

## **ABSTRACT**

TIMPO, PHYLLIS N. Neighborhood Influence on Memory: Do Neighborhood Characteristics Play a Role in Memory Declines in African American Older Adults? (Under the direction of committee co-chairs Jason Allaire and Craig Brookins.)

To date, few studies have assessed the relationship between neighborhood characteristics and cognitive functioning in African American older adults. The preponderance of the literature has found older African American adults more likely to; live in low income areas, be physically unhealthy, be less educated and report lower income levels compared to other groups of older adults (Cagney & York-Cornwall, 2011; Latkin & Curry, 2003; Sigel, 2000). These characteristics are also referenced as risk factors for cognitive decrements observed in adults over the age of 50 (Allaire & Whitfield; Whitfield, et al., in press; Whitfield et al., 2003). The current study explored the possible role neighborhood characteristics have in explaining racial differences in memory functioning. Data from the Carolina African American Twin Study of Aging (CAATSA) were used in the analyses. African American older adults over the age of 50 living in North Carolina (n=361) were sampled. Mediation analysis revealed associations between neighborhood auditory levels and education level. However, path analysis found neighborhood factors did not explain power in the observed relationships between stress, health and memory. Future directions and limitations are discussed.

Neighborhood Influence on Memory: Do Neighborhood Characteristics Play a Role in  
Memory Declines in African American Older Adults?

by  
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Neighborhood influence on memory: Do neighborhood characteristics play a role in memory declines in African American older adults?

There is a consensus in the field of cognitive aging that memory performance declines over the course of adulthood (Craik & Bialystock, 2006; Grady & Craik, 2000; Hoyman & Kiyak, 1993; Prull, Gabrieli & Bunge; Singh- Manoux, 2012 Smith & Earles, 1996; Zack, Hasher& Li, 2000). Memory declines have been associated with neurological changes that occur in the later portion of the lifespan, which to some extent take place beyond the control of the individual (Hess & Pullen, 1996; Osterman et al., 2010; Rogalsk et al., 2009; Simon et al., 2009). Changes in processing speed, executive functioning, and the atrophy of particular brains structures have all been associated with cognitive decrements later in life (Dirk & Scmeldek, 2012; McCabe et al., 2010; Salthouse, 1996; Urtzkly, 2010).However, individual differences in memory declines are not solely determined by physiological changes. Contextual factors may also play a role in cognitive declines (Cargin et al., 2007; Comijis et al., 2002; Hogenhout, Groot, & Jolle, 2011). In fact, Hess (2005) postulates that there is “significant individual variability in the nature of age-related change as individuals experience and respond to unique life circumstances” (p. 384). This contextual approach hypothesizes, in part, that the environment in which an individual develops, or currently lives, can impact development (Baltes, 1987; Brofenbrenner, 1977; Sameroff, 2009). While contextualism can take on many different meanings or levels, the purpose of the current study is to determine if aspects of the neighborhood in which an older adult resides are associated with memory performance.

For the purpose of this study the neighborhood will be defined as “a subsection of a larger community, in which a collection of both people and institutions occupy a spatially

defined area, influenced by ecological, cultural, and sometimes political forces” (Sampson, 2002, p. 446). The neighborhood is the immediate residence of an individual that is a collection of both relational and physical characteristics occupying an area in close proximity to an individual. The term neighborhood characteristics will be used to describe the physical and social environment, as well as any socio-economic characteristics of a community. Neighborhood factors or context will be used as proxies for the term neighborhood characteristics.

### **Neighborhood Effects**

The notion that an association exists between the physical environment and psychological constructs is not new (e.g., Faris & Dunham, 1939; Park & Burgess, 1925). Literature in the area provides evidence that environmental contexts, particularly neighborhood characteristics, are associated with health and well-being (Cagney & Cornwell, 2010; Ellen, Mijanovich, Dillman, 2001; Krause, 1996; Robert, 1999; Ross, 2000; Sampson, Morenoff & Gannon Rowley, 2002). Feldman and Steptoe (2004) found living in a lower socioeconomic neighborhood is linked to greater perceived neighborhood strain, which, in turn, was associated with poorer physical functioning. Augustin and colleagues (2008) studied the relationship between neighborhood psychosocial hazards and health. Visible neighborhood characteristics (violence, abandoned buildings, signs of incivility) which illicit a heightened state of vigilance, alarm, or threat, were significantly associated with self-reported cardiovascular disease after adjustment for individual level risk factors. The amount

of traffic, the amounts of debris in the streets, air pollution, and crime have been associated with mental distress (Ruback & Pandey, 2002).

Mathew and Yang (2010) found three elements of the physical characteristics of a neighborhood (traffic exposure, hazardous waste exposure and medical infrastructures) to have both direct and moderating associations with health.

Many physical aspects of neighborhoods have been found to be associated with health outcomes. Perceived air quality has been linked to an increase in depressive symptoms (Jacobs, Evans, Catalano & Dooley, 1984). Higher density of major streets, greater vehicular burden in the neighborhood (Song et al., 2007) and perceived traffic stress (Gee & Takeuchi, 2004) are linked to lower health status and increased depressive symptoms. Population density has been related to increased stress levels and somatic and emotional distress (Fleming, Baum, & Weiss, 1987). Excessive noise and inadequate lighting were also associated with increased difficulty in carrying out physical tasks in an elderly sample (Balfour & Kaplan, 2002).

Older adults are likely to spend more time in their communities and tend to be more dependent on the context that the community provides (Whitfield, Thrope, & Szanton, 2011). The physical environment of the neighborhood may determine whether it is possible to take a walk, easily go food shopping, or remain engaged in community activities (Cagney, et al, 2005). Due to mobility constraints, the immediate environment proves to be more important to older adults in comparison to other groups (Whitfield, Thrope, & Szanton, 2011). As a result, they may suffer deficits due to particular characteristics of the neighborhoods in which they reside. Older adults living in deleterious neighborhoods were also found to report more

physical health problems than those who resided in improved physical environments (Krause, 1996). Krause used a six -item measure to capture the overall living experiences of respondents by assessing the conditions of yards sidewalks, noise levels, and air quality. This resulted in an estimate of the amount of dilapidation in a particular neighborhood. In a related study, older adults who reported residing in problematic neighborhood environments were at a greater risk for functional deterioration over one year compared with those in living in neighborhoods with fewer problems (Balfour & Kaplan, 2002). Krause (1993) concluded that being exposed to stressors, environmental toxins, excessive noise, inadequate sanitation, overcrowding, and man-made environmental characteristics such as deteriorating stairways and buildings were all thought to be major predictive factors of health problems in older adults.

A related line of research has examined the relationship between cognition and living arrangements, namely the differences between older adults who reside in their own home or in assisted living communities. Sibley and colleagues (2001) found living alone, with a spouse, with others or in a nursing home were related to the severity of dementia at diagnosis. Specifically, those living alone suffer the fastest cognitive decrements compared to those living with others. Van Gelder and colleagues (2006) found that men who lost a partner, who were unmarried, or those who lived alone during the 5-year period experienced cognitive decline at least twice the rate as men who were married or who lived with someone in those years. Other studies have found that living arrangements are linked to how satisfied individuals feel with their lives (Carp, 1975; Rourke, Grey, Fuller, & Mcclean, 2004). Sugiyama and Thompson (2009) found that the pleasantness and safety of open spaces

increased reported life satisfaction in older adults. From a review of the literature it is clear that the living arrangements of older adults are related to cognitive declines as well as overall feelings of satisfaction with one's life. In particular older adults living alone appear most at risk for negative outcomes. It is likely that older adults living in single family units are likely to live in lower income neighborhoods due to income constraints.

