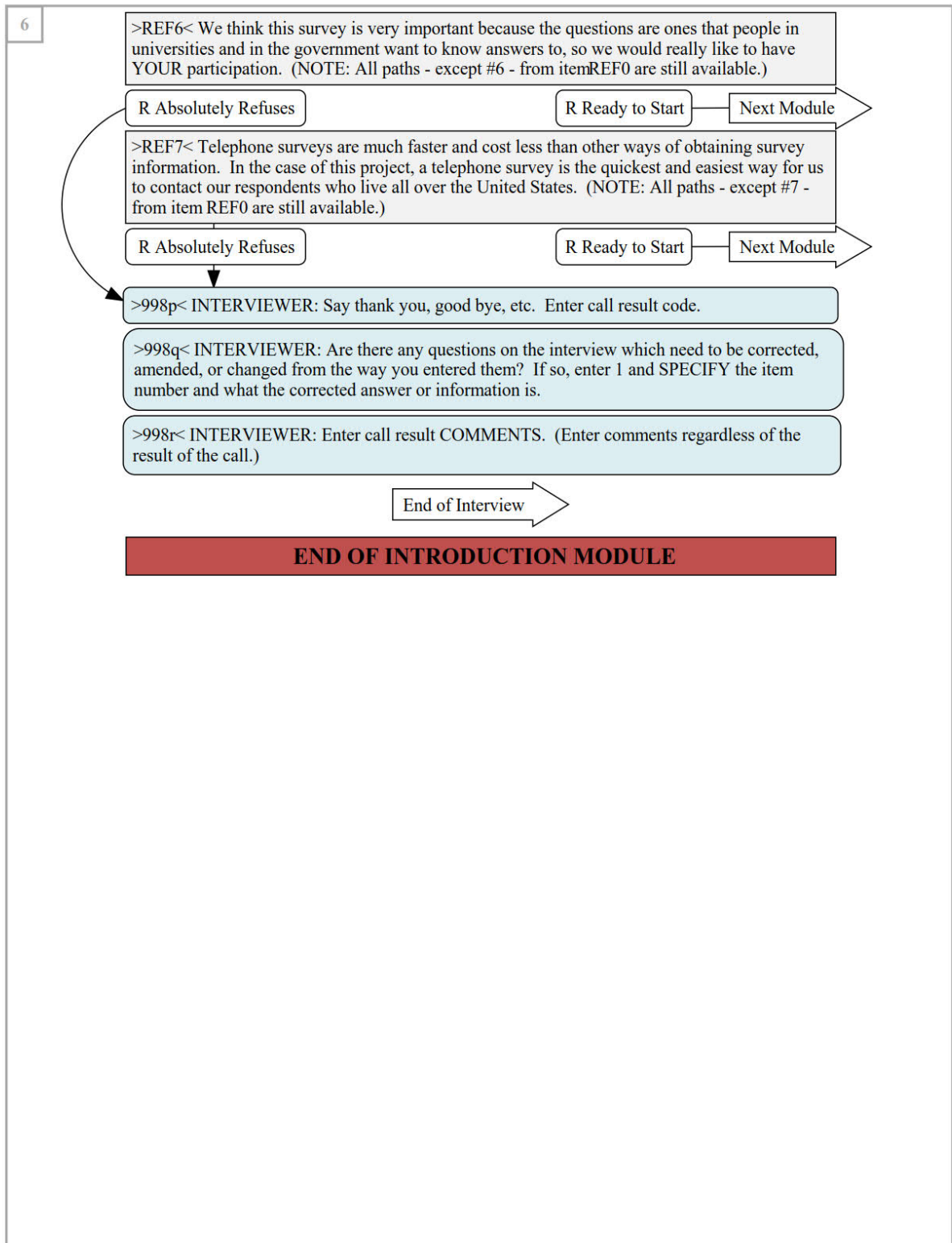
INTRODUCTION CATI FLOWCHART



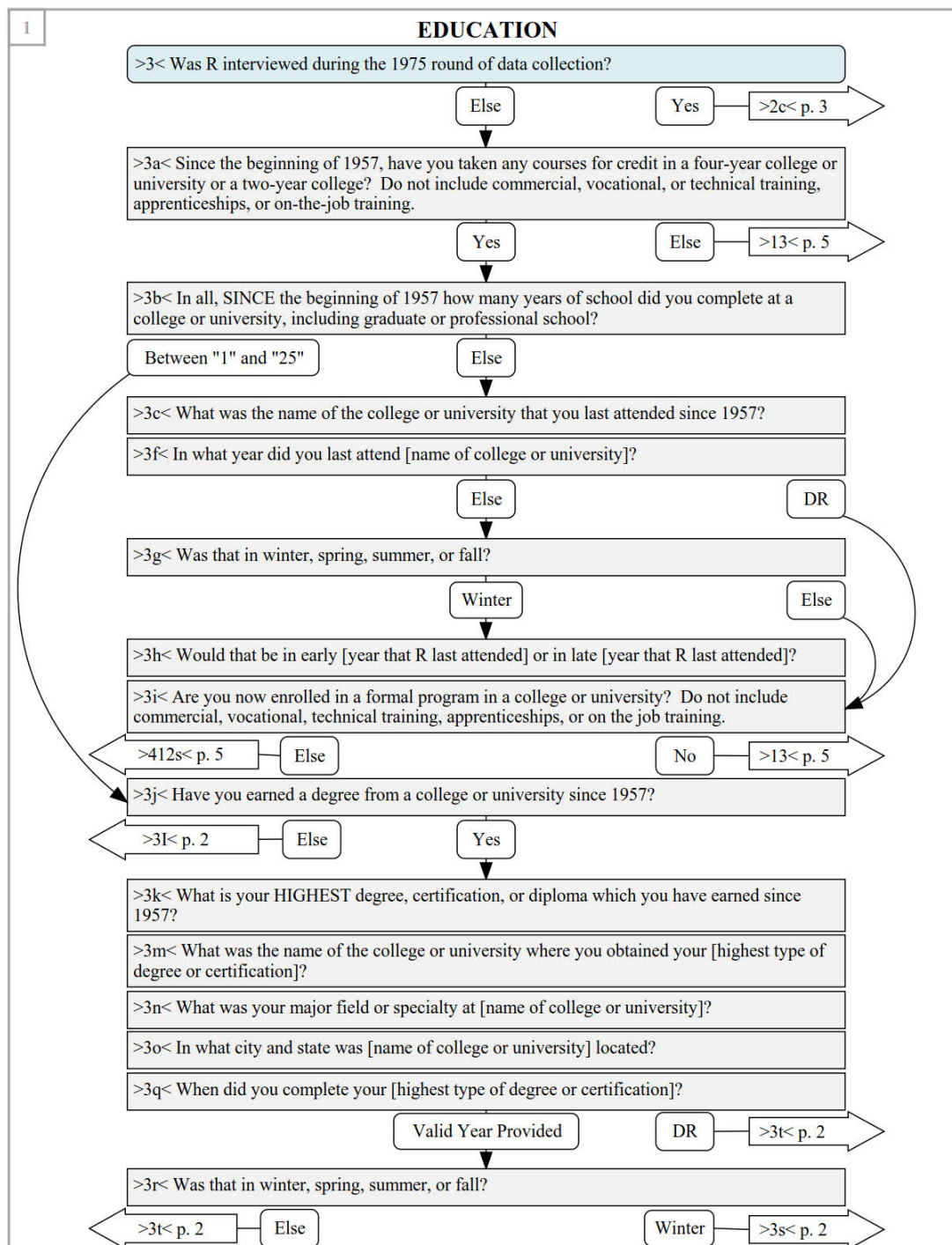


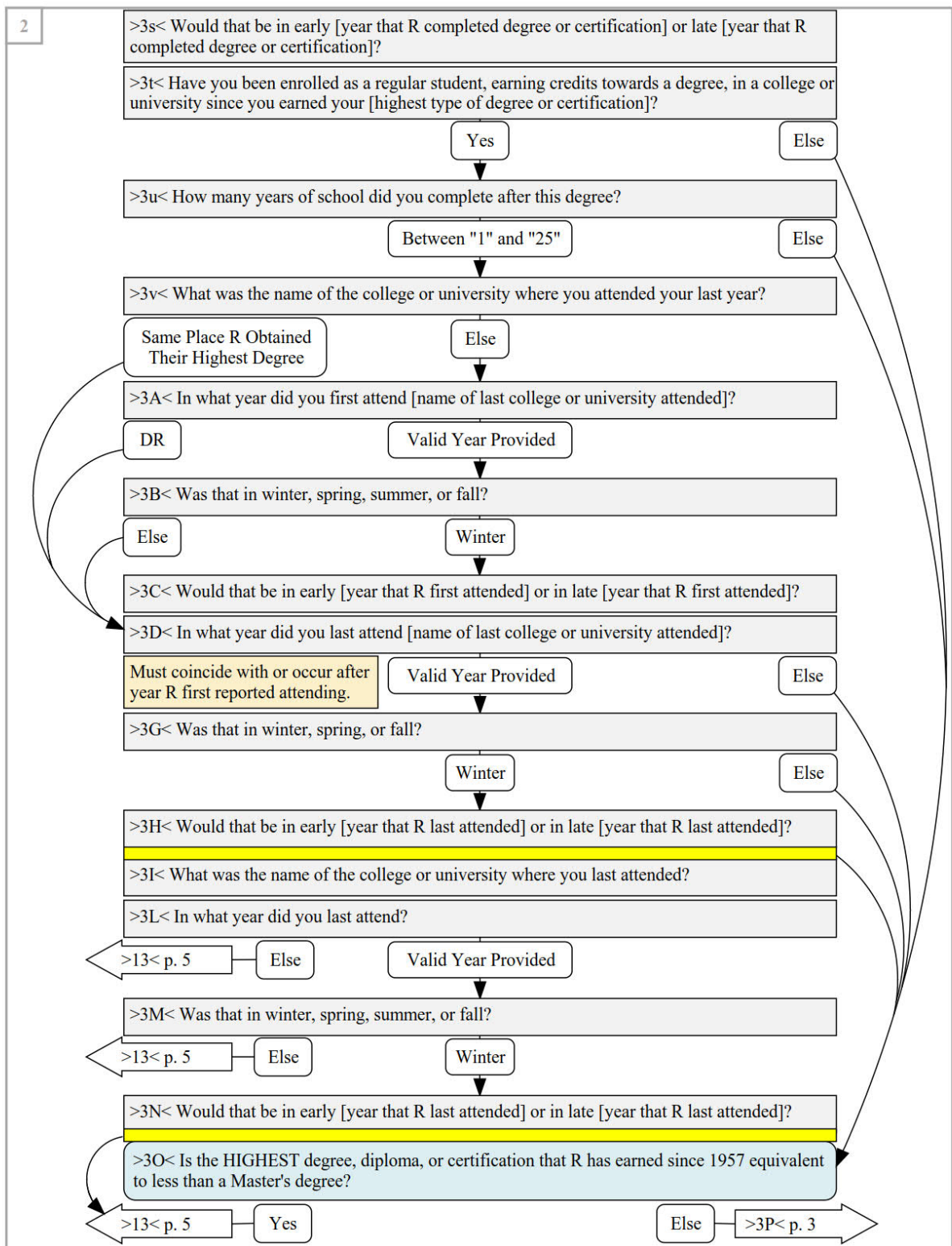


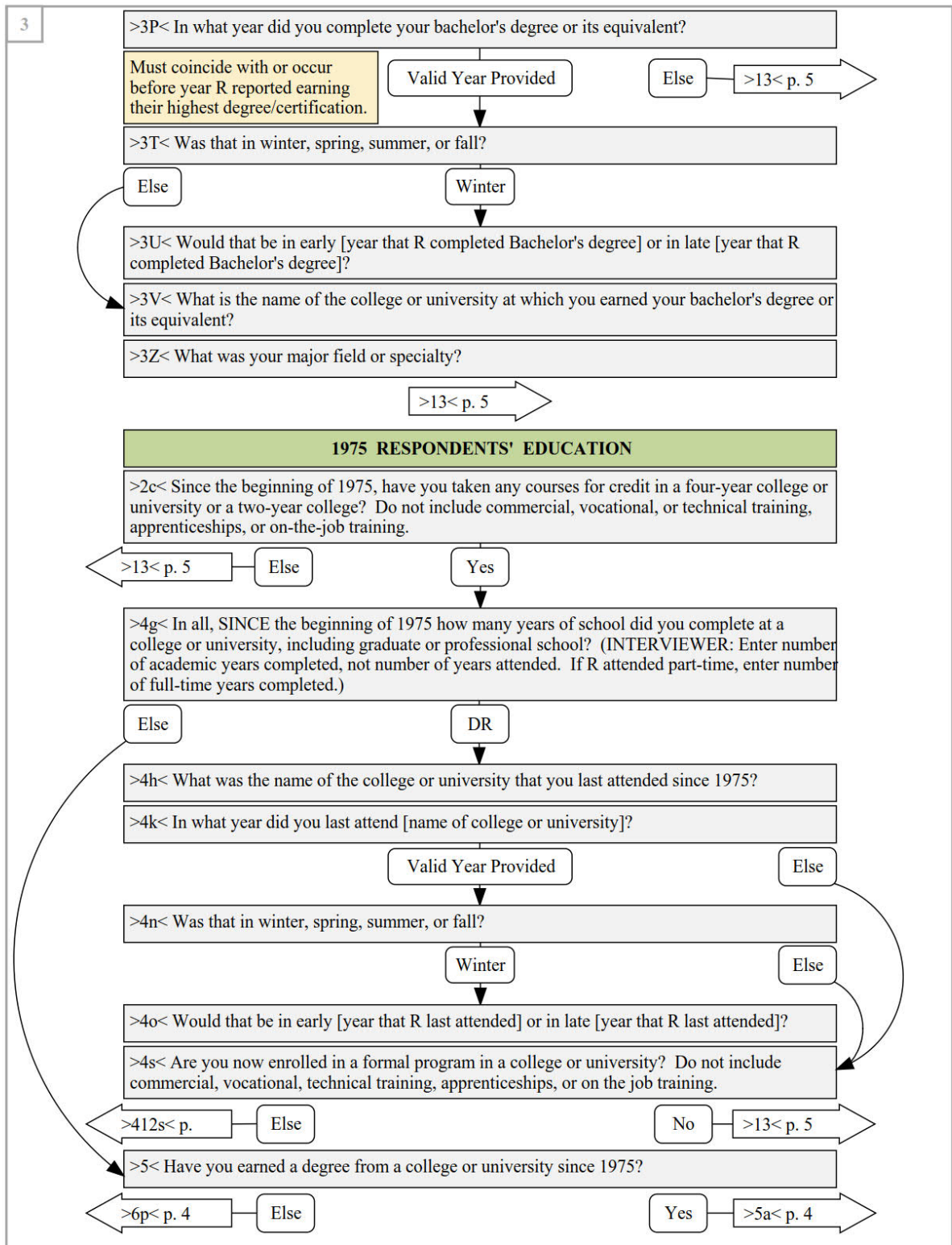


