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Article

The Moderating Role of Employment Status and Gender on Relationships Between Psychological Age and Health: A Two-Wave Cross-Lagged Panel Analysis of Data From the Health and Retirement Study

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ABSTRACT

In this study we explored the direction of over-time relationships between psychological age (PA) and 4 facets of health for older adults, with social comparison theory (SCT) and stereotype embodiment theory (SET) providing the rationale for competing causal orderings of these relationships. Expanding on recent longitudinal work (Petery, 2015; Spuling, Miche, Wurm, & Wahl, 2013) we investigated whether over-time employment status (employed, transition to retired, retired), gender, and the interaction of employment status and gender moderate the nature of these relationships for older (over 50 years old) adults. We examined data on PA and indicators of general, functional, physical, and mental health from the Health and Retirement Study collected at 2 time points, 4 years apart. Hypothesis testing on the causal ordering of the 2 constructs and the proposed moderations were conducted, with each health facet examined independently using cross-lagged panel path analysis and multigroup analysis of employment by gender subgroups. Effect sizes for relationships between PA and health were small in magnitude for all health facets and all employment status and gender subgroups. The apparent primary causal direction of relationships differed by health facet, with support provided for both Health → PA and PA → Health temporal orderings. Furthermore, with the exception of physical health, which exhibited consistent support for a Health → PA relationship, the primary causal direction of the relationship between PA and health depended on both employment status and gender, jointly. These provide further evidence of the complexity of the health-PA relationship.

Organizations in most industrialized nations are concerned with the "greying" of their workforces. For example, in the United States it is estimated that 43% of adults age 55 and older will be participating in the labor force in 2020; the proportion is highest for those in the 55–64 age range, with participation rates in that age group projected to be greater than 68%, while participation rates for adults age 65 and older aged is expected to be nearly 23% (Toossi, 2012). Several factors contribute to continued labor force participation, including economic need, desire to remain in the employment role, and reluctance to transition to the role of "retiree" (Barnes-Farrell, 2003; Wang & Shultz, 2010). Nonetheless, a key factor that either permits (allowing an individual to act on personal preferences/needs), requires (e.g., in order to maintain/access healthcare benefits) or disallows continued employment (forcing an individual into early or undesired retirement) is health (cf. McGarry, 2004). Thus, it has been argued that "healthy aging" is important, not only for the well-being of adults as they age (as a component of successful aging), but also for the well-being and effectiveness of our labor force (cf. Ilmarinen & Ilmarinen, 2015; Kuh & the New Dynamics of Ageing Preparatory Network, 2007; Peel, McClure & Bartlett, 2005; Westerhof & Barrett, 2005). With this in mind, understanding connections between health and aging has understandably received considerable attention, both among those who study the so-called aged and, somewhat more recently, among those who study mid-life and older members of the workforce. It has also been suggested that relationships between health and aging can be better appreciated if we recognize that aging does not simply refer to the passage of time, but also refers to our psychological experience of the aging process (psychological aging). Understanding the connection between these two key constructs may offer insights into how we can preserve health, facilitate continued workforce participation, and

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foster well-being among adults who have entered a phase in their lives where both health and psychological awareness of the aging process become salient features of their identities.

It is important to recognize that health is not a unitary concept, but is instead multifaceted (Fisher, Faul, Weir, & Wallace, 2005). Although it is possible to conceptualize health in many different ways, four key facets of health have been recognized that capture differences in the breadth (broad vs. narrow) of the definition, the domains captured (e.g., physical and mental/emotional), and the extent to which one's state of health has practical implications for daily life (functional). General health (GH) is a global assessment of overall health that is generally rendered as a subjective judgment. Functional health (FH) considers whether physical health conditions hamper daily functioning. Physical health (PH) represents diagnoses of illnesses and sensory impediments, such as hypertension and visual impairment. Mental health (MH) refers to psychological well-being. Although these facets are not independent of one another, they are conceptually distinct with sometimes differing antecedents and consequences.