### **Education, Income, and Cognition**

Characteristics of an individual's neighborhood are not often specifically included in studies of cognitive aging, proxies for the physical environment. For example, education and income are often used as markers of socioeconomic status (SES), with the underlying assumption that older adults with more education and greater income will have higher socioeconomic statuses and live in locations that reflect this status. Previous research, has found a positive relationship between education and cognitive functioning, where less education is associated with cognitive decline (Christensen & Henderson, 1991). However, Salthouse (2010) found that education was not a major determinant of the association between age and cognition. It is possible that the discrepancies in the literature are due to use of different indexes of educational attainment (Allaire & Whitfield, 2004; Cagney & Lauderdale, 2002; Whitfield & Willis, 1998).

Studies have also examined the link between income and cognition. Material deprivation caused by low wealth and income is thought to negatively affect the cognitive performance of older adults (Sloan & Wang, 2005). Low SES has been shown to be associated with a higher prevalence of dementia, increased psychiatric comorbidity, and

worse baseline cognitive functioning (Gard et al., 2009). Increased age, less education, and less annual income were all found to be associated with a diagnosis of dementia in an inner-city setting (Gard et al., 2009). Cagney and Lauderdale (2002) found wealth and current income were associated with cognitive well-being in Caucasian, Latino and African-American aging adults. African -American adults who reported living in low income households as children had lower cognitive functioning than those who did not report any financial strains in their pasts (Szanton, Thrope & Whitfield, 2010). Fors, Lennartsson and Lundberg (2009) studied the link between a history of being in a lower income bracket and cognitive functioning later in life. The authors found having a father classified as a manual worker, being less educated, and/or being classified as a manual worker themselves in adulthood was associated with lower levels of cognitive functioning later in life. In the current study, the effect of education and income on memory will be examined alongside more proximal indices of the environment in order to determine the unique and shared effects of both sets of predictors.

### **Environmental Stressors**

A question does arise, however, as to whether certain neighborhood characteristics are directly related to memory performance or whether they work through another variable. One possibility is that certain neighborhood factors may increase stress levels in older adults, and this stress will have a direct effect on memory performance. Previous research has found a number of environment characteristics, such as crowding, crime, noise pollution, discrimination, and other hazards to contribute to chronic stress in individuals (Baum,

Garfalo, & Yali, 2006; Steptoe & Felman, 2001). Schulz and colleagues (2008) found particular aspects of a neighborhood's physical environment to be related to stress. Specifically, neighborhoods that had high percentages of minority residents and reported more residents living in poverty also have more individuals who reported increased stress levels. Studies have also found that living in neighborhoods containing a number of the above mentioned characteristics, can influence residents. This influence occurs through two mechanisms. One by briefly influencing behaviors and attitudes and after through a long term process described by Geronimus (1992) as "weathering." Weathering is a process in which stress, poor environment quality, and limited access to resources experiences are compounded over a prolonged period of time ending in a culmination of negative outcomes. These outcomes are thought to be the result of prolonged exposure to stress.

Pearlin (1999) describes neighborhoods as entities comprised of individuals of similar status. As a result, residents "will share similar hardships, similar reactions, and have similar resources to respond to these hardships" (p., 402). Aneshensel and Sucoff (1996) describe these hardships as ambient stressors. Residents of low income neighborhoods are likely to experience more ambient stressors than other groups (Grzywacz, Alameda, Neupert, & Ettner, 2004). Ambient stressors that occur daily as a result of interactions with one's environment are known as daily hassles (Wheaton, 1999). Daily hassles could be being stuck in traffic, being harassed, noise, foul odors, and/or crowding. These hassles are often seen as more minor than chronic stressors, however the accumulation of daily hassles can have very negative consequences. Grzywacz et al. (2004) found daily hassles have the strongest effect

on health in individuals, compared to short term stressors. Experiencing daily hassles has also been found to increase negative physical and psychological symptoms (Almeida, 2005).

### **Stress and Cognition**

Several studies have linked stress to cognitive functioning (Lupein & Lepage, 2001; McEwen, 2000; McEwen & Saplosky, 1995; Sapolsky, 1999; Schwabe, & Wolf, 2010). Stress has been identified as a main factor involved in the acceleration of cognitive changes which occurs during the aging process (Almela, et al., 2011; Garrett, Grady, & Hasher, 2010). Vondras and colleagues (2004), suggest that stressors place added demands on the limited processing resources of working memory. Daily stressors, as well as extreme stress, also produce high levels of cortisol which have been found to impair memory functioning (McEwen & Sapolsky, 1995; Neupert et al., 2006). The long term exposure to increased levels of cortisol has been found to cause damage to the hippocampus, a brain structure linked to cognitive declines later in life. Lupien et. al, (2009) also found the frontal cortex (another brain structure that suffers major losses as individual's age ) to be particularly vulnerable to the effects of stress,. These losses have been found to account for changes in executive functioning and working memory (Kalpouzios & Nyberg, 2012). Morczek and Alemdia (2004) also found older adults to show more reactivity to stressors compared to younger adults. It is clear that older individuals with higher stress levels are most at risk for memory declines and impairments.

### **Health and Cognition**

Another potential mediator of the relationship between physical environment and

memory is health. Several studies have found evidence to support the impact of health on cognitive functioning in older adults (Colcombe & Kramer, 2003; Holden et al., 2008; Smits et al, 1999). In particular, poorer cardiovascular (Andre´-Petersson, Hagberg, Janzon, & Steen, 2001; Insel, Palmer, Stroup-Benham, Markides, & Espino, 2005; Muller Aleman, de Hann, & Van der Schouw, 2005) and pulmonary functioning (Allaire, Tamez, Whitfield, 2007; Aleman et al., 2005; Anstey et al., 2004; Whitfield, 2000) have been linked to poorer cognitive functioning, particularly in African- American older adults (Allaire et al., 2008; Manly, 1998; Seeman, 2002).

Previous studies have found that physical environmental factors such as crowding, noise, sanitation and crime are related to poorer health outcomes, such as high blood pressure, chronic conditions, and overall self-rated health (Jacobs, Wilson, Smith, Evans, 2009; Li, Harmer, & Vongjaturapat, 2009; Yao & Robert, 2008). However, poorer health, particularly cardiovascular functioning, is associated with increased reported stress (Gulliford, Mahabir, & Rocke, 2004; Jackson, Knight, & Rafferty, 2010). Consequently, it is possible that the physical environment directly impacts health or indirectly impacts health by increasing the amount of contact with stressors.

### **Cognition in African Americans**

The current study will be conducted using a sample of African American older adults. It is important to conduct studies exclusively testing African Americans as few studies have examined memory declines specifically in this population (Gamaldo et al., 2010; Sims, Whitfield, Ayotte, Galamdo, 2011; Whitfield et al., 2000), and African Americans

experience greater age-related declines in memory functioning compared to other ethnic groups (Gamaldo, et al., 2010; Sims et al., 2008; Whitfield et al., 2000). Manly et al. (1998) found African Americans obtained lower scores on learning and memory, abstract reasoning, fluency and visio-spatial ability compared to White Americans.