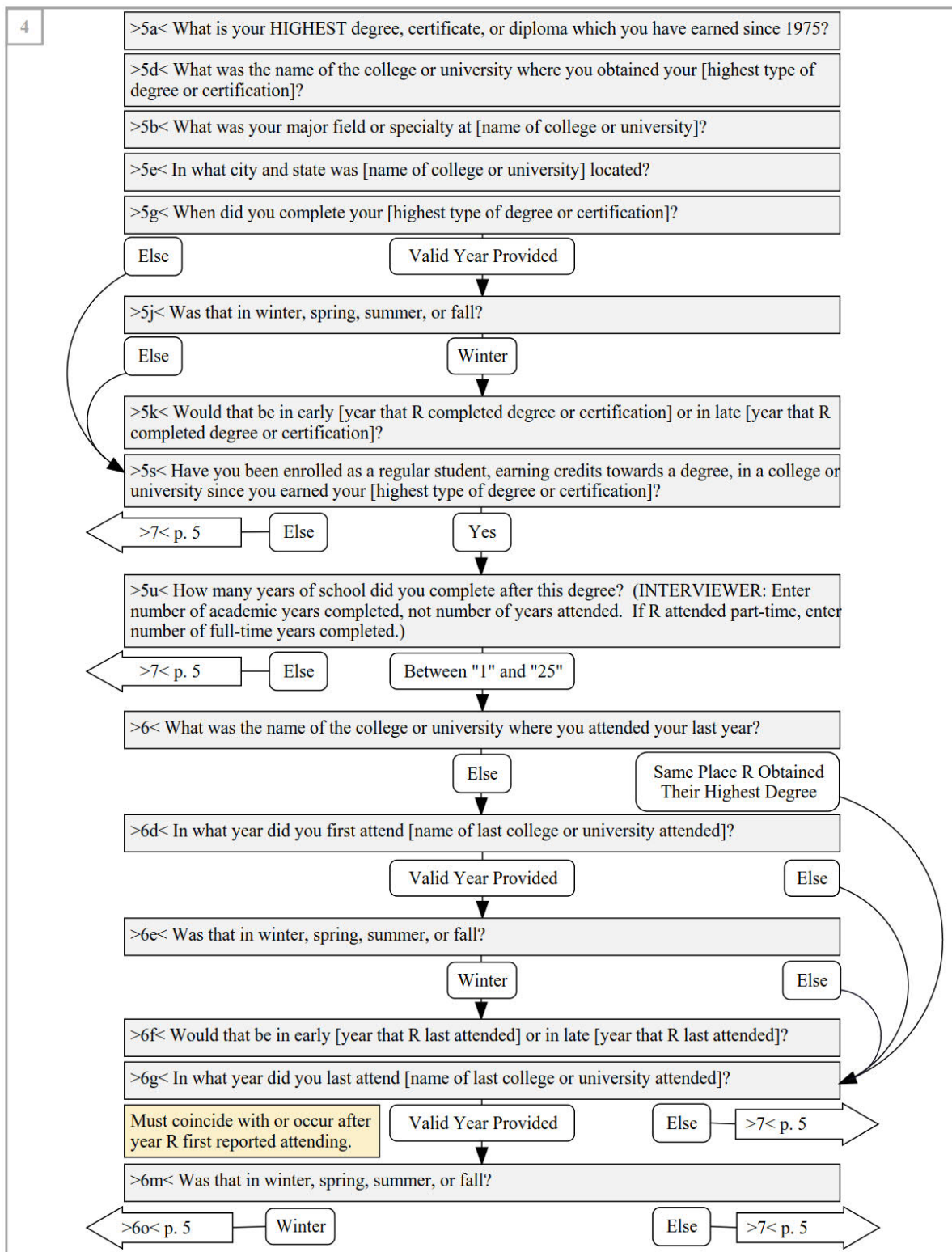


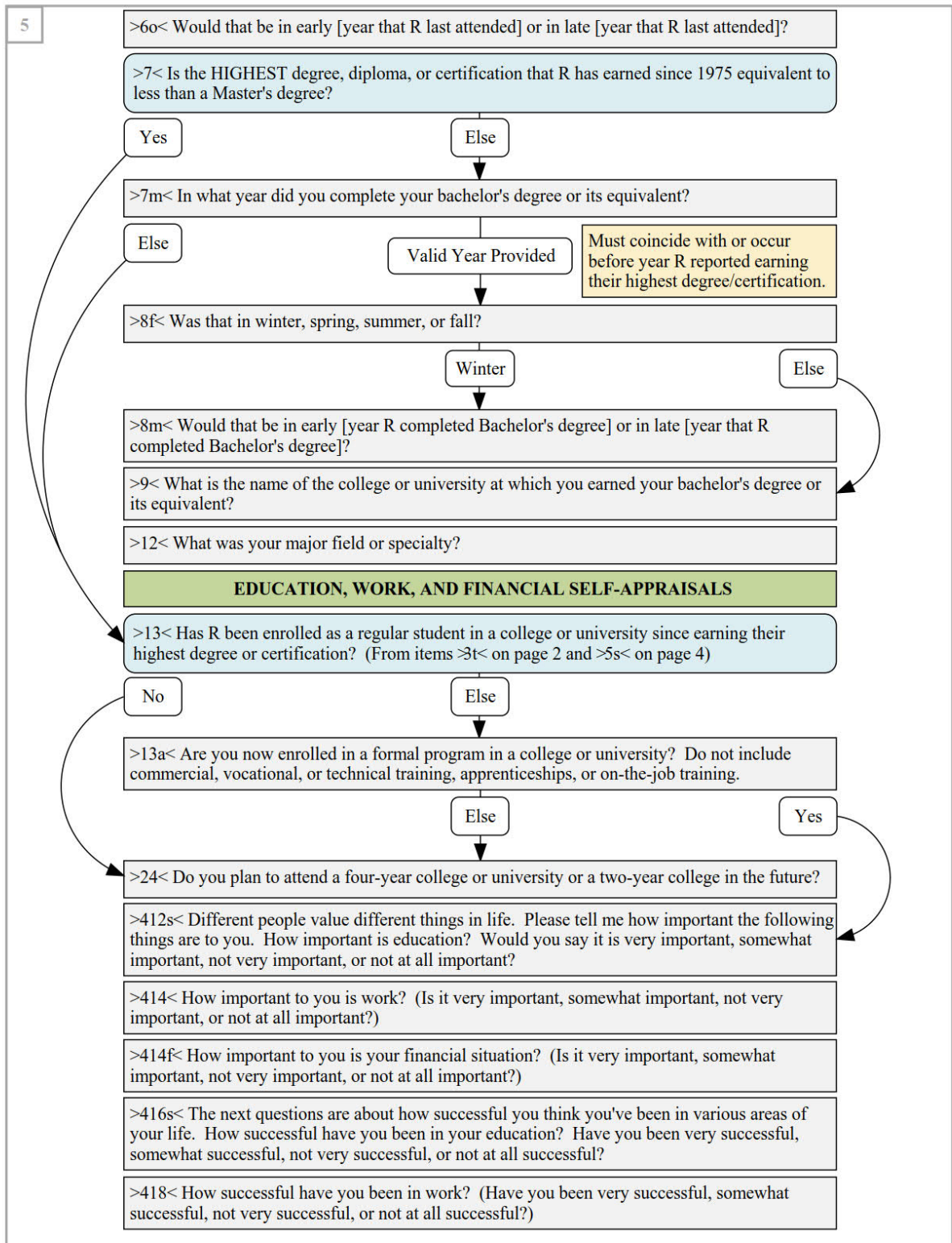
EDUCATION CATI FLOWCHART









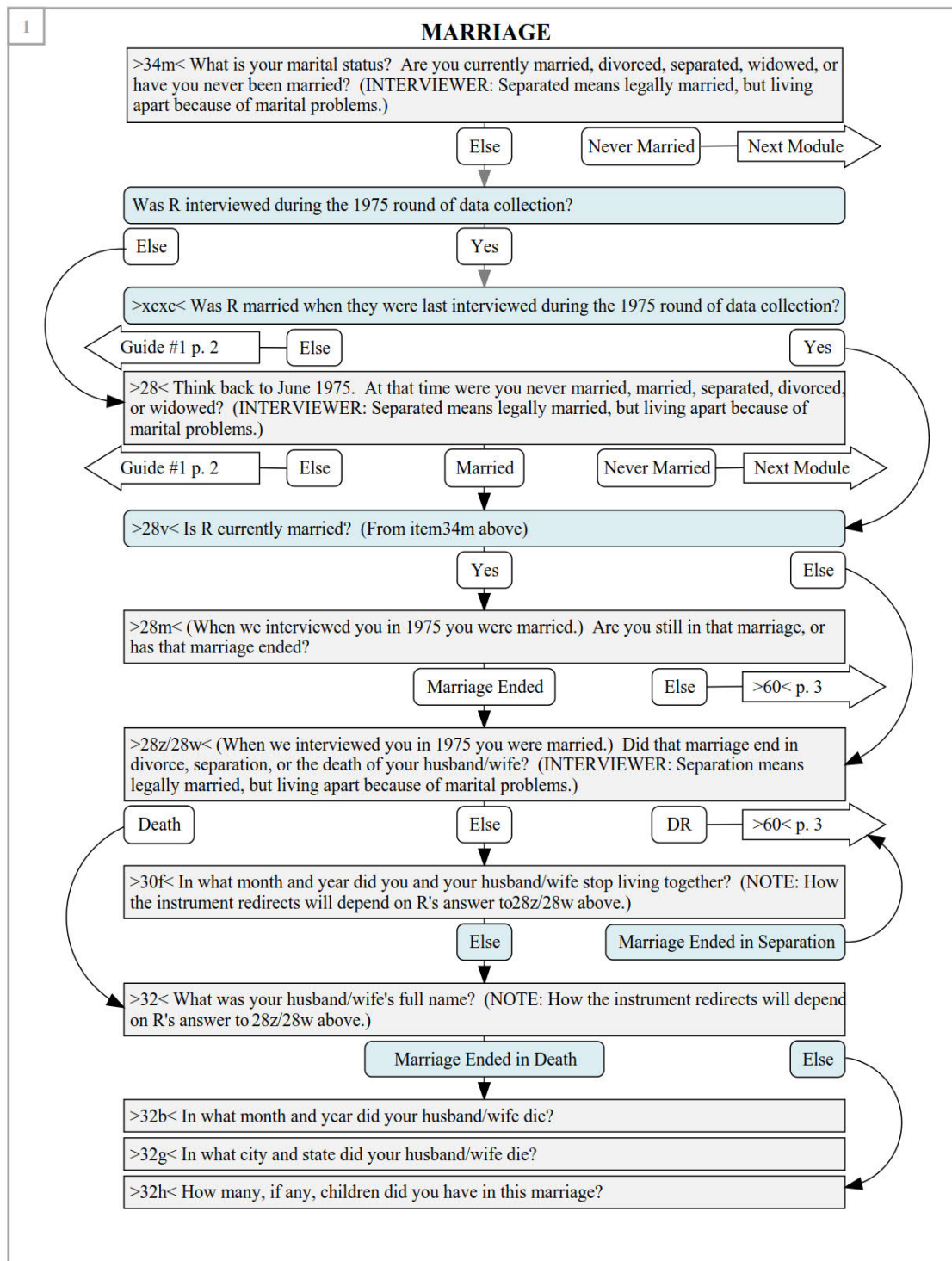