There is a large body of research on health-related changes that accompany increases in chronological age (CA). We will not review that literature here, other than to note that there is considerable variation in the rate and extent of age-related health changes among adults (e.g., Aldwin & Gilmer, 2013; Case & Deaton, 2005; Ng & Feldman, 2013; Pinquart, 2001). For example, cognitive function may remain stable or even improve over time for older adults, particularly those who regularly engage in inductive reasoning and numerical abilities (Salthouse, 2012; Schaie, 1990; Shimamura, Berry, Mangels, Rusting, & Jurica, 1995). And while clinical indicators may signal decline for some aspects of health (e.g., hypertension, BMI, and cholesterol), these declines may be gradual and unnoticeable and may not interfere with functioning (Ng & Feldman, 2012). In sum, there is considerable variability in health among individuals who share a common CA.

Furthermore, although CA (also known as calendar age) is used in research on aging workers as the most common index of age, CA is simply a measure of time elapsed since birth (Schwall, 2012) that often serves as a proxy for assumed shared characteristics, behaviors and events, including those associated with health, such as decline in functioning. Added to this is the persistent, yet largely unfounded stereotype that older workers are less healthy compared to younger workers (Ng & Feldman, 2012). Such stereotypes are not only pertinent to the way employers treat older workers; they also have implications for expectations that individual workers have about their own health and functional capabilities as they age.

Bearing in mind the variability in characteristics, behaviors, and health among workers with similar CAs, researchers who study aging workers have appealed for alternative measures of individual age that broaden our conceptual understanding of age and capture features of aging beyond the passage of time (e.g., Blau, 1956; Hedge, Borman, & Lammlein, 2006; Truxillo & Fraccaroli, 2013). Psychological age (PA) is an option that has been used for nearly half a century throughout numerous fields of study to subjectively assess personal construals of age. Furthermore, past research has consistently found PA and health to be related (e.g., Demakakos, Gjonca, & Nazroo, 2007; Hubley & Russell, 2009; Petery, 2015; Sargent-Cox, Anstey, & Luszcz, 2012; Westerhof et al., 2014), independent of the relationships of those phenomena with CA.

However, findings reported to date provide limited guidance on whether observed relationships between PA and health represent a causal influence of PA on health or a causal influence of health on PA, because the overwhelming majority of existing research that has looked at this association has used cross-sectional data, which cannot speak to this issue. Furthermore, it is unclear whether these relationships are consistent across the four facets of health, as most studies tend to focus on one, or at most two, aspects of health. To address these issues we first explore two theoretical perspectives that produce opposing hypotheses about the causal direction between PA and health, with the goal of comparing support for these opposing propositions across a full array of health facets. We then consider two possible moderators of the PA–health relationship that may be especially pertinent to older adults. The study described in this paper is intended to move our understanding of how PA and health are connected forward by providing evidence that speaks to each of these issues.

Causal Relationships Between PA and Health

Social comparison theory (SCT; Festinger, 1954) offers reasoning that health cues act as antecedents to personal construals of age by signaling that an individual's health status is consistent or inconsistent with "expected health status" for a particular CA. This produces feelings of being older than or younger than one's CA (well-represented by the commonly used "felt age" [FA] operationalization of PA). Simply stated, SCT proposes health as an antecedent of PA. This theoretical rationale applies to all four aspects of health, although it is possible that some facets of health provide clearer or stronger signals about PA than others.

Hypothesis 1: (a) general health, (b) functional health, (c) physical health, and (d) mental health are antecedents to PA.

In contrast, stereotype embodiment theory (SET; Levy, 2009) purports that PA represents a form of personal identity that activates personally held age stereotypes, which manifest as health outcomes. Individuals behave in ways that are stereotype-consistent with their PA, including behaviors that impact their health. For example, an individual with an "old" PA may refrain from engaging in health-promoting behaviors (such as engaging in physical exercise and tackling cognitively demanding tasks) because they simply accept that physical infirmities and cognitive slowing are part of what it means to be "old." Thus, PA becomes a driver of health.

Hypothesis 2: PA is an antecedent to (a) general health, (b) functional health, (c) physical health, and (d) mental health.