This population is more likely than Caucasian older adults to live in poverty as result of several SES factors, particularly income and living arrangements (Siegel, 1999). African American older adult's health and cognitive functioning have been found to be negatively impacted by SES (Allaire & Whitfield, 2004; Whitfield, et al., in press; Whitfield et al., 2003). In addition, African American elders are especially vulnerable to environmental factors, as a result of the group's overall low SES (Cagney & York-Cornwall, 2010).

About one-third of older adults, have lived in the same community for 30 years or more, regardless of ethnicity or socioeconomic status (Bryan & Morrison, 2004). It is possible this may be a result of many subsets of the aging populations lacking the financial resources needed to relocate. This is most salient for those living in low income communities. South and Crowder (1997) found that the probability of moving from a low income neighborhood to a higher income neighborhood declines greatly with age, with the odds of older African Americans moving being close to zero.

Stress is also a particularly salient factor for African Americans. For instance, Geronimus and colleagues (2010) found stress to hasten biological aging in middle-aged African American women. Stress and poverty accounted for 27% of the variance, in the sample where African American women were 7.5 years older biologically than white women of the same chronological age. It is possible that the distribution of stress in these

neighborhoods is higher compared to other neighborhoods and as a result residents come in contact with more stressors (Latkin & Curry, 2003). From a review of the literature it is clear that many studies have found a relationship between living in low socio economic neighborhood and stress. Because older African American adults, are more likely to live in low income areas, which have been found to contain more stressors (Latkin & Curry, 2003), it is apparent that this group is most at risk for cognitive declines. African Americans on average are less physically healthy, have lower education levels and income compared to other groups (Williams, Yu, Jackson, & Anderson, 1997). It is possible these factors put African Americans at a greater risk for increased memory decrements across the lifespan.

### **Neighborhood Characteristics and Cognitive Functioning**

To date, only a handful of studies have assessed the relationship between the neighborhood one resides and cognition in older adults. Wright and colleagues (2006) examined the relationship between overall education levels of neighborhood and cognition. Using United States urban census tracts, the authors found particular aspects of neighborhoods are associated with cognitive functioning, specifically the overall level of education in a neighborhood was associated with worse cognitive scores controlling for median household income of a neighborhood. The authors deduced that cognition in late life is a product of the personal characteristics of the individual's interaction with the environment. In another study assessing a similar relationship, Clarke and colleagues (2011) found that after adjusting for individual risk factors, those living in more affluent neighborhoods with more institutional resources showed increased cognitive functioning.

The authors also found that long term residence in a neighborhood with more elderly residents was also related to cognitive declines in the sample.

To the author's knowledge, no studies exist that examine the relationship between neighborhood characteristics and cognitive functioning among older African Americans adults. It is evident that there are proximal (e.g. health, stress, income) and distal (e.g. education) influences of the environment that have an effect on cognitive functioning. However, it is not clear whether these influences are in fact serving as a proxy for the impact of the environment on cognitive functioning, in African American populations in particular, as this group appears to be especially at risk to detrimental neighborhood effects.

### **The Current Study**

The purpose of this study was to expand the literature on neighborhood effects by five specific aims. The first aim examined the extent to which perceived neighborhood characteristic variables (e.g. individuals living arrangements, feelings about sense of safety, environmental quality, and neighborhood SES) are related to older African Americans memory functioning. The second aim examined whether perceived neighborhood variables mediate the age-related variance in memory. The third explored whether the effects of perceived neighborhood characteristics on memory performance are mediated by stress. The fourth determined whether the impacts of perceived neighborhood variables on memory are mediated by health. The final aim determined the interrelations among perceived neighborhood characteristics, stress, and health individual differences in memory.

## Methods

### Participants

Data for the analyses were a subset of the Carolina African American Twin Study of Aging (CAATSA) designed to investigate the health status, cognitive functioning physical and psychosocial functioning of adult African American twins (Whitfield, Brandon, Wiggins, Vogler, & McClearn, 2003). The participants were identified from birth records between the years of 1913 and 1975 from 23 vital statistics offices in counties across North Carolina. Birth records were entered in a computerized database of twin births. After the records were computerized, potential participants were located through voter registries and telephone white page searches.

The participants consisted of a sub-sample of 361 individuals over the age of 50, with a mean age of 62.24 (SD= 9.2). The sample was 62.5 % female, 48.2% were married, and the average educational level was 11.80 (SD= 3.9) years. Just over half of the sample, 56.3%, was retired, and 52.9% reported a monthly income over \$1,500 dollars. According to federal guidelines, 36.1% of the sample met poverty guidelines, reporting making \$1,100 or less monthly. Similarly, 35% of the sample felt their current income covered their needs poorly or not at all. A random sample of this group was taken to ensure only one twin member was included.

## Measures

**Perceived Neighborhood Characteristics.** Eleven items assessed participants' perceptions of the neighborhoods in which they currently reside. Four constructs were assessed from these eleven items based on the neighborhood subjects each item addressed. The first factor was *living arrangements*. These items included: the type of building where one resided, whether participants lived independently, and the number of times the participant reported moving within the past five years. The second construct determined was *sense of safety*. This construct included items concerning feelings of safety in their own home from intruders and feelings of overall neighborhood safety. The third construct was *neighborhood environmental quality*. These items asked respondents questions concerning air quality, noise, and living near high traffic areas. The final construct addressed *neighborhood socio-economic status (SES)*. These questions concerned participants' feelings on neighborhood level SES factors including education level, wealth, and ethnicity of neighbors (see Table 1).

**Alpha Span** (Craik, 1990). Is used as a measure of working memory, where words are presented in random order. Subjects were read a list of words one at a time. These word lists began with two words and gradually increased to nine. Once each list was read, participants were asked to repeat the list of words in alphabetical order. For example, if the participant was presented with the words *edge–bag*, then the correct response was *bag–edge*. Correct and incorrect responses were recorded by the interviewer. Participants completed a practice trial in order to ensure comprehension of the instructions before beginning the actual

trials. Participants were presented with increasing alphabet strings until they were unable to complete two consecutive recall attempts correctly. The longest string consecutively recalled twice served as the participants score on the task. Responses were recorded as pass/fail, with two consecutive failed attempts ending the test.

**Forward and Backward Digit Span** (*Weschler, 1972*). Is used as a measure of attention (forward) and auditory working memory (backward). A series of digits ranging from four to nine were presented orally to each participant, after which they were asked to repeat the series either forward or backward order, depending on the test. Each participant was allowed 20 seconds to reproduce each series, which ranged from 4-9 digits. Responses were recorded as pass or fail, with two consecutive failures of the same string ending the test. The total number of correct responses on each task was used in analyses.

**Wechsler Logical Memory Scale** (*Weschler, 1981*). The scale assesses memory through a two part task: Immediate Prose Memory Recall and Delayed Prose Memory Recall. During this task, participants were asked to listen to a short story read to them aloud. Immediately after (immediate prose recall) and then again 10 minutes later (delayed prose recall), participants were asked to recall as much of the story as possible verbatim. The total number of correctly recalled pieces of information from the story was used for the immediate and delayed recall variables.