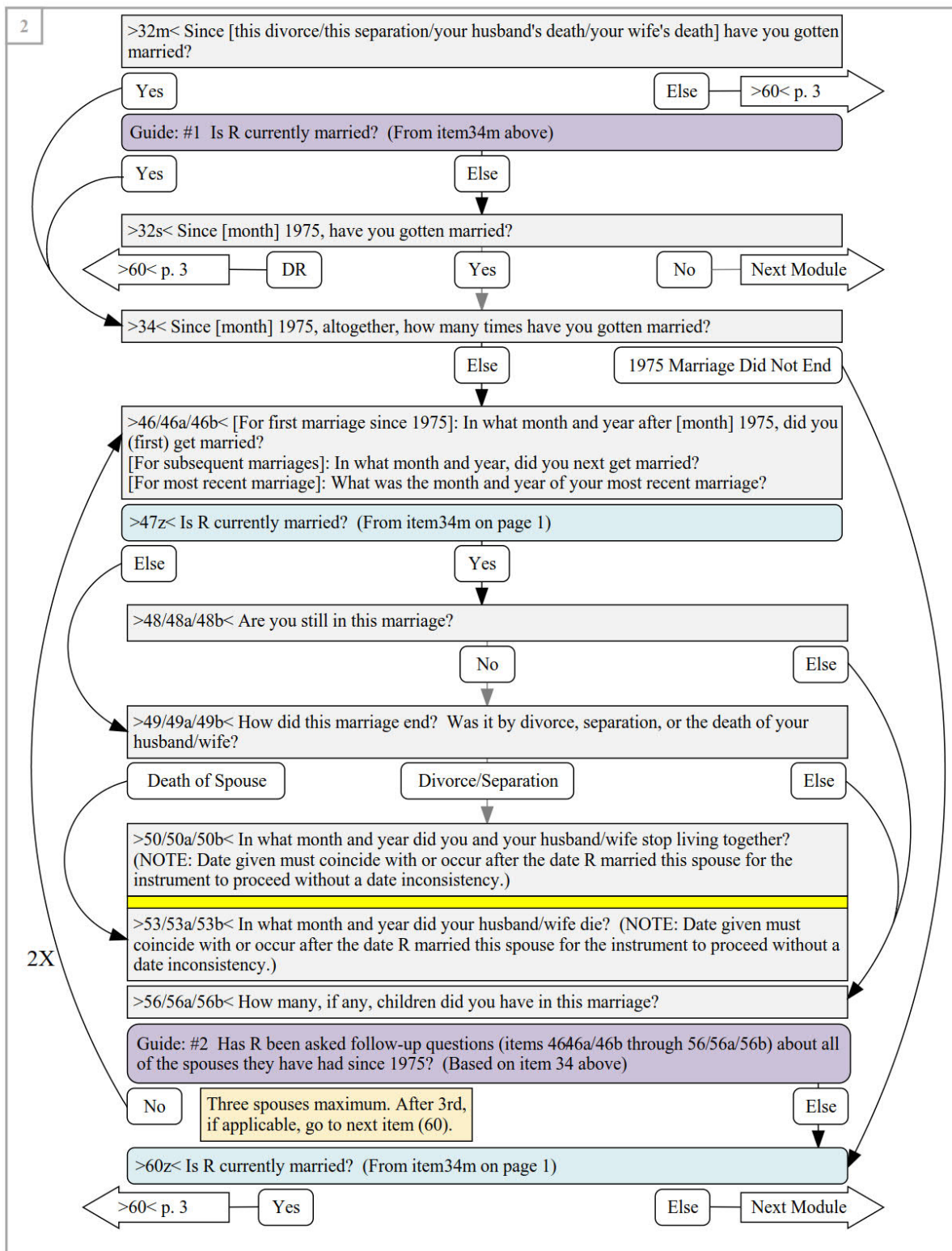
6

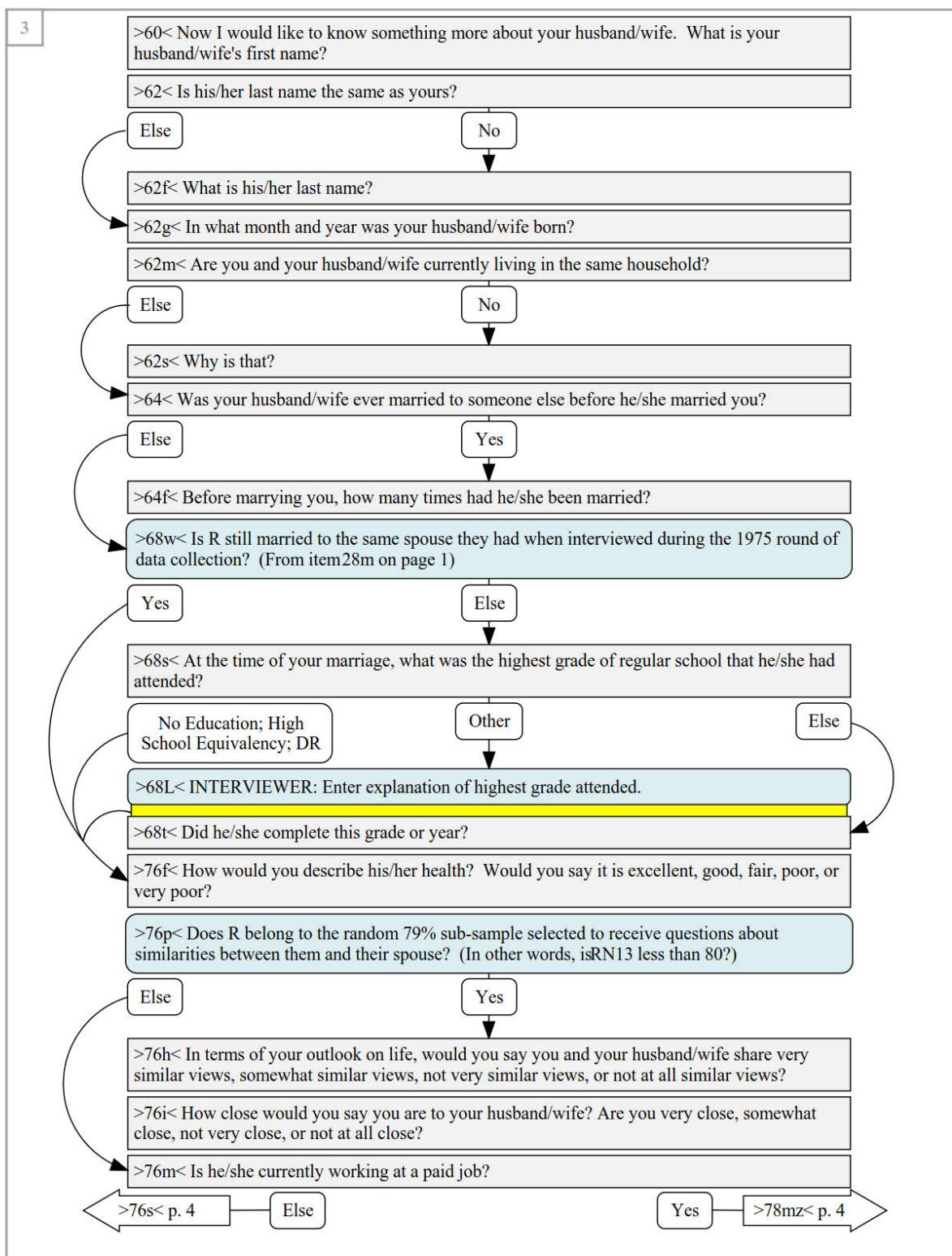
>418f< How successful have you been financially? (Have you been very, somewhat, not very, or not at all successful?)