As noted earlier, most published work on the relationship between PA and health has been cross-sectional, which precludes drawing inferences about causal directions. There are a few exceptions to the cross-sectional methodology. A meta-analysis of 19 studies that examined the influence of PA on one or more dimensions of health with designs that included an over-time component found that PA (assessed in a variety of ways across these studies) had a significant, but small, effect on health (Westerhof et al., 2014). Unfortunately, this meta-analysis only evaluated support for the impact of PA on health and did not

examine evidence for the impact of health on PA. Among the studies included in the meta-analysis were a small number of studies that used longitudinal designs to test for alternate temporal orderings of the relationship between PA and health. Sargent-Cox, Anstey, & Luszcz, (2012) conducted a longitudinal study of adults 65 years and older, drawn from participants in the Australian Longitudinal Study of Aging, that looked specifically at FH measures and perspective of aging at 5 time points during a span of 16 years. They concluded that negative views of aging were predictive of declines in FH. In addition, a pair of studies based on data from the German Aging Survey both tested for temporal ordering and uncovered a stronger relationship from PA to health than from health to PA (Spuling, Miche, Wurm, & Wahl, 2013; Wurm, Tesch-Romer, & Tomasik, 2007). Thus the bulk of published longitudinally-based research tends to favor the SET view of PA as a driver of health, rather than vice versa, although these studies have rarely considered possible modifiers of those relationships. Furthermore, with the exception of the two studies cited above that drew on data from the German Aging Survey, few of these studies have included consideration of more than one or two aspects of health in their examination of PA–health relationships.

Building on the work of Spuling, Miche, Wurm, and Wahl (2013), Petery (2015) conducted a three-wave longitudinal study with a sample of full-time manufacturing workers of varying ages that examined empirical evidence for the direction of relationships between PA (specifically, proportional discrepancies between reported "FA" and CA that indicate feeling "older" or "younger" than one's CA) and the four facets of health identified earlier: GH (overall), PH, FH, and MH. Key features of the Petery study were inclusion of measures for all four health facets and consideration of the potential moderating effect of worker age group on conclusions about the strength and direction of relationships between PA and health. In contrast with Spuling et al.'s (2013) conclusions, her findings provided some support for both SCT and SET arguments regarding the direction of the PA–health relationship, with somewhat different stories emerging for those under the CA of 50 compared to those with a CA of 50 or older. For those under the CA of 50, the evidence was primarily consistent with a model casting health as an antecedent of PA (consistent with SCT). On the other hand, for those with a CA of 50 or older, PA influenced future PH and FH (consistent with SET); for GH, there was evidence of a reciprocal relationship between PA and health. Her results also suggested that PA–health links may be stronger for some health facets (e.g., GH and FH) than others. In light of the anticipated growth of the over 50 work force and the importance of health in decisions regarding continued work, it is important to develop a clearer understanding of the ways PA and health are connected for this segment of our population. We do this by building off Petery's (2015) study of relationships between PA and multiple facets of health for older workers, and expanding our study to include moderators that may be particularly relevant in understanding these relationships among older workers.

Moderators of PA–Health Relationships Among Older Adults

As noted above, Petery demonstrated that one modifier of PA–health longitudinal relationships is CA itself. Petery, Barnes-Farrell, and Cherniack (2015) conducted additional analyses for the GH facet of health and further reported that gender modified longitudinal relationships between PA and this health facet. Findings from these two recent studies (i.e., Petery, 2015; and Petery, Barnes-Farrell, & Cherniack, 2015) provide some insight into the complexity of the longitudinal interplay between PA and facets of health. They also offer a starting point for investigations that further address these issues as they pertain specifically to older adults. Little research has considered whether other variables that affect the aging experience of adults have implications for the nature and strength of connections between PA and various facets of health. We propose that two such features that are directly pertinent to an aging workforce are employment status and gender. Although there are undoubtedly other contextual features and individual characteristics that have the potential to modify the nature of relationships between PA and health, we believe that employment status and gender are particularly good candidates for consideration among the population of older adults who are currently or formerly employed, in light of the important function that each of these roles plays in framing adults' experiences of the aging process and their personal health.