**Global Measure of Perceived Stress (PSS)** (*Cohen, Kamarck, & Mermelstein, 1983*). This 14 item measure was designed to measure the degree to which situations in

one's life are appraised as stressful. The PSS has been shown to correlate with; life event scores, depressive and physical symptomatology, utilization of health services, and social anxiety. Participants were asked about their feelings and thoughts during the last month, and were asked to report the frequency of certain thoughts or feelings. Responses were reported on a five point scale, with zero indicating never and four indicating very often. Scores were summed, with higher score indicating more perceived stressors. Coefficient alpha reliability for the Perceived Stress Scale ranges from 0.84 to 0.86. Test-retest reliability ranges between 0.55 and 0.85 depending upon time to retest.

## **Health**

### **Subjective Composite Health**

The health variables used in this analysis include participant's ratings of their own current health status as well as their responses to the question: "Have you ever been told by the doctor that you have the following: (diabetes, cardiovascular disease and high blood pressure)"? A composite health variable was created, summing a diagnosis of the three health conditions. The variable ranged from 0 to 3, with a score of three indicating the worst current health status.

### **Objective Health**

**Pulse Pressure.** Pulse pressure (PP) is hemodynamic index demonstrated to have important implications for cardiovascular disease. It is a measure of the force an individual heart generates each time it contracts. PP was calculated for each subject by subtracting the

average sitting diastolic blood pressure value from the average sitting systolic blood pressure value.

**Forced Expiratory Functioning.** Pulmonary lung function was measured using Forced Expiratory Functioning (FEV). FEV measures the volume of air that can forcibly be blown out in one second, after full respiration. Three readings were taken from each participant. The average of score was used for subsequent analysis.

### **Aims**

*Aim 1:* Examined the extent to which perceived neighborhood characteristic variables related to older African American's memory functioning. To address this aim, correlations were estimated among the neighborhood variables, health, demographic characteristics, and memory.

*Aims 2 - 4:* Examined the extent to which perceived neighborhood characteristics mediated the relationships between age, income, education, stress, health and memory. Specifically, the first test determined whether perceived neighborhood variables mediated age, income, and education-related variance in memory. The second examined whether the effects of perceived neighborhood characteristics on memory performance were mediated by stress. The third mediation analyses tested the impact of perceived neighborhood variables on memory and whether this relationship worked through health.

*Aim 5:* The final aim of the study was addressed using a path analytic technique using the statistical package AMOS in order to determine the interrelationships among perceived neighborhood characteristics, stress, and health when examining individual differences in

memory by estimating the significant relationships found in the previous analyses within a single model.

## **Results**

The following section will discuss the results of the study. The findings from the data reduction strategies will be reported first. Specifically, results from the factor analysis conducted using neighborhood, health and memory measures are noted. Results gleaned from each aim will follow.

### *Data Reduction*

Analyses began by examining eleven perceived neighborhood characteristic variables in order to determine whether four underlying factors could be identified. First, standardized scores were created for all variables by creating z- Scores. The z-Scores for each variable were then used in subsequent analyses. Prior to performing the exploratory factor analysis, the suitability of the data for factor analysis was assessed. Inspection of the correlation matrix did not reveal the presence of many coefficients above .3. The Kaiser Meyer- Olkin value was .51, just under the recommended value of .6 for a factorable measure (Kaiser, 1970). However the Bartlett Test of Sphericity did reach statistical significance supporting the factorability. Results using a Promax rotation did not find evidence to support the four hypothesized factors. The loadings ranged from .11 to .85 however, no clear factor emerged (See Table 2). Additional analyses examined models ranging from two to six factors, also resulted in an absence of a clear factor solution. Because no neighborhood constructs could be determined from these items, a theoretical approach was taken to select the neighborhood

variables that would be used in the analysis. These specific items were chosen as they are commonly used in the literature assessing neighborhood effects (Ruback & Pandey, 2002; Jacobs et.al, 1984; Balfour & Kaplan, 2002; Israel et al. 2008; Perlin, 1999; Perlin, 2005; Barlie, 2010). The variables chosen were; *What type of building do you live in?; Is your neighborhood safe?; Is the air in your neighborhood clean?; Is there much noise from traffic and other things?; How financially well off would you say most of the people who live in your neighborhood are?; and Of the people over 50, did most of them finish HS or get a GED?*

The nominal variable, *Type of Building*, was then dichotomized into single and double occupancy. The original nominal variable was distributed on a scale of 0 to 6, with all responses excluding zero representing a residence in which the participant shared with others. Manipulating the variable into single and double or more occupancy allowed the variable to be used in subsequent analysis, as a categorical predictor while maintaining its original meaning. In addition, all memory measures included in the study were highly correlated (see Table 3). As a result, a composite memory variable was calculated including; Forward and Backwards Digit Span, Alpha Span, and Wechsler Logical Memory using the sum of standardized scores from each variable.

The first aim of the study examined the extent to which neighborhood characteristics were related to memory functioning. As seen in Table 4, memory was significantly related to neighborhood noise levels and neighborhood education. Older adults who reported less noise in their neighborhoods tended to have better memory functioning ( $r=.12$ ;  $p=.05$ ). In addition,

older adults who perceived their neighbors to have higher education levels had better memory functioning ( $r = -.13, p = .05$ ).

Mediation analyses were conducted in order to address aims 2-4. The goals of these analyses were to explore if neighborhood characteristics mediated the following relationships: a) demographic characteristics (age, income and education level) and memory; b) perceived stress and memory; and c) health and memory. This study used the approach advocated by Baron and Kenny (1986). As a condition of mediation analysis, all variables must be significantly correlated to one another. As seen in Table 4, only perceptions of neighbor's education level were significantly correlated to all the other variables in the analysis in reference to aims two and three. As a result, this variable will be used to represent neighborhood characteristics in these analyses. In the fourth aim, neighborhood noise was also found to be significantly correlated to memory and health variables. Thus was added as an additional neighborhood measure in this analysis.

The first mediation analysis conducted determined if neighborhood variables mediated the age- related variance in memory. A hierarchical regression was conducted, with age entered into the equation in the first step and the mediating variable (neighborhood education level) in the second step. Age was found to be a significant and negative predictor of memory functioning. Increased age was related to a decrease in memory functioning, as seen in Table 5. With the addition of neighborhood education level in the second step, age continued to be negatively and significantly related to memory. Although the significance did not change, the value of the relationship was slightly altered with the addition of

neighborhood education level. As a result a Sobel Test (1982) was conducted to determine if this met criterion for mediation. Results from the Sobel Test indicated that neighborhood education level ( $t = -1.2$ ;  $p = .24$ ) did not mediate the relationship between age and memory functioning.

A second mediation analysis was conducted to determine if neighborhood education level mediated the income- related variance in memory. A hierarchical regression was conducted with income entered into the equation in the first step and the mediating variable (neighborhood education level) in the second step. Gross monthly income was found to be a significant and positive predictor of memory functioning, with increased monthly income being related to increased memory functioning, as seen in Table 6. With the addition of neighborhood education level in the second step, income continued to be a positive and significant predictor. However, the magnitude of the relationship did decrease with the addition of neighborhood education. Results from the Sobel Test, found neighborhood education level ( $t = .96$ ;  $p = .34$ ) to not be a significant mediator in the relationship between income and memory in older adults.