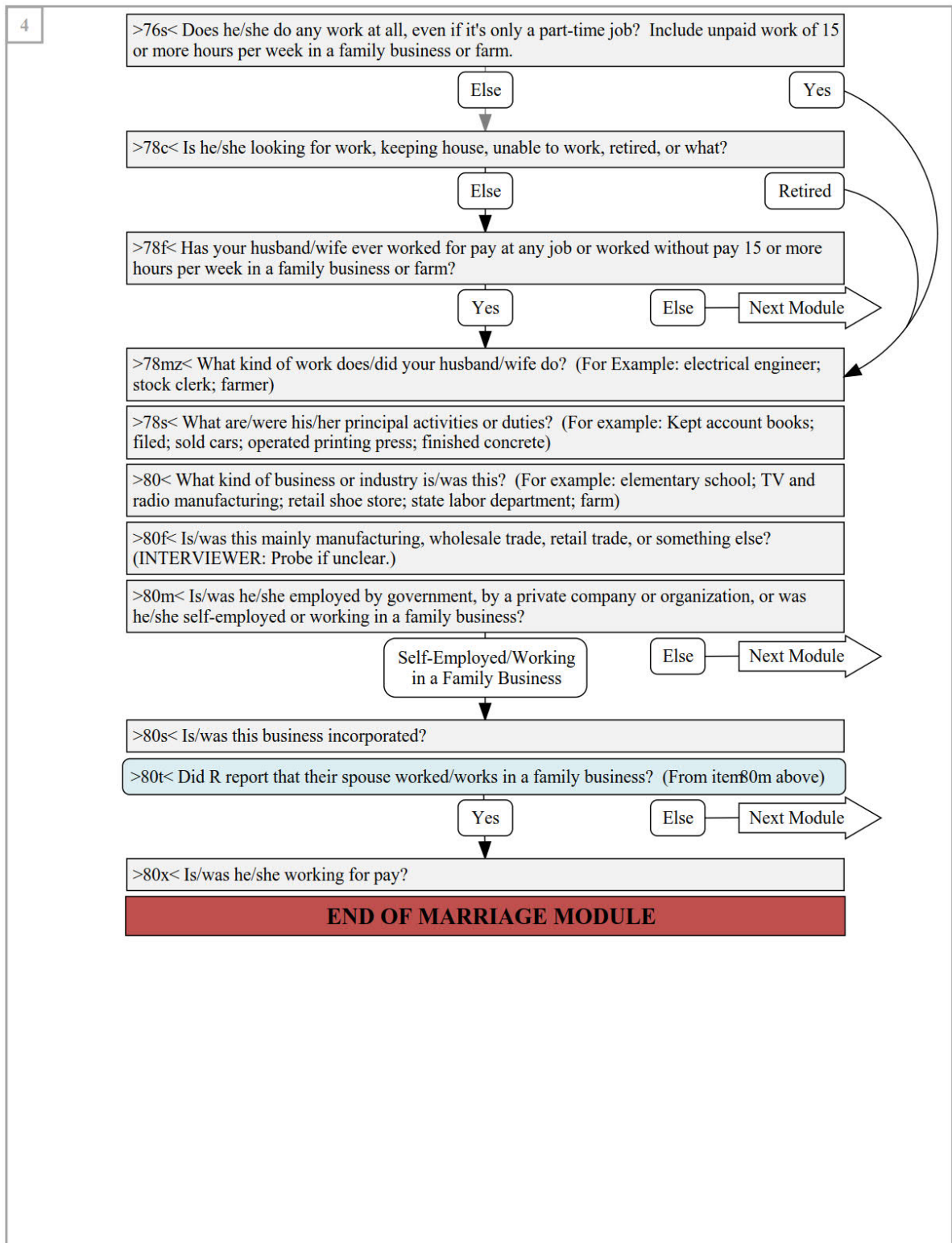
END OF EDUCATION MODULE

MARRIAGE CATI FLOWCHART

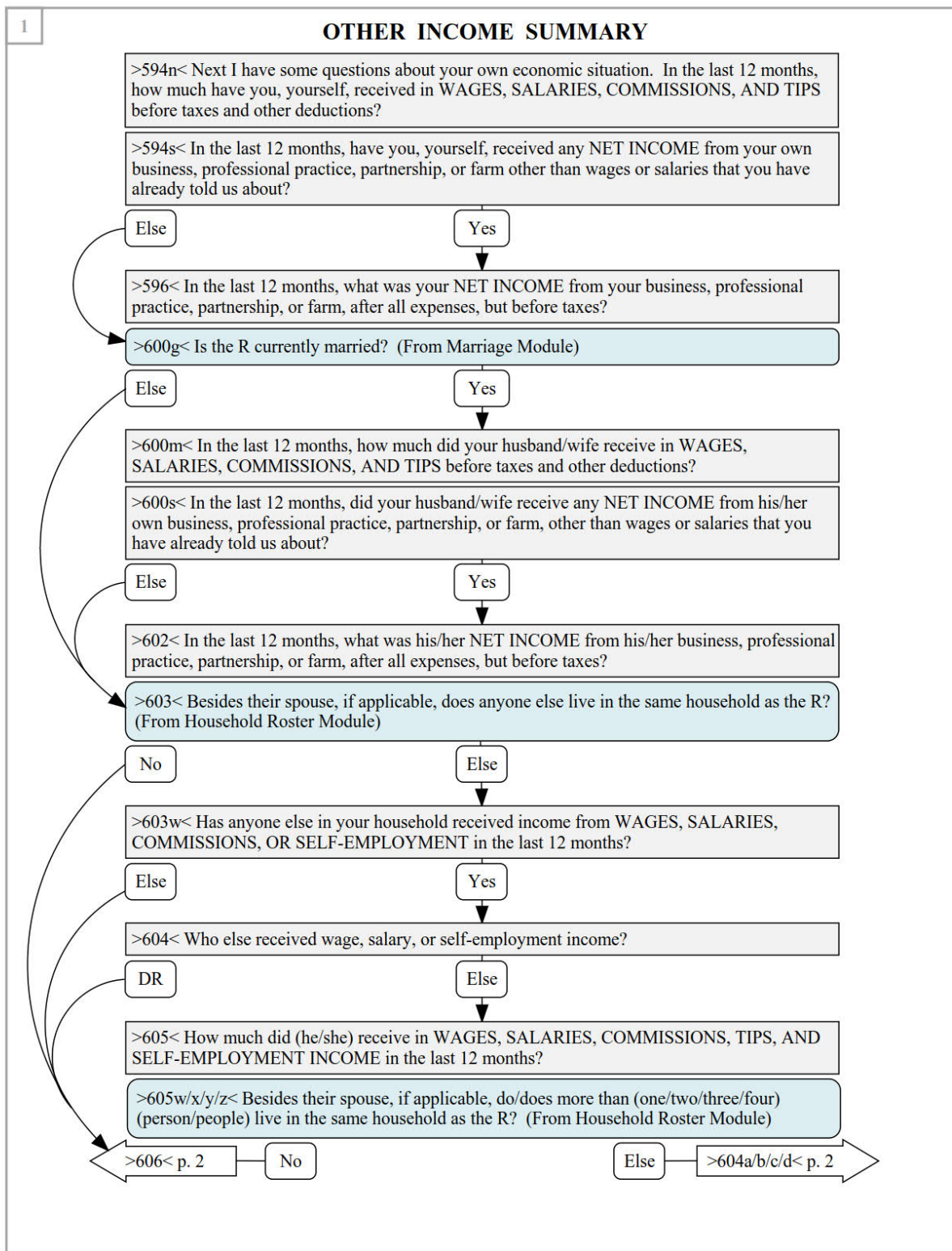


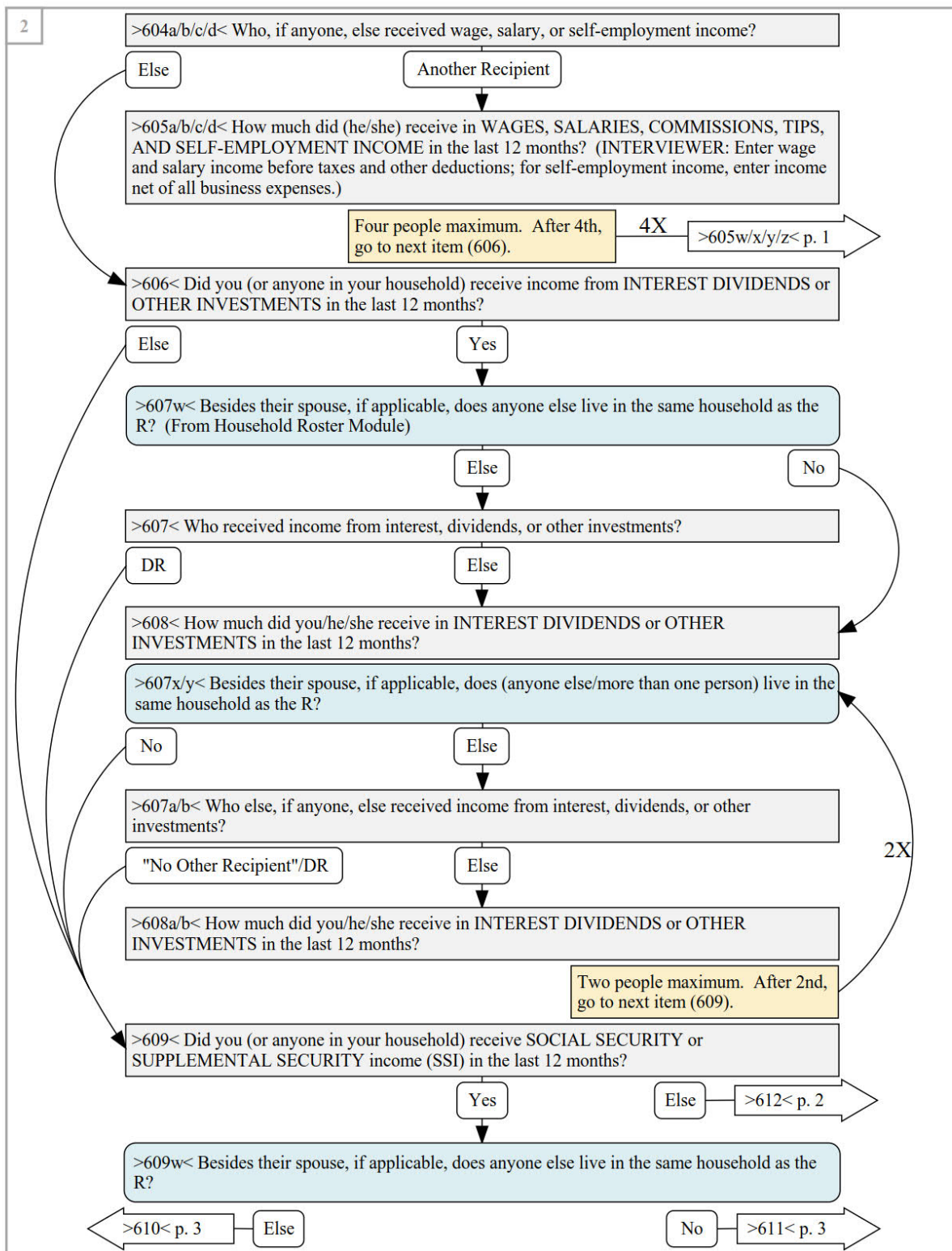


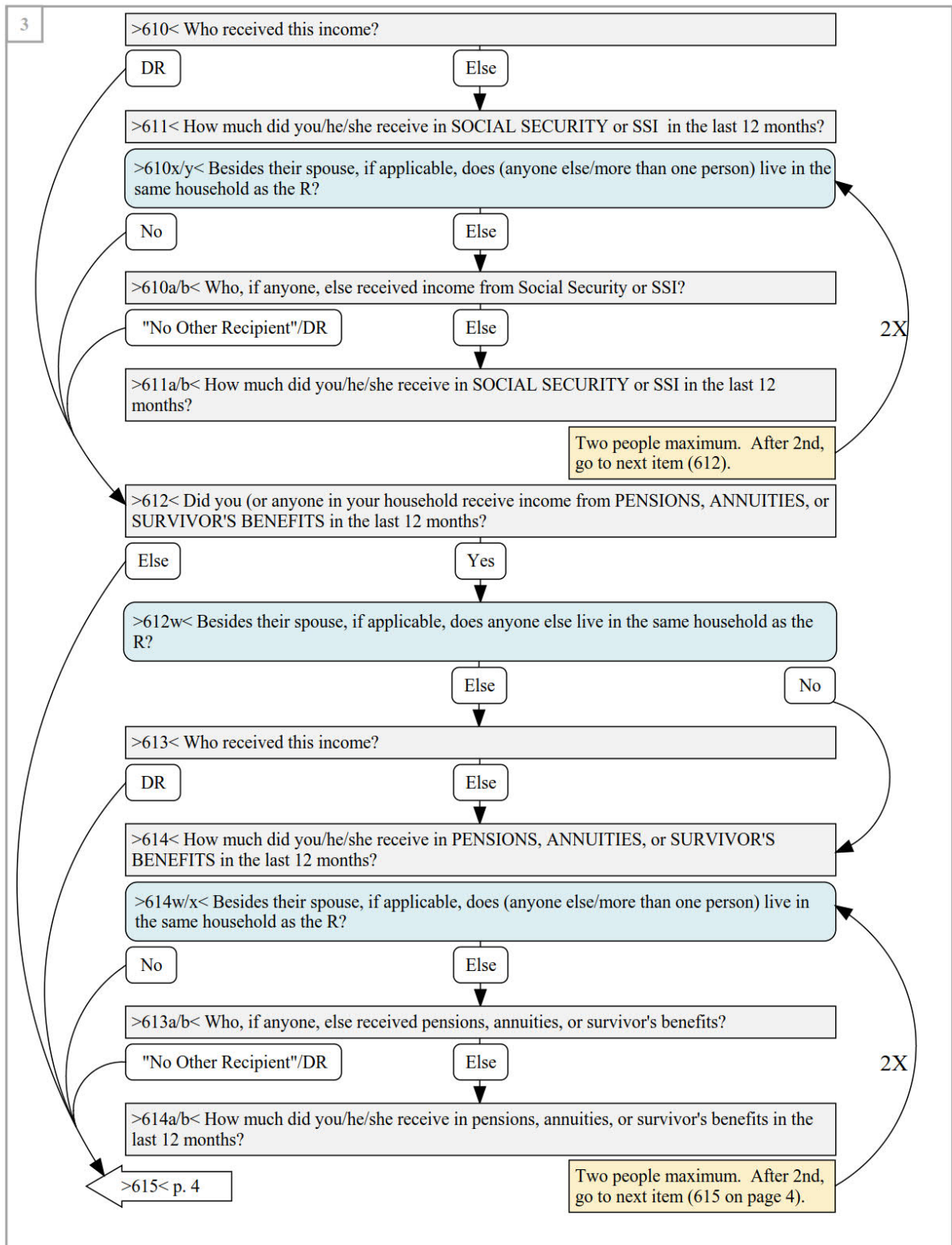


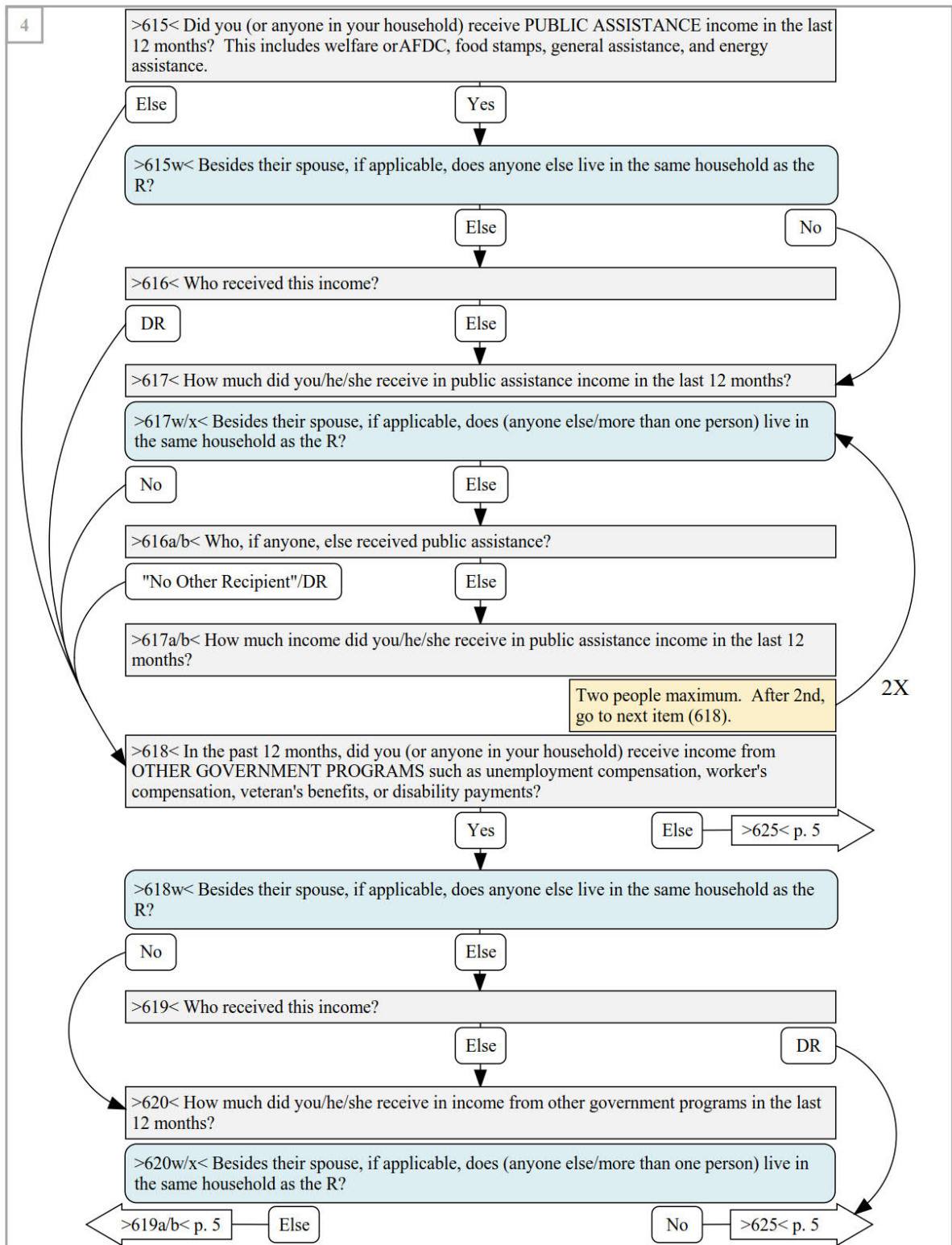


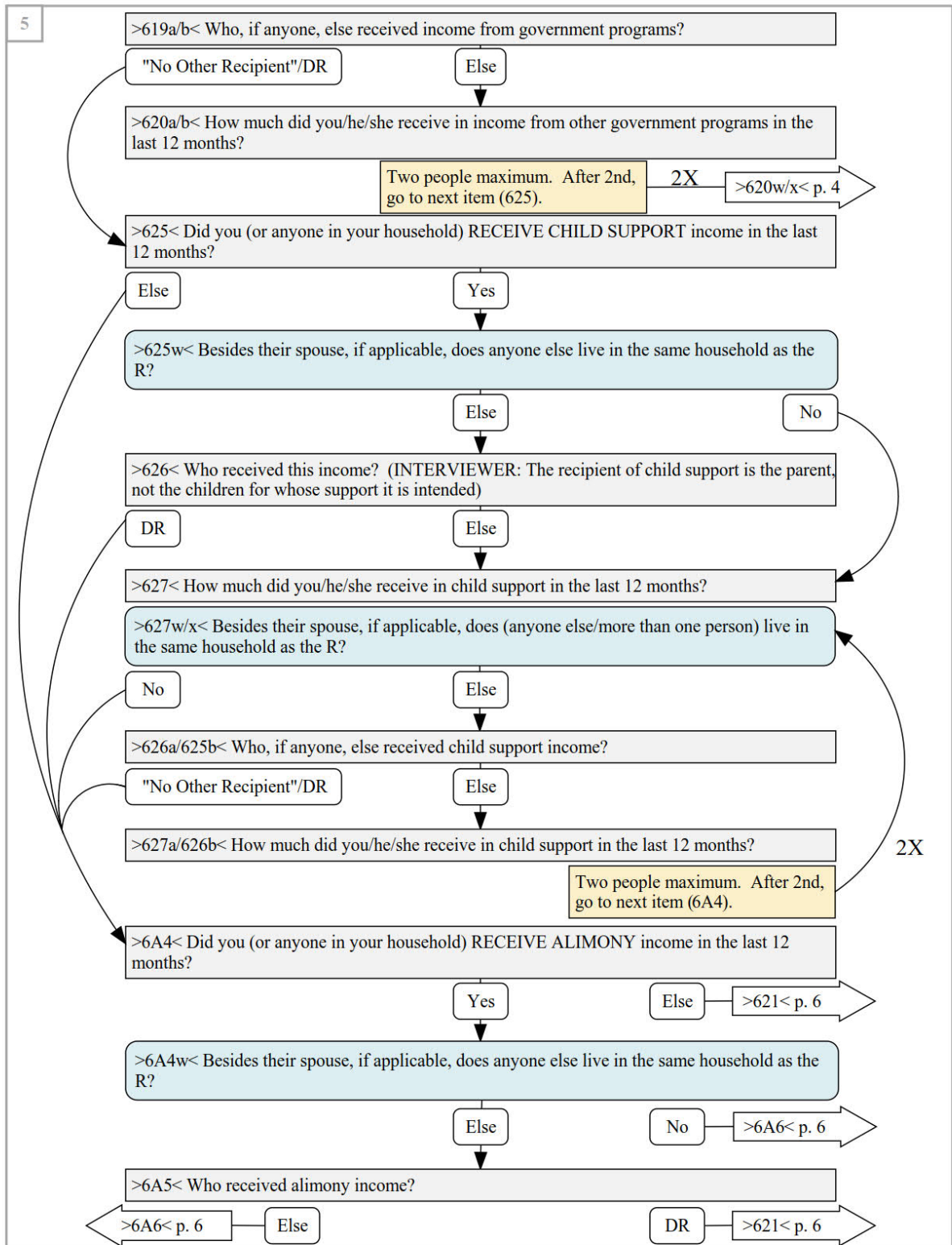
INCOME CATI FLOWCHART

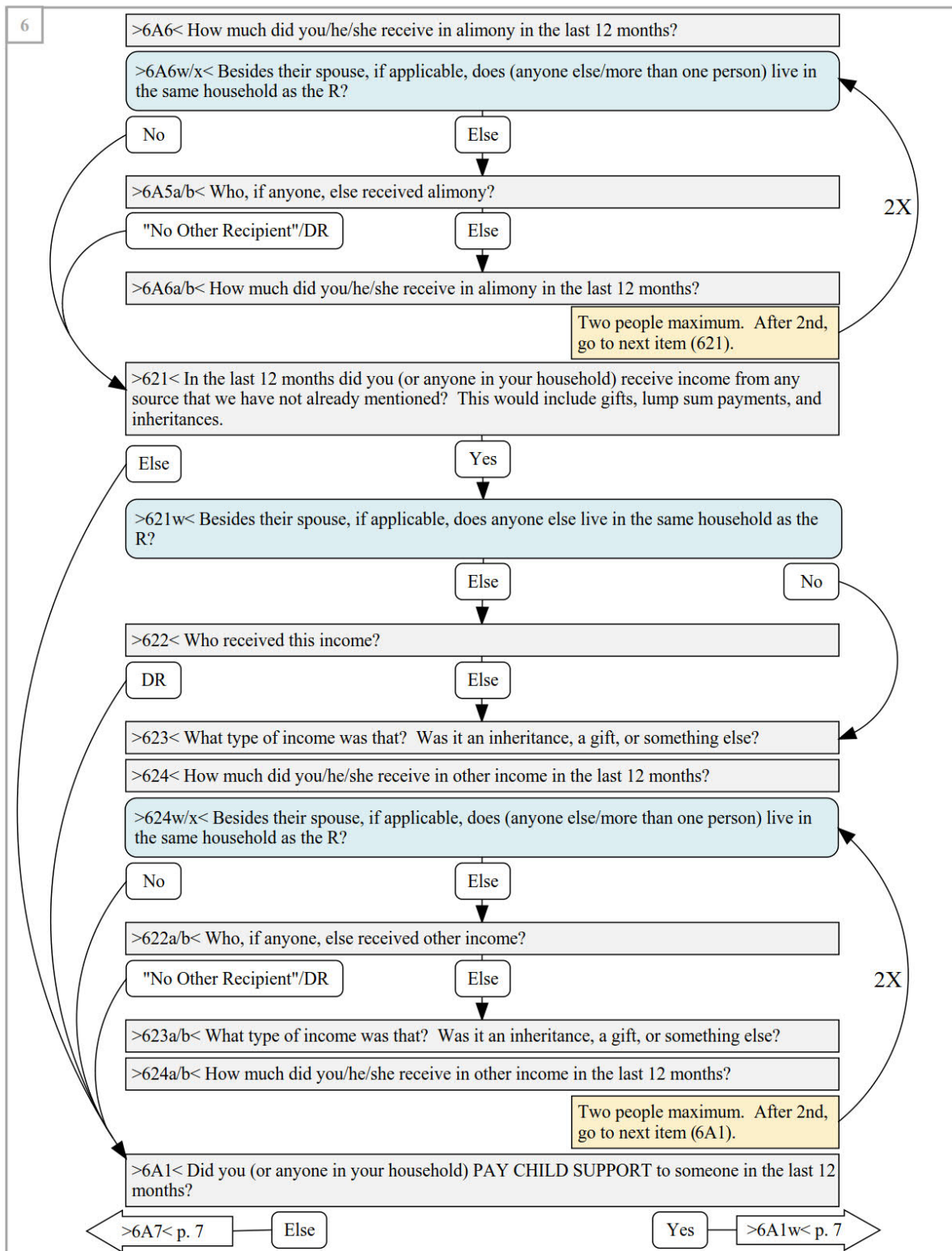


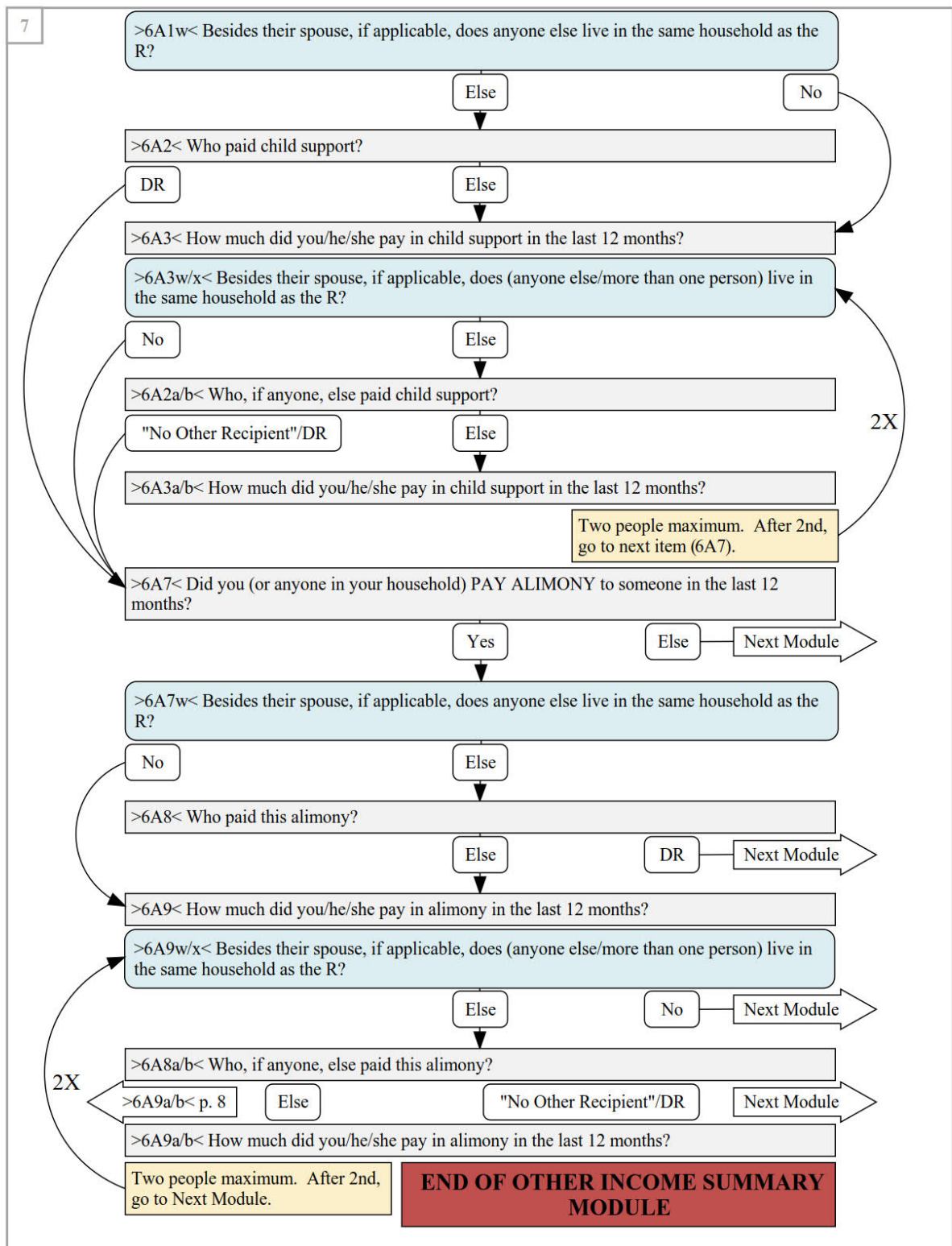












HEALTH QUESTIONNAIRE – SAQ

Please note time started: _____

I. HEALTH

We would like to begin the questionnaire with some general questions about your health.

1. How would you rate your health...					
	<i>Circle one number for each lettered item.</i>				
	Very Poor	Poor	Fair	Good	Excellent
a. at the present time?	1	2	3	4	5
b. compared with other people your age and sex?	1	2	3	4	5

2. Compared with 10 years ago...					
	<i>Circle one number for each lettered item.</i>				
	Much Worse	Somewhat Worse	About the Same	Somewhat Better	Much Better
a. how would you rate your health?	1	2	3	4	5
b. how would you rate your appearance?	1	2	3	4	5

3. How often do you participate in...				
	Circle number of the most appropriate response.			
	Three or more times per week	Once or twice per week	About one to three times per month	Less than once per month
a. light physical activity--such as walking, dancing, gardening, golfing, bowling, etc.?	1	2	3	4
b. vigorous physical exercise or sports--such as aerobics, running, swimming, bicycling, etc.?	1	2	3	4

4. During the last year, how many days, if any, did you stay in bed for more than half of the day because of illness or injury? *(Enter number of days or circle none.)*