Drawing on role theory (Biddle, 1986; Eagly & Steffen, 1984), an assortment of factors may affect the various roles individuals occupy. As noted earlier, health can influence the decision to maintain an employment role or move to a retirement role (McGarry, 2004). Likewise, PA has been linked to retirement timing and retirement intentions (Barak & Stern, 1986; Cleveland, Shore & Murphy, 1997). The two roles, which form important underpinnings for personal identity, also provide qualitatively different contexts that may affect how adults think about and act on their health, as well as the over-time interplay between self-construals of age and health. As Petery (2015) noted in her findings, the pattern of relationships between PA and health appeared to vary somewhat, both by age and among different facets of health for her sample of full-time employees. We further suggest that some aspects of health may be more salient to adults who are maintaining an employment role, which may magnify their relationships with PA. Other indicators of health may be more salient to those who have transitioned to a retirement role, with similar consequences. For example, based on health decline stereotypes associated with age (Ng, Allore, Trentalange, Monin, & Levy, 2015), FH (i.e., health issues that limit functioning) may be particularly influential for working adults as this type of health is crucial for continuing employment; meanwhile, PH may be more important for retired individuals given the stereotypical expectation of an increasing number of health ailments as one progresses through old age. Segel-Karpas (2015) found support for employment status moderating the relationship between health status (i.e., number of illnesses) and self-perceived health and also between self-perceived health and depressive symptoms. As such, we expect to find differences in patterns of PA–health relationships for employed adults and retired adults and among the four facets of health. However, as we are unaware of prior research that has examined employment status as a possible moderator of the PA–health relationship, we do not have strong reason to hypothesize what the specific nature of those differences will be or whether they will tend to favor SCT versus SET explanations for temporal ordering of these relationships.

Role theory may also offer an explanation for gender differences in the relationship between PA and health. It is well-known that women and men experience work and retirement differently, often in response to differing gender role expectations regarding work and home (e.g., Fisher, Chaffee, & Sonnega, 2016; Loretto & Vickerstaff, 2012; Madero-Cabib, Gauthier, & Le Goff, 2016; Roxburgh, 1996). As mentioned above, Petery et al. (2015) also reported gender differences in longitudinal

PA–health relationships for GH. Although the temporal orderings generally favored an SCT explanation of longitudinal relationships between PA and GH for both men and women in their sample of employed manufacturing workers, the cross-lagged paths from health to PA were substantially stronger for women than they were for men. Other empirical research has found that among same age-group women and men, older women tend to feel older and have worse subjective health compared to older men (Barrett, 2005; Pinquart & Sörgensen, 2001), and work by Fuller-Thomson, Yu, Nuru-Jeter, Guralnik, and Minkler (2009) reveals that older women tend to have higher rates of chronic illness and disability than older men. We anticipate that these kinds of gendered experiences of health and the constant attention to aging that is directed toward women in our society may elevate the salience of both PA and health and enhance connections between them. Thus, we anticipate gender differences in over-time PA–health relationships for employed older adults. These may display in the form of gender differences in support for SCT and SET temporal orderings of PA and health, although that is somewhat speculative. In addition, because of the likely higher salience of PA and health for older women, we anticipate that relationships between PA and health will be stronger for women.

Because of the unique features of how women and men enter and experience retirement, we further expect that gender will interact with employment status, producing patterns of PA–health relationships that depend jointly on employment status and gender. As such, we examined evidence for a nuanced understanding of PA–health relationships that requires joint consideration of employment status and gender. As with employment status, we do not have a specific basis for hypothesizing the nature of over-time differences in these relationships (vis a vis support for SCT vs. SET). However, we expect the relationship between PA and health will be stronger for women than men, and strongest for retired women.

Thus, a second aim of this study is to expand on the findings regarding PA–health relationships for employed older adults provided by Petery (2015) to consider employment status as a possible modifier of over-time relationships between PA and health that interacts with gender to affect the direction and magnitude of relationships between PA and health.

Hypothesis 3: Employment status (consistently employed, employed to retired, or consistently retired) modifies the relationship between PA and health.

Hypothesis 4: Gender modifies the relationship between PA and health.

It is expected that the PA–health relationship will be stronger for women than men.

Hypothesis 5: Employment status and gender will jointly moderate relationships between PA and health. It is expected that the strongest relationship between PA and health will be with retired females.