The third mediation analysis was conducted to determine if neighborhood variables mediated the relationship between education and memory. In the first step, education was entered into the equation followed by the mediating variables (neighborhood education) in the second step. Education was a significant and positive predictor of memory functioning, with more education being related to increased memory functioning, as seen in Table 7. With the addition of neighborhood education level in the second step, education continued to be a

positive and significant predictor. Although the significance did not change with the addition of neighborhood education level, the magnitude of the relationship decreased slightly. A subsequent Sobel Test found neighborhood education level to not significantly mediate this relationship ( $t = .95$ ;  $p = .34$ ).

The fourth and fifth meditation analyses were conducted to determine if neighborhood variables mediated the relationship between stress and memory. Of the six neighborhood variables, only neighborhood education level and the amount of noise in the neighborhood were significantly correlated to both stress and memory. Two separate hierarchical regressions were conducted with perceived stress entered into the first step and mediating neighborhood variables (neighborhood education level, noise) entered into the second step in both analyses. Stress was found to be a significant and negative predictor, with increased amounts of stress an individual perceived being related to decreased memory functioning in both models. With the addition of the neighborhood variables in the second steps, stress was no longer a significant predictor; these relationships can be seen in Tables 8 and 9. This suggests these neighborhood characteristics could possibly mediate the effect of stress on cognition. Two follow up Sobel Tests were conducted to determine if noise or neighborhood education level were significant mediators. Results from the Sobel Tests indicated that neighborhood education level ( $t = -1.4$ ,  $p = .25$ ) and noise ( $t = -1.4$ ,  $p = .17$ ) did not mediate the relationship between stress and cognition.

The final mediation analysis was conducted to determine if an older adult's health mediated the relationship between neighborhood education levels and memory. Of the health

measures in this study (overall health, average forced expiratory volume (FEV) and pulse pressure, only FEV was found to be correlated to neighborhood education level and memory in the analysis (see Table 4). As a result, the mediation analysis determined if FEV mediated the relationship between neighborhood education levels and memory. A hierarchical regression was conducted with neighborhood education level entered into the first step and FEV into the second. Neighborhood education level was found to be a positive and significant predictor of memory functioning with completion of high school being associated with increased memory functioning (Table 10). When FEV was added into the second step, neighborhood education level was no longer a significant and positive predictor (Table 11). A follow up Sobel test found that FEV ( $t= 1.6; p = .11$ ) was not a significant mediator of the relationship between neighborhood education levels and memory functioning in older African American adults.

To address aim five, path analysis was used to determine the interrelations between neighborhood characteristics, health, and stress when examining individual differences in memory. A correlational analysis was conducted in which all variables involved in previous analyses were used in order to determine the paths to include in the model. The magnitude of the relationships between the variables ranged from .10 to .95, and each variable was correlated to at least one other variable with each Pearson correlation statistic being significant at the .05 level of less (See Table 4.). As a result, no variables were excluded in the initial path analytical model.

The modeling process began with the hypothesized model, shown in Figure 1. The model contained indirect paths for building occupancy, safety, air, neighborhood SES (income and education). These worked through overall health, mean FEV, pulse pressures and stress, in the variables relationship to memory. Control variables included age, income and education levels. Eleven of the 46 paths were statistically significant. All of the fit indices for this initial path model were not acceptable ( $\chi^2 = 420.99$ ,  $p = <.01$ ; RMSEA = .17; CFI = .35; AIC: 586.9) suggesting a poor fit for the data. In the next step, all of the insignificant paths were removed in order to create the reduced model.

In the reduced model, the neighborhood characteristics used were building occupancy, noise, air quality and neighborhood education level. Indirect paths connected these variables influence on memory functioning, as they worked through the proxies for health variables and stress. The proxies for health used were FEV and pulse pressure. The control variables were kept in the reduced model. All the paths in this model were significant except the direct effect of noise on pulse pressure (See Figure 2). Again, the fit indices for the reduced model did not reflect a well-fitting model ( $\chi^2 = 336.77$ ,  $p = <.01$ ; RMSEA = .14; CFI = .41; AIC: 406.77). Therefore neither the hypothesized nor reduced model explains the interrelationship between the variables of interest.

### **Discussion**

The current study investigated the relationship between perceived neighborhood characteristics and older African American adults' memory functioning. The following

sections will address the findings associated with each aim, note limitations to the study, discuss implications, and future directions of the research.

Results from this study suggest perceived neighborhood noise levels are associated with memory functioning. Older African Americans reports of residing in a noisier neighborhood were associated with worse memory functioning. This finding is consistent with existing literature showing an association between auditory distractions and memory decrements in older adults (Bell & Buchner, 2007; Hasher, et al, 2007; Hasher & Zacks, 1988). Due to deficiency in older adults inhibitory control systems, older adults are less able to control irrelevant environmental events from interacting with working memory functioning and as a result suffer memory decrements (Hasher & Zacks, 1994). Noise found in neighborhoods, as a result of traffic and other factors has also been found to be related to memory decrements across the lifespan (Hygee, Bowman,& Enmarker, 2003; Meidema, 2007; Stansfel, Haines, & Brown, 2000). Despite the weak association, this study is unique in its demonstration of this association specifically in African Americans. The finding underscores the fact that African Americans living in urban neighborhood areas characteristically known to be nosier and could be at risk to suffer memory decrements as a result of their environment.

The study also found memory functioning to be marginally related to the perceived education level of the neighborhood in which participants resided. As discussed earlier, several studies have found a similar link between education and cognitive functioning at the individual level in Americans (Cagney & Lauderdale, 2002; Fisher, 2009; Lang et al., 2008;

Christen & Henderson, 1991). Few studies have investigated education at a contextual levels impact on cognitive functioning, those that have produced results consistent with the findings of this study. Wight and colleagues (2005) found that older adults living in “low education” areas showed more cognitive declines than those living in “high education” areas, when controlling for contextual level income. Although the relationship was modest, at least one study has found similar results with more heterogeneous samples. It appears that African American older adults mirror the pattern found in other groups.

Perceived neighborhood factors were not found to be a mechanism explaining commonly observed relationships between demographics, stress, lung functioning and memory. Because neighborhood education level and noise were the only characteristics which met the criteria for use in the analysis, the results are limited to these specific aspects of a neighborhood. Although neighborhood education level is not commonly used as a standalone variable in the literature, it is often included in assessments of neighborhood socio-economic status (NSES). The literature in this area is diverse. Shih and colleagues (2011) found higher NSES to be associated with higher cognitive functioning above and beyond individual demographic characteristics in older women. The authors included neighborhood education level as one indicator of NSES on a scale similar to the one used in this study. In accordance with the results of this study NSES was not found to be associated with cognitive decrements in older African American women.

Results vary in the discussion of the relationship between NSES and health. Wight and colleagues (2006) believed educational attainment of neighborhood residents to be a

central gauge of socio economic context, as it sets the stage for a variety of socioeconomic factors which impact health. Robert and Li (2001) found NSES to be associated with self-reported health and chronic disease independently of individual SES. In contrast, Robert (1998) found NSES not to be associated with health outcomes after controlling for individual SES. Similarly, Shih (2011) reported that NSES did not explain the relationship between health outcomes and cognition in older adults.