___ Day(s) None

5. During the last year, how many times, if any, have you been hospitalized for at least one night? *(Enter number of times or circle none.)*

___ Time(s) None

6. How much do you weigh? _____ Pounds

7. How tall are you? _____ Feet _____ Inches

8. Have you ever smoked cigarettes regularly? (*Circle number*)

1 Yes

(Go to Q8a)

2 No

GO TO QUESTION 9A, PAGE 4 ----->

8a. Do you smoke regularly now? (*Circle number*)

1 Yes

(Go to Q8d)

2 No ----->

8b. For how many years did you smoke regularly?

(*Enter number of years.*)

_____ Years

8c. About how many packs did you usually smoke per day then?

(*Circle number.*)

0 Half a pack or less

1 One pack

2 Two packs

3 Three packs

4 Four packs or more

GO TO QUESTION 9A, PAGE 4

8d. For how many years have you smoked regularly? (*Enter number of years.*)

_____ Years

8e. How many packs of cigarettes do you usually smoke in a day now?

(*Circle number.*)

0 Half a pack or less

1 One pack

2 Two packs

3 Three packs

4 Four packs or more

EVERYONE

The following is a list of physical symptoms that people sometimes experience.							
9A. Which symptoms have you had in the past six months? (Circle the letter of each symptom you have had.)	9B. How often have you had this symptom? (Circle one for each of your symptoms.)			9C. How much discomfort has this symptom caused you in the past six months? (Circle one for each of your symptoms.)			
	Monthly or less often	About once a week	Daily or more often	None	A Little	Some	A Lot
a. Lack of energy	1	2	3	0	1	2	3
b. Trouble sleeping	1	2	3	0	1	2	3
c. Fatigue/exhaustion	1	2	3	0	1	2	3
d. Headache	1	2	3	0	1	2	3
e. Visual problems	1	2	3	0	1	2	3
f. Dizziness/faintness	1	2	3	0	1	2	3
g. Numbness	1	2	3	0	1	2	3
h. Ringing in ears	1	2	3	0	1	2	3