Current Study

The Health and Retirement Study (HRS), an ongoing longitudinal survey study that focuses primarily on adults aged 51 and over, offers a unique opportunity to build on recent PA–health longitudinal research involving older manufacturing workers (Petery, 2015) by examining to a broad-based national sample of older adults that includes men and women employed in a wide variety of occupations and industries. In addition, the HRS provides a vehicle to extend this field of research by investigating two potential, and previously unexplored, modifiers to these relationships among older adults, namely gender and employment status, specifically focusing on employment statuses that are unique to older adults: retirement, and the transition from employment to retirement.

We drew on data from two waves of the HRS to examine these hypotheses. The primary goal of this study was to augment our understanding of the PA and health relationship among older adults by examining three issues. The first issue concerns the nature of the over-time relationships between PA and four facets of health, which we address by comparing support for SCT and SET explanations of causal ordering between these variables. The second issue we address is whether health facet affects the nature of this relationship. Third, we investigate two potential moderators that may explain differences in these relationships. We accomplish this by examining the over-time relationships between PA and health for men and women aged 51 and older who were either employed or retired during a 4-year span of time (2008–2012), or who transitioned from employment to retirement during that period, giving explicit consideration to employment role, gender role, and their interaction as modifiers of these relationships. As such, we anticipate that the findings from this study will shed further light on how health is intertwined with older adults' perceptions of their own aging, with a spotlight on the role that employment status and gender may play in this process. This work contributes to theory on work and aging by directly comparing two contrasting theoretical positions on the causal directions of relationships between PA and health and by identifying contextual features and subgroup memberships that play a role in the nature of those relationships. It further serves to identify potential subgroups for targeted policies or interventions regarding health and well-being.

METHOD

Study Design

We conducted a two-wave cross-lagged panel path analysis of relationships between PA and health utilizing data from years 2008 and 2012 (designated as T1 and T2, respectively) of the HRS (Health and Retirement Study, 2014a, 2014b, 2014c), an ongoing longitudinal cohort study of American adults over age 50. Thorough details of the HRS are documented elsewhere (Juster & Suzman, 1995; National Institute on Aging, 2007; Sonnega, Faul, Ofstedal, Langa, Phillips, & Weir, 2014). These two waves were selected because they are the only two waves that included data on the key variables in our study for a single continuing sample of participants. The 2008 wave was the first year that the leave behind questionnaire portion of the survey included the question used to compute our PA measure. Although the core portion of the HRS survey is administered during every wave, half of HRS respondents are eligible for the leave behind questionnaire in one wave, and the other half is eligible in the next wave. Thus, those who were offered the leave behind questionnaire in 2008 were not offered that questionnaire again until 2012. With the exception of the FA and gender questions, all measures and covariates were obtained from the RAND HRS enhanced fat file (Health and Retirement Study, 2014d),

which is a respondent-level longitudinal dataset developed at RAND Corporation with funding from the National Institute on Aging and the Social Security Administration. It includes data from Wave 1 (1992) through Wave 11 (2012) and contains single item imputed variables for a variety of constructs, including health and employment (Chien et al., 2014).

Participants

Several criteria were used to determine eligibility for inclusion in this study (see Supplementary Appendix A for a flowchart depicting the selection process). Of the 8,295 participants who were invited to complete the leave behind questionnaire in 2008, our final sample comprised individuals who met all of the study criteria, which included the following: no missing data on the study measures, and who fit one of three employment statuses: Employed in both waves, retired in both waves, or transitioned from employed at T1 to retired at T2. [See Supplementary Appendix B for a summary of participant sample sizes in each possible employment status category. A rule of thumb often used to determine minimum sample size for model testing is a sample-size-to-parameter ratio of 20:1 (Kline, 2005); our most parameterized model contains six parameters, yielding a target minimum sample size of 120. One of the subgroups from the three employment status groups we selected for inclusion is below this minimum sample size (employed to retired males, $n = 98$); nonetheless, we chose to retain the employment to retirement status group in our analyses because (a) it represents an important employment status transition experienced by many working adults at some point and (b) there may be gendered differences in how this transition affects the relationship between our study variables. Although there were other employment status subgroups (e.g., retired to employed) of potential interest, the sample sizes for most of these other groups were too small to conduct meaningful analyses and comparisons.] For households with two respondents that met all other study criteria, one respondent was randomly selected for inclusion in the final study sample ($N = 2{,}156$). We conducted *t* tests and chi-squared tests, as appropriate, to determine if those who were eligible to complete the leave behind questionnaire in these waves yet failed to meet all of our study inclusion criteria were significantly different from those who were included in our study on several demographic characteristics (Included: $N = 2{,}156$; Excluded: $N = 6{,}139$). Results revealed statistically significant differences on most of these characteristics. Specifics of these comparisons are provided in Supplementary Appendix C. Included respondents were significantly younger and had higher incomes at both waves of data collection. Additionally, our analysis sample had proportionally fewer individuals who were African American or married, and proportionally more who were college educated.