The study found perceived neighborhood variables did not mediate the age, income, or education related variance in memory. Although all three demographic characteristics were found to predict memory functioning, neighborhood characteristics did not mediate these relationships. The lack of mediation in each aim could possibly be evidence of the unique characteristics of; age, education and income and environmental context in their relationships with the memory function of older African American adults. It is possible that the neighborhood in which an individual resides has its own role in cognitive declines, a role that is unrelated to demographic characteristics health and or stress. More research is needed in this area to untangle the possible distinctive relationship neighborhood features may have in the cognition of older adults.

The current study also found perceived stress to be a predictor of poorer memory, a finding that has been reported in numerous studies (Lupein & Lepage, 2001; McEwen, 2000; McEwen & Saplosky, 1995; Pilgrim & Lupien, 2010; Sapolsky, 1999; Schwabe, & Wolf, 2010). Given that stress is particularly relevant in the lives of African Americans, especially as the environment is often listed as a stressor in the lives of this group this finding is

important (Baum, Garofalo & Yali, 1991; Gapen, et al, 2011; Goldmann, et al., 1990; Warren-Findlow, 2006). However, perceived neighborhood factors were not found to mediate this relationship. Although noise and neighborhood education levels were found to be associated with memory declines in this study, interestingly these relationships did not mediate the relationship between stress and memory. It is possible that noise in the environment is not seen as a source of stress to this population. Contrary to this, Baum and colleagues (2006) suggest that chronic stressors found in low SES neighborhoods; including noise may have harmful effects on the health outcomes. Perceived environmental stress was also found to increase the allostatic load of older adults and impact cognitive functioning in older adults (Juster, McEwen, & Lupein, 2010).

Finally, the path analytic model proposed in order to discover the interrelations among demographic factors of stress, health, neighborhood factors and memory found significant direct and indirect effects. The model was not found to be a good fit for the data. The poor fit is not surprising given the neighborhood factors were not found to mediate any of these relationship in prior analyses.

The results found in this study provide evidence that more research is needed in this area to tease apart these complex relationships. From the data presented, neighborhood characteristics appear to be related to memory functioning in older adults to a small degree. However these characteristics do not mediate the relationships found to exist between health, stress, demographic characteristics and memory in this study. Although these concepts

appear to be interrelated, when examining individual difference on memory, the direct and indirect relationships between them are not clear.

### **Limitations**

There are several limitations which may have a role in the results of this study. One limitation to the study is the sample was drawn from a single state. Although there was variance in the location within the state, all of the neighborhoods sampled were within the state of North Carolina. There could be contextual cohort issues specific to people living in a neighborhood within North Carolina that could have an impact on the relationships studied. Issues such as segregation, integration, and housing discrimination, could all have influenced on the development of this cohort over the life course. Another limitation of the study is the nature of the data. The neighborhood data collected are entirely self-reported, more objective measures of neighborhood characteristics could paint a truer picture of the context in which the respondents reside. For example the question of “how often a respondent moved in the past five years” does not truly capture the amount of time a participant may have spent in a particular neighborhood. A more appropriate measure would determine the length of residence through census data, or by acquiring specific address details from respondents. Limitations also exist with respect to the sample. The sample being entirely African American limits the generalizability to other aging populations. The lack of objective data is also a major limitation to this study. Particularly, the neighborhood data collected was solely based on participant’s perceptions. Including census track data to obtain a clearer picture of the neighborhoods in which these individuals lived, may have shown stronger neighborhood

effects. Future studies, examining neighborhood effects on memory declines in older African American adults should include census data when assessing neighborhood characteristics. Finally, the cross sectional nature of the data does not allow for any causal pathways to be determined in the relationship between neighborhood factors and memory.

### **Implications and Future Research**

Despite these limitations there are several important implications of this study. This is one of the first studies to address the relationship between cognition and the neighborhood context in African Americans. Although the study did not produce conclusive results testing these relationships, it is a foundation to begin the discussion of the impact of context in aging populations, specifically in African American. It has been established that this group is particularly at risk for cognitive decrements, thus this study has begun to discern the layers of risk in this population. Most importantly, through this and similar analyses, groups most at risk for cognitive deficits can be determined based on environmental data. The findings suggest that context specific assessments are needed to determine possible intervention sites for this population. More importantly, these assessments can facilitate early identification of risk factors and serve as possible site of prevention of cognitive health complications by targeting those living in disadvantaged neighborhoods. The findings also have policy implications, as they suggest that policies which address improving the residences and communities of older adults can have vast public health benefits. Systems of social welfare and health care can begin to work in tandem with neighborhood design and reformers to meet the needs the current demographic changes occurring in our society. Glass and Balfour

(2003) discuss a “structure lag” in our society, in which the design of living spaces will need to catch up to the demographic reality of the world as one of the major challenges of the century. This study provides some empirical support for addressing this problem.

Because African American older adults are spending more time in their neighborhoods and may be differentially vulnerable to contextual effects, the findings that neighborhood education levels and noise do not play a factor in the relationship between memory declines, stress, health and other demographic factors are positive. It is possible that there are some protective factors being used that may help buffer the contextual effects in these relationships. More work is needed in this area that expands the type of neighborhood characteristics studied and which also incorporates possible protective factors being utilized by this group.

Given the strength of relationships found in the study, future research should include stronger neighborhood indices. The current study was only able to investigate a limited number of neighborhood characteristics. Studies should include more neighborhood characteristics, including objective data, as well as physical and social characteristics. Census data, as well as neighborhood observations, would be useful in studying neighborhoods more holistically. More research is also needed to determine if there are resilience factors in older African American populations that may protect them from detrimental effects of living in deleterious neighborhoods. Overall, the study provides a good starting place for future research. From the results, it is clear that the neighborhood that one resides is associated with cognitive declines, although the mechanisms guiding this relationship remain unclear.

Table 1  
*Perceived Neighborhood Characteristic Variables*

Construct/ Variable	Item
Living arrangement	(1) What type of building do you live in? (Building Occupancy)
	0 = <i>Private home</i> 4 = <i>Hotel/Motel</i>
	1 = <i>Condominium</i> 5 = <i>Rooming House</i>
	2 = <i>Duplex</i> 6 = <i>Other</i>
	3 = <i>Apartment Building</i>
	(2) Are you presently living in your own home opposed to being with a child or parent? (Live Alone)
	0 = <i>No</i> 1 = <i>Yes</i>
	(3) How many times have you changed where you lived during the past five years? (Frequency of Move)
Sense of Safety	(1) Do you feel that your house (apartment) is safe from burglars and other intruders? ( Safe from Intruders)
	0 = <i>no</i> 1 = <i>yes</i>
	(2) Is your neighborhood safe? (Neighborhood Safety)
	0 = <i>no</i> 1 = <i>yes</i>

Table 1 Continued

Environmental Quality	(1) Is the air in your neighborhood clean? (Air Quality)
	<i>0= Very clean                      3 = Somewhat dirty</i>
	<i>1= Reasonably clean      4 = Very dirty</i>
	<i>2= Average</i>
	(2) Is there much noise form traffic and other things? ( Noise from Traffic)
	<i>0= A great deal                      3 = Some</i>
	<i>1 = More than average      4 = Very little</i>
	<i>2 = Average</i>
	(3) Do you live near a freeway, airport, or railroad?( High Traffic Area)
	<i>0 = No 1 = Yes</i>
Neighborhood Socio-Economic Status	(1) How financially well of would you say that most of the people who live in your neighborhood are? ( Neighborhood Income)
	<i>0 = Very well off: they have more than enough money for bills, food and anything extra they want.</i>
	<i>1 = Doing well: have enough money for bills, food and most of the extra things they want.</i>
	<i>2 = Doing ok= have enough money for bills, food and a few of the extra things they want</i>
	<i>3= Barely getting by: have just enough money for bills and food, cannot buy any of the extra things they want</i>
	<i>4 = Not getting by: don't have enough money for bills and food and cannot buy any of the extra things they want.</i>