i. Nausea	1	2	3	0	1	2	3
j. Vomiting	1	2	3	0	1	2	3
k. Upset stomach	1	2	3	0	1	2	3
l. Constipation	1	2	3	0	1	2	3
m. Diarrhea	1	2	3	0	1	2	3
n. Urination problems	1	2	3	0	1	2	3
o. Aching muscles	1	2	3	0	1	2	3
p. Stiff/swollen joints	1	2	3	0	1	2	3
q. Back pain/strain	1	2	3	0	1	2	3
r. Chest pain	1	2	3	0	1	2	3
s. Shortness of breath	1	2	3	0	1	2	3
t. Excessive sweating	1	2	3	0	1	2	3
u. Respiratory problems	1	2	3	0	1	2	3
v. Skin problems	1	2	3	0	1	2	3

This question is about illnesses or medical conditions.						
10A. Circle the letter of each illness or condition that a medical professional says you have. (Circle each one that applies.)		10B. How much does each of your illnesses or conditions currently interfere with what you like to do? (Circle one for each of your illnesses or conditions.)				
		Not at all	Very little	Some	Quite a bit	A great deal
a.	Anemia	1	2	3	4	5
b.	Asthma	1	2	3	4	5
c.	Arthritis/rheumatism	1	2	3	4	5
d.	Bronchitis/emphysema	1	2	3	4	5
e.	Cancer	1	2	3	4	5
f.	Chronic liver trouble	1	2	3	4	5
g.	Diabetes	1	2	3	4	5
h.	Serious back trouble	1	2	3	4	5
i.	Heart trouble	1	2	3	4	5
j.	High blood pressure	1	2	3	4	5
k.	Circulation problems	1	2	3	4	5
l.	Kidney/bladder problems	1	2	3	4	5
m.	Ulcer	1	2	3	4	5
n.	Allergies	1	2	3	4	5
o.	Multiple sclerosis	1	2	3	4	5
p.	Colitis	1	2	3	4	5
q.	Other; specify _____	1	2	3	4	5

11. Do you have a physical or mental condition that limits the amount or kind of work you can do for pay?
(Circle number of your answer.)

1 Yes

2 No

12. Does your husband or wife have a physical or mental condition that limits the amount or kind of work he or she can do for pay? (Circle number of your answer.)

0 Not married
(single, separated,
divorced, or widowed)