Measures

Psychological age

At each wave, participants were asked to indicate the age he or she felt, in years (FA; Kastenbaum, Durbin, Sabatini, & Artt, 1972; Underhill & Cadwell, 1983). Within each wave we tested for and corrected extreme values in FA. Following guidelines from Hoaglin and Iglewicz (1987), upper and lower limits were established based on the 25th (Q1 = 50) and 75th (Q3 = 65) percentile from T1 using the following formulas:

$$\text{Upper} = Q3 + 2.2(Q3 - Q1)$$

$$\text{Lower} = Q1 - 2.2(Q3 - Q1)$$

Values outside of these limits were Winsorized (Dixon, 1960), with those above the upper limit assigned a value of "upper + 1" (98 + 1 = 99) and those below the lower limit assigned a value of "lower − 1" (17 − 1 = 16). Twelve outliers were recoded for T1 (three at the lower end, and nine at the upper end; 2008 pre-recode $M = 57.32$, $SD = 13.49$; post-recode $M = 57.30$, $SD = 13.27$), and 15 were recoded for T2 (Four at the lower end, and 11 at the upper end; 2012 pre-recode $M = 62.30$, $SD = 24.40$; post-recode $M = 61.86$, $SD = 13.61$). The identified outliers at T1 were associated with different participants than those identified at T2.

Based on individual values for FA and CA, a PA proportional discrepancy (Kotter-Grühn & Hess, 2012; Rubin & Berntsen, 2006; Stephan, Sutin, & Terracciano, 2015) value was calculated for each participant at each time point using the following formula:

$$(FA - CA)/CA = \text{psychological age proportional discrepancy}$$

While most research on PA has utilized absolute discrepancy values (i.e., PA absolute discrepancy = FA−CA), this approach does not take into consideration the effect CA has on the potential magnitude of the discrepancy (i.e., the maximum possible negative value for FA−CA is positively associated with CA; cf. Edwards, 1994; 2001). The proportional discrepancy controls for the artificial constraint that CA places on the potential magnitude of negative FA−CA discrepancy values. The PA proportional discrepancy value is interpreted as the percentage older or younger an individual feels in relation to his or her CA (e.g., +.25 indicates feeling 25% older than one's CA, whereas −.25 reflects feeling 25% younger). Psychological proportional discrepancy is the operationalization of PA that is used in all of the analyses we report, and will be referred to throughout the remainder of the manuscript as PA.

Health

We assessed multiple dimensions of health (i.e., general, functional, physical, and mental) to take into account that health is a multifaceted construct (see Fisher, Faul, Weir, & Wallace, 2005). GH, representing individual evaluation of overall health, was determined from the answer to the question "In general would you say your health is…," with answer choices ranging from *excellent* (1) to *poor* (5; Ware & Sherborne, 1992). FH was captured with a variable derived from five items on functional mobility: walking a block, walking several blocks, walking across a room, climbing one flight of stairs without resting, and climbing several flights of stairs without resting. Responses were dichotomized (0 = *no difficulty*, 1 = *some difficulty*) and then summed (0 = *no mobility difficulty*, 5 = *most mobility difficulty*). PH was determined by summing the number of eight health conditions a participant reported ever having (high blood pressure/hypertension; diabetes or high blood sugar; cancer or a malignant tumor of any kind except skin cancer; chronic lung disease except asthma; heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems; stroke or transient ischemic attack; and arthritis or rheumatism), comprising a range from zero (indicating no health conditions