Table 1 Continued

(2) Of the people over 50, did most of them finish HS or get a GED?  
(Neighborhood Education)

*0 = No 1 = Yes*

(3) More than half of the people in your neighborhood are of what  
ethnicity? ( Neighborhood Race)

*0 = Black 1 = White 2 = Hispanic 3 = Asian 4 = Other*

Table 2  
*Exploratory Factor Analysis of the Perceived Neighborhood Measures*

Item	Factor 1	Factor 2	Factor 3	Factor 4
Safety from intruders	.86			
High traffic Area	.82			
Neighborhood Income		.77	-.14	.14
Neighborhood safety	-.13	.65		-.13
Neighborhood Education		.53	.19	-.13
Frequency of move	.17		.59	.35
Building Occupancy		.15	.58	
Live Alone	.16	.17	-.56	.21
Neighborhood Race	-.13	-.14	.44	
Noise from Traffic	-.15		.15	.72
Air quality		.11	.23	-.70

\*Note: Items can be found in Table 1

Table 3  
*Correlations Among Memory Variables (N=361)*

	Alpha Span	Forward Digit Span	Backwards Digit Span
Forward Digit Span	.45**		
Backwards Digit Span	.55**	.45**	
Wechsler Logical Memory	.46**	.17**	.37**

Note. \*Indicates significance at the .05 level.

Table 4

*Correlations among Income, Age, Memory, Stress, Composite Health, FEV, and Neighborhood Variables (n=361)*

	Age	Income	EDU	Memory	Health	Pulse Pressure	FEV	Stress	Air	Noise	Neighbor Education	Safety Occupancy
Income	-.12*											
Education	-.47**	.28**										
Memory	-.38**	.20**	.57**									
Health	.29	-.13**	-.14**	-.18**								
Pulse Pressure	.43**	-.06	-.23**	-.23**	.38**							
FEV	-.4**	.20**	.34**	.27**	-	-.15**						
					.18**							
Stress	-.04	-.28**	-.17**	-.12*	.05	-.10	-					
							.16**					
Air	-.07	-.08	-.18**	-.05	-.02	.04	-.10	.15**				
Noise	-.06	.07	.15**	.12*	-.03	-.07	.01	-.11*	-.21**			
Neighborhood EDU	.20**	-.14**	-.23**	-.13*	.05	.06	-	.16**	.17*	.08		
							.19**					
Safety	-.06	-.01	-.02	-.04	-.05	-.01	-.04	.03	.05	.05	.08	
building occupancy	-.04	-.16**	-.04	-.06	.04	.001	-.07	.16**	.13*	-.04	.10	.12*
Neighborhood	.07	.07	-.05	-.07	.08	.11*	-.02	-.004	.02	.05	.21**	.24**
Income												-.01

Note. \*Indicates significance at the .05 level. \*\*Indicates significance at the .01

Table 5  
*Hierarchical Regression Predicting Memory Functioning (n=361)*

Predictors	B	Block 1		B	Block 2	
		SE	$\beta$		SE	$\beta$
Age	-.04	.01	-.39**	-.04	.01	-.38**
Neighborhood Education				-.19	.16	.08
R <sup>2</sup>		.15			.16	
$\Delta R^2$					.006	

Note. \*\*Indicates significance at the .01 level.

Table 6  
*Hierarchical Regression Predicting Memory Functioning (n=361)*

Predictors	B	Block 1		B	Block 2	
		SE	$\beta$		SE	$\beta$
Income	.24	.06	.25**	.22	.07	.23**
Neighborhood Education				.17	.17	.07
R <sup>2</sup>		.06			.06	
$\Delta R^2$					.004	

Note. \*\*Indicates significance at the .01 level.

Table 7  
*Hierarchical Regression Predicting Memory Functioning (N=361)*

Predictors	B	Block 1		B	Block 2	
		SE	$\beta$		SE	$\beta$
Education	.13	.01	.55**	.13	.15	.55**
Neighborhood Education				-.007	.15	-.003
R <sup>2</sup>		.31			.31	
$\Delta R^2$					.000	

Note. \*\*Indicates significance at the .01 level.

Table 8  
*Hierarchical Regression Predicting Memory Functioning n=361)*

Predictors	B	Block 1		B	Block 2	
		SE	$\beta$		SE	$\beta$
Perceived Stress	-.01	.01	-.14**	-.01	.01	-.1
Neighborhood						
Education				-.01	.01	-.12
R <sup>2</sup>		.02			.03	
$\Delta R^2$					.01	

Note. \*Indicates significance at the .05 level.

Table 9  
*Hierarchical Regression Predicting Memory Functioning (n=361)*

Predictors	B	Block 1		B	Block 2	
		SE	$\beta$		SE	$\beta$
Perceived Stress	-.01	.01	-.13*	-.01	.01	.12
Noise				.08	.04	.13
R <sup>2</sup>		.02			.04	
$\Delta R^2$					.02	

Note. \*Indicates significance at the .05 level.

Table 10  
*Hierarchical Regression Predicting Memory Functioning (n=361)*

Predictors	B	Block 1		B	Block 2	
		SE	$\beta$		SE	$\beta$
Neighborhood						
Education	.33	.17	.12*	.25	.17	.10
FEV				.001	.00	.19**
R <sup>2</sup>		.02			.05	
$\Delta R^2$					.03	

Note. \*\* Indicates significance at the .01 level  
 \* Indicates significance at the .05 level.

Table 11  
*Mean Income, Age, Memory, Stress, Composite Health,  
 FEV and Perceived Neighborhood Variables Scores*

Variable	M (SD)
Age	61.50 (9.3)
Income	1.84 (.89)
Education	12.0 (3.9)
Memory	1.2(.86)
Health	1.0(.87)
Pulse Pressure	59.1 (17.6)
FEV	288.10 (130.6)
Stress	18.33 (7.9)
Air	1.13 (.94)
Noise	2.98 (1.31)
Safety	1.79 (.87)
Neighborhood Income	1.2 (.67)
Neighborhood Education	.73 (.75)
Occupancy	1.17 (.87)

(n=361)