1 Yes

2 No

PERSONALITY QUESTIONNAIRE – SAQ

EVERYONE: II. VALUES AND ATTITUDES

This section lists a number of characteristics that may or may not apply to you. Please read the statements below and decide the extent to which each statement describes you.

17. I see myself as someone who...						
Circle the number that best describes your agreement or disagreement with each statement.	Agree			Disagree		
	Strongly	Moderately	Slightly	Slightly	Moderately	Strongly
a. is talkative.	1	2	3	4	5	6
b. tends to find fault with others.	1	2	3	4	5	6
c. does a thorough job.	1	2	3	4	5	6
d. is reserved.	1	2	3	4	5	6
e. prefers the conventional, traditional.	1	2	3	4	5	6
f. is full of energy.	1	2	3	4	5	6
g. prefers work that is routine and simple.	1	2	3	4	5	6
h. is a reliable worker.	1	2	3	4	5	6
i. can be tense.	1	2	3	4	5	6
j. tends to be quiet.	1	2	3	4	5	6
k. values artistic, aesthetic experiences.	1	2	3	4	5	6
l. tends to be disorganized.	1	2	3	4	5	6
m. is emotionally stable, not easily upset.	1	2	3	4	5	6
n. has an active imagination.	1	2	3	4	5	6
o. is sometimes rude to others.	1	2	3	4	5	6
p. is generally trusting.	1	2	3	4	5	6
q. is lazy at times.	1	2	3	4	5	6
r. worries a lot.	1	2	3	4	5	6
s. wants things to be simple and clear-cut.	1	2	3	4	5	6
t. is sometimes shy, inhibited.	1	2	3	4	5	6
u. does things efficiently.	1	2	3	4	5	6
v. generates a lot of enthusiasm.	1	2	3	4	5	6
w. can be cold and aloof.	1	2	3	4	5	6
x. remains calm in tense situations.	1	2	3	4	5	6
y. is considerate to almost everyone.	1	2	3	4	5	6
z. gets nervous easily.	1	2	3	4	5	6
aa. is sophisticated in art, music, or literature.	1	2	3	4	5	6
bb. likes to cooperate with others.	1	2	3	4	5	6
cc. is easily distracted.	1	2	3	4	5	6