reported) to eight (indicating all health conditions reported). MH was assessed with a shortened, eight-item version of the Center for Epidemiologic Studies Depression scale (CES-D; Kohout, Berkman, Evens, & Cornoni-Huntley, 1993; Radloff, 1977; for background on development and validation of this shortened version used in the HRS see Steffick, 2000). Six of the items are indicators of negative affect (e.g., felt sad; depression), and two items indicate positive affect (i.e., happy; enjoyed life, all or most of the time). Respondents answered yes or no to whether they felt a certain way much of the time over the prior week. Values range from zero (did not feel any depressive symptoms) to eight (felt all depressive symptoms). Validation work on this measure for the HRS showed this shortened version of the CES-D had a Cronbach's alpha of greater than .80, indicating good internal reliability of the scale.

All health variables were reverse coded to make interpretation of analysis coefficients more intuitive, such that higher values indicated better health.

Employment status

An employment status variable was generated from responses on two RAND variables, one indicating whether or not the participant was working for pay, and the other specifying if the participant was retired. For this computed variable, within each wave an individual could be classified into one of four categories: (a) not working for pay, not retired (i.e., unemployed); (b) retired, not working for pay (i.e., fully retired); (c) working for pay, not retired (i.e., fully employed); or (d) retired, working for pay (i.e., partially retired). Cross tabulation analysis revealed three categories of employment status over time that formed groups with the following characteristics: (a) unambiguously classifies participant into an employment role or a retirement role at T1 and T2, (b) includes a sufficient number of participants to be viable for multigroup analyses that include the interaction between employment status and gender, and (c) clear interpretation of what the category represented. These categories were the two stable statuses of either fully employed both times (subgroup total n = 573; men = 202, women = 371) or fully retired both times (subgroup total n = 1,342; men = 556, women = 786), and the change in status from employed at T1 to retired at T2 (subgroup total n = 241; men = 98, women = 143).

Covariates

The following demographic variables were identified for potential inclusion as covariates in our analyses, based on prior empirical research linking them to our focal variables and theoretical reasoning for controlling their influence on examination of over-time relationships between PA and health: CA, gender, race, marital status, education, and income. Past research has shown significant relationships between health and CA (e.g., Blackwell, Lucas, & Clarke, 2014), gender (e.g., Cleary, Zaborski, & Ayanian, 2004; National Heart, Lung, and Blood Institute, 2012), race (e.g., Blackwell et al., 2014), education (Winkleby, Fortmann, & Barrett, 1990), marital status (e.g., Robles, Slatcher, Trombello, & McGinn, 2014), and income (e.g., Economou & Theodeossiou, 2011), as well as between CA and PA (e.g., Barak & Stern, 1986; Bergland, Nicolaisen, & Thorsen, 2014). Theoretically, role theory suggests that individuals tend to conform to societal behavior expectations, or roles (Biddle, 1986), that are based on stereotypical beliefs and behaviors (Eagly & Steffen, 1984) that vary according to individual characteristics, such as our potential covariates (i.e., CA, gender, e.g., Van Wijk, Kolk, Van Den Bosch, & Van Den Hoogen, 1995; race, e.g., Hinterlong, 2006; education, e.g., Doosje, Rojahn, & Fischer, 1999; marital status, Williams & Umberson, 2004; and income, e.g., Judge, Livingston, & Hurst, 2012). Furthermore, the roles may change as identifying characteristics change, such as CA (Phillips, 1957), marital status (Williams & Umberson, 2004), and income (Liu & Umberson, 2008). Thus, values and changes on these variables have the potential to cloud interpretation of the relationships we are primarily interested in studying.

All proposed covariates were significantly related to most or all focal variables. Thus, we controlled for the effects of all proposed covariates in our analyses. Gender, date of birth (used to calculate CA), race, and education are time invariant and were only measured at the initial interview when the respondent joined the HRS panel; the remaining covariates (marital status and household income) are time varying and were measured in both 2008 and 2012, and controlled for in their respective waves only.