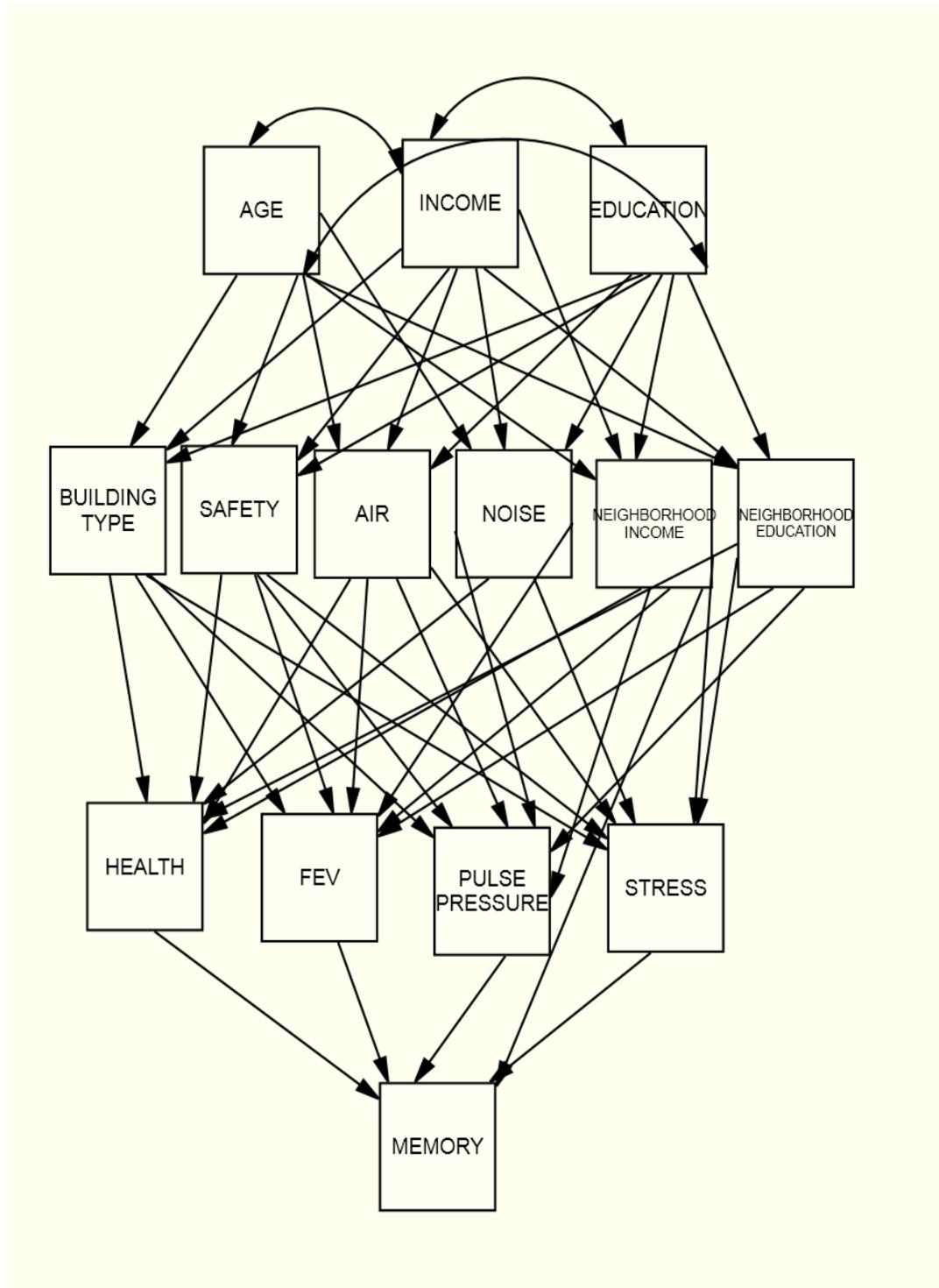


Figure 1 Hypothesized Model.

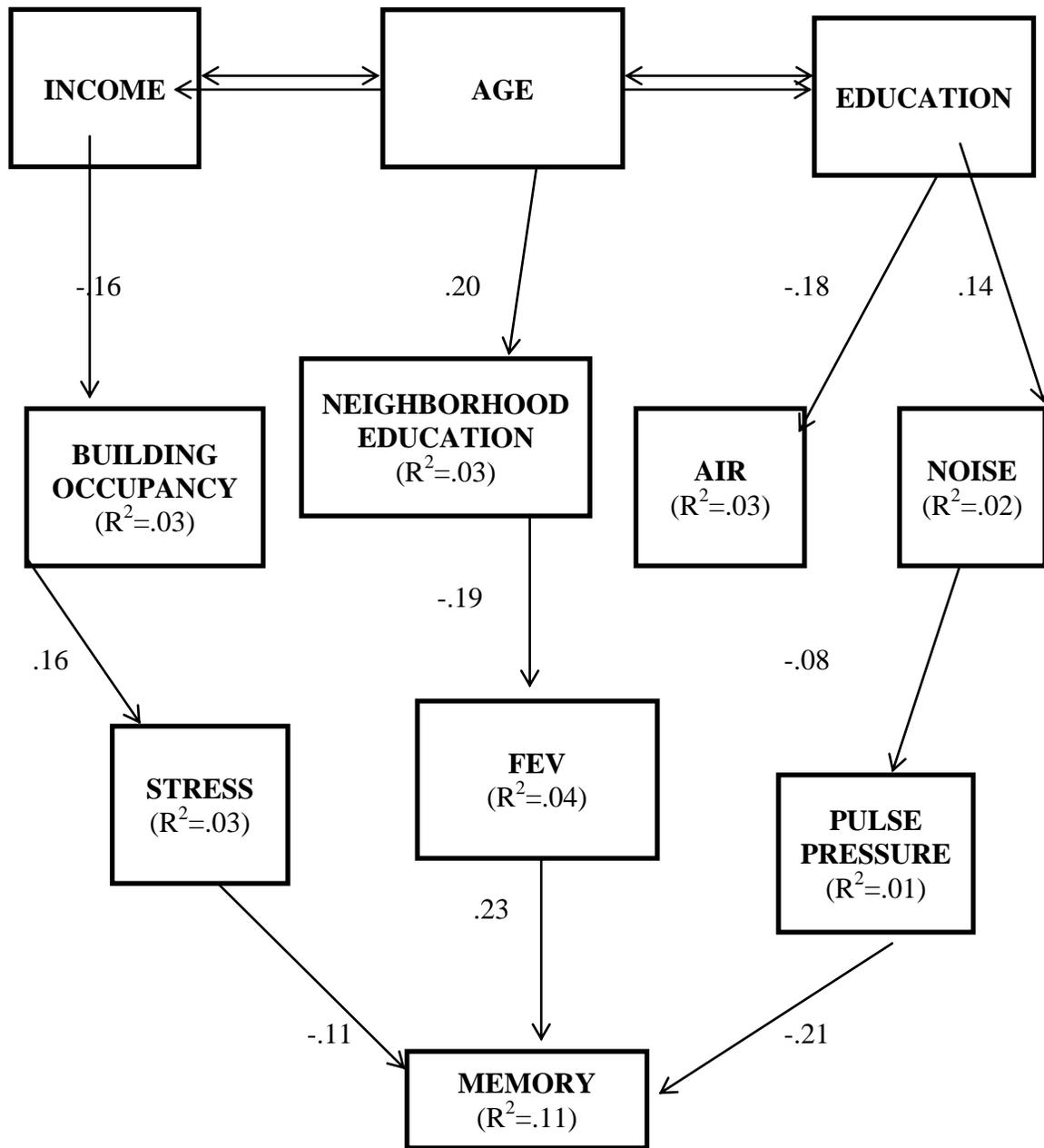


Figure 2 Trimmed Path Model of the Intercorrelations of Demographic, Perceived Neighborhood Characteristics, Health, Stress, on Individual Differences in Memory. (Significant standard  $p < .01$  path coefficients are shown)

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