WLS RETENTION RATES

Survey year/wave	Variables	Total Sample	Not Eligible	Eligible	Sub-total	As Respondent/Proxy	Reproduced from duplicate	Sub-Total	Refused	Known Deceased	Non-Contact	Non-Sample*	Unknown Eligibility	Non-Contact+ Non-Sample	Retention = Interviews /Eligible	Retention w/ deaths censored = Interviews/ (Eligible - Known Deceased)	Retention exclude deaths & unknown eligibility = Interviews/ (Eligible - Known Deceased - Unknown Eligibility)	Retention ex. Deaths & Not-Fielded = Interviews/ (Eligible - Known Deceased - Not-Fielded)	Retention ex. Deaths & Non-Contact/ Not-Fielded = Interviews/ (Eligible - Known Deceased - Not-Fielded - Non-Contact)
1957 Grad		10317																	
1964 Grad Parent	rs64fu	10317		10317	8988	8988		1329	393		936			936	87.12%	87.12%	87.12%	87.12%	95.81%
1964 Grad	rs64fu, liv64	10317		10317	8922	8922		1395	392	71	932			932	86.48%	87.08%	87.08%	87.08%	95.79%
1975 Grad	stat75	10317		10317	9138	9138		1179	387	174	618			618	88.57%	90.09%	90.09%	90.09%	95.94%
1993 Grad Phone	stat93p	10317		10317	8493	8493		1824	588	590	646			646	82.32%	87.31%	87.31%	87.31%	93.52%
1993 Grad Mail	stat92m	10317		10317	6875	6875		3442	1450	590	168	1234		1402	66.64%	70.68%	70.68%	80.95%	82.58%
2004 Grad Phone	stat04p	10317		10317	7265	7265		3052	983	1299	362	408		770	70.42%	80.56%	80.56%	84.38%	88.08%
2004 Grad Mail	stat04m	10317		10317	6846	6846		3471	1380	1299	385	407		792	66.36%	75.91%	75.91%	79.50%	83.22%
2004 Grad Phone or Mail	stat04p, stat04m	10317		10317	7733	7733		2584	628	1299	250	407		657	74.95%	85.75%	85.75%	89.80%	92.49%
2004 Grad Spouse Phone	stat04gs	10317	1548	8769	3890	3890		4879	1200	22	223	186	3248	409	44.36%	44.47%	70.74%	73.22%	76.42%
2011 Grad in-Person/Phone	stat11p	10317		10317	5967	5967		4350	1097	2048	125	1080		1205	57.84%	72.16%	72.16%	83.00%	84.47%
2011 Grad Mail	stat11m	10317		10317	5391	5391		4926	1687	2060	99	1080		1179	52.25%	65.29%	65.29%	75.11%	76.17%
2011 Grad All Instruments	stat11p, stat11m	10317		10317	6152	6152		4165	940	2049	96	1080		1176	59.63%	74.41%	74.41%	85.59%	86.75%
Medicare Part D SAQ	statmdsq	10317		10317	5552	5552		4765	2584	1528	653			653	53.81%	63.17%	63.17%	63.17%	68.24%
2008 (1st Wave) Grad DNA Kit	stat08	10317		10317	4617	4617		3700	3737	1525	438			438	44.75%	52.51%	52.51%	52.51%	55.27%
2011 (2nd Wave) Grad DNA Kit	stat11	10317	4425	5892	1827	1827		4065	1207	1765	1093			1093	31.01%	44.27%	44.27%	44.27%	60.22%
Grad Cumulative DNA Kit	statkdna	10317		10317	5979	5979		4338	2383	1657	298			298	57.95%	69.04%	69.04%	69.04%	71.50%
2008 (1st Wave) Grad DNA Consent	stat08	10317		10317	4605	4605		5712	3748	1526	438			438	44.64%	52.38%	52.38%	52.38%	55.13%
2011 (2nd Wave) Grad DNA Consent	stat11	10317	4424	5893	1842	1842		4051	1195	1765	1091			1091	31.26%	44.62%	44.62%	44.62%	60.65%
Grad Cumulative DNA Consent	statkdna	10317		10317	5984	5984		4333	2380	1657	296			296	58.00%	69.10%	69.10%	69.10%	71.54%
Grad DNA and Consent	statkdna, statcdna	10317		10317	5967	5967		4350	2395	1657	298			298	57.84%	68.90%	68.90%	68.90%	71.36%
2011 Grad Medicare Waiver	statw11	10317	749	9568	5269	5269		4299	1435	1755	1109			1109	55.07%	67.44%	67.44%	67.44%	78.59%
2011 Grad Social Security Waiver	stats11	10317	749	9568	4693	4693		4875	2002	1760	1113			1113	49.05%	60.11%	60.11%	60.11%	70.10%
1977 Sib	xstat77, sibslv	10317	746	9571	2133	2108	25	7438	110	27	184	6327	790	6511	22.29%	22.35%	24.37%	87.89%	95.10%
1994 Sib Phone	xstat93p, sibslv	10317	746	9571	4804	4778	26	4767	547	471	1608	1351	790	2959	50.19%	52.79%	57.81%	69.03%	89.78%
1994 Sib Mail	xstat93m, xstat93p, sibslv	10317	746	9571	4062	4039	23	5509	1635	471	445	2168	790	2613	42.44%	44.64%	48.88%	66.19%	71.90%
1994 Sib Phone or Mail	xstat93p, xstat93m, sibslv	10317	746	9571	5365	5339	26	4206	547	471	2094	304	790	2398	56.05%	58.96%	64.56%	67.01%	90.75%
2005 Sib Phone	xstat05p	10317	746	9571	4270	4270		5301	911	1256	639	1705	790	2344	44.61%	51.35%	56.74%	73.37%	82.42%
2005 Sib Mail	xstat05m	10317	746	9571	3977	3977		5594	1187	1256	656	1705	790	2361	41.55%	47.83%	52.85%	68.33%	77.01%
2005 Sib Phone or Mail	xstat05p, xstat05m	10317	746	9571	4676	4676		4895	619	1256	525	1705	790	2230	48.86%	56.24%	62.14%	80.34%	88.31%
2005 Sib Spouse Phone	xstat05s	10317	1708	8609	2125	2125		4484	815	22	132	52	5463	184	24.68%	24.75%	68.02%	69.17%	72.28%
2011 Sib In-Person/Phone	stat11p	10317	746	9571	3397	3397		6174	981	1768	119	2516	790	2635	35.49%	43.53%	48.44%	75.54%	77.59%
2011 Sib Mail	stat11m	10317	746	9571	2990	2990		6581	1398	1771	106	2516	790	2622	31.24%	38.33%	42.65%	66.53%	68.14%
2011 Sib All Instruments	xstat11p, xstat11m	10317	746	9571	3533	3533		6038	864	1768	100	2516	790	2616	36.91%	45.28%	50.38%	78.56%	80.35%
2008 (1st Wave) Sib DNA Kit	xstatk08	10317	746	9571	2551	2551		7020	1993	1453	2784		790	2784	26.65%	31.42%	34.81%	34.81%	56.14%
2011 (2nd Wave) Sib DNA Kit	xstatk11	10317	3373	6944	1252	1252		5692	849	1504	2549		790	2549	18.03%	23.01%	26.92%	26.92%	59.59%
Sib Cumulative DNA Kit	xstatkdna	10317	746	9571	3448	3448		6123	1407	1514	2412		790	2412	36.03%	42.80%	47.45%	47.45%	71.02%
2008 (1st Wave) Sib DNA Consent	xstatc08	10317	746	9571	2548	2548		7023	1996	1453	2784		790	2784	26.62%	31.39%	34.77%	34.77%	56.07%
2011 (2nd Wave) Sib DNA Consent	xstatc11	10317	3372	6945	1259	1259		5686	845	1503	2548		790	2548	18.13%	23.13%	27.06%	27.06%	59.84%
Sib Cumulative DNA Consent	xstatcdna	10317	746	9571	3451	3451		6120	1404	1514	2412		790	2412	36.06%	42.83%	47.49%	47.49%	71.08%
Sib DNA and Consent	xstatkdna, xstatcdna	10317	746	9571	3440	3440		6131	1415	1514	2412		790	2412	35.94%	42.70%	47.34%	47.34%	70.85%
2005 Sib Medicare Waiver	xstatw05	10317	3198	7119	1129	1129		5990	424	1029	287		4250	287	15.86%	18.54%	61.36%	61.36%	72.70%
2011 Sib Medicare Waiver	xstatw11	10317	3049	7268	1655	1655		5613	774	1498	2551		790	2551	22.77%	28.68%	33.23%	33.23%	68.14%
Sib Cumulative Medicare Waiver	xstatw11	10317	3049	7268	1655	1655		5613	774	1498	2551		790	2551	22.77%	28.68%	33.23%	33.23%	68.14%
2011 Sib Social Security Waiver	xstatw11	10317	1448	8869	2683	2683		6186	1343	1497	2556		790	2556	30.25%	36.39%	40.76%	40.76%	66.64%

* Sometime this includes not-fielded cases that are duplicates if the duplicates have not been reproduced for the records.

WLS Overall Retention Rates	Regardless of the 1975/1977 Response Status	Also completed 1975/1977 survey
Grad Phone Interview	N=10317	N=10317
Grad completed at least one of the 1992-2011 phone interviews	84.56%	79.96%
Grad completed at least two fo the 1992-2011 phone interviews	72.65%	69.01%
Grad completed all three of the 1992-2011 phone interviews	53.37%	51.15%
Grad Phone or Mail Interview		
Grad completed phone or mail in at least one of the 1992-2011 waves	85.74%	81.13%
Grad completed phone or mail in at least two of the 1992-2011 waves	74.59%	70.78%
Grad completed phone or mail in all three 1992-2011 waves	56.58%	54.13%
Grad Phone and Mail Interview		
Grad completed both phone and mail in at least one of the 1992-2011 waves	76.57%	72.79%
Grad completed both phone and mail in at least two of the 1992-2011 waves	61.74%	59.11%
Grad completed both phone and mail in all three 1992-2011 waves	40.60%	39.18%
Sib Phone Interview	N=8778	N=8778
Sib completed at least one of the 1992-2011 phone interviews	62.99%	20.60%
Sib completed at least two fo the 1992-2011 phone interviews	49.28%	16.12%
Sib completed all three of the 1992-2011 phone interviews	29.80%	10.55%
Sib Phone or Mail Interview		
Sib completed phone or mail in at least one of the 1992-2011 waves	65.62%	21.19%
Sib completed phone or mail in at least two of the 1992-2011 waves	52.73%	16.77%
Sib completed phone or mail in all three 1992-2011 waves	36.28%	11.35%
Sib Phone and Mail Interview		
Sib completed both phone and mail in at least one of the 1992-2011 waves	53.99%	17.85%
Sib completed both phone and mail in at least two of the 1992-2011 waves	38.36%	12.70%
Sib completed both phone and mail in all three 1992-2011 waves	20.73%	7.35%

SECTION THREE

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