RESULTS

Data Preparation and Overview of Analyses

Descriptive statistics for all study variables and covariates are summarized in Table 1 for the full sample and for each of the six employment status × gender subgroups included in the study. Following the practice of prior research that has employed cross-lagged panel model testing (e.g., Arnett et al., 2012; Elovainio, Heponiemi, Jokela, Hakulinen, Presseau, Aalto, & Kivimäki, 2015), SPSS version 22 (IBM Corporation, 2013) was used to perform linear regression analyses to generate residual values for each health and PA variable, controlling for the potential confounding effect of the covariates. This offers the advantage of preserving degrees of freedom in the analyses of interest, while still accounting for the potential effects of covariates on relationships under consideration. Each focal variable (e.g., PA, health measures) was regressed on time invariant (gender, CA, race, and education) and time varying (marital status and household income) covariates, and the unstandardized residuals were used in subsequent model testing as specified below. The proportion of variance in our focal variables accounted for by these covariates ranged from 0.01 to 0.11.

Cross-lagged model testing was used to determine support for hypotheses 1 and 2 based on comparison of best-fitting models. This method is used to determine the direction and relative strength of over-time cross-lagged effects (i.e., does X_{T1} predict Y_{T2}, or does Y_{T1} predict X_{T2}), or whether effects occur in both directions (i.e., X_{T1} predicts Y_{T2} and Y_{T1} predicts X_{T2}), while controlling for autoregressive effects of previous levels of a predicted construct (Selig & Little, 2012). Multigroup invariance testing was used to determine the presence of subgroup moderation, as proposed in hypotheses 3, 4, and 5, and to determine whether separate models should be estimated for subgroups formed by the moderator variables. When multigroup invariance testing indicated moderation based on group membership, estimation of best-fitting cross-lagged models was carried out at the subgroup level. All models were tested using Mplus 7.3 (Muthén & Muthén, 2014) and ML estimation. Model fit was evaluated using several fit statistics. Chi-square difference testing was utilized to assess fit of nested models (Bentler & Bonnett, 1980). Statistically significant differences (p < .05) indicated worse data fit with the more parameterized model

Table 1. Descriptive Statistics (Mean, *SD*, and Frequencies) by Group

	Full Sample		Employment Status × Gender Subgroups											
	N = 2,156		Emp Males (*n* = 202)		Emp2Ret Males (*n* = 98)		Retired Males (*n* = 556)		Emp Females (*n* = 371)		Emp2Ret Females (*n* = 143)		Retired Females (*n* = 786)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
T1 CA	68.91	8.91	61.40	6.58	65.29	6.71	73.91	7.11	59.98	6.32	64.92	6.41	72.69	7.11
T1 Income ($K)	67.1	97.4	130.3	150.4	83.9	74.5	55.0	84.2	88.2	129.0	67.0	55.1	47.4	66.3
T2 Income ($K)	54.5	89.5	123.6	220.2	56.8	59.0	42.6	49.1	78.2	83.4	49.5	65.9	34.5	36.8
T1 PA	−0.17	0.16	−0.20	0.16	−0.15	0.14	−0.15	0.15	−0.18	0.17	−0.19	0.16	−0.17	0.16
T1 GH	3.32	1.00	3.67	0.91	3.36	0.98	3.17	0.99	3.62	0.96	3.32	0.98	3.19	1.00
T1 FH	4.10	1.28	4.63	0.87	4.42	1.01	4.16	1.22	4.42	0.94	4.10	1.22	3.72	1.47
T1 PH	5.95	1.36	6.73	1.20	6.16	1.16	5.61	1.40	6.55	1.16	6.17	1.22	5.64	1.30
T1 MH	6.83	1.77	7.14	1.50	7.07	1.49	7.02	1.56	6.84	1.82	6.91	1.78	6.55	1.95
T2 PA	−0.15	0.15	−0.16	0.15	−0.15	0.12	−0.13	0.14	−0.18	0.15	−0.18	0.17	−0.15	0.16
T2 GH	3.22	1.02	3.56	0.85	3.28	1.09	3.03	1.04	3.53	0.99	3.27	1.00	3.10	0.99
T2 FH	3.85	1.45	4.61	0.85	4.40	1.08	3.75	1.53	4.23	1.16	3.94	1.37	3.46	1.53
T2 PH	5.51	1.46	6.36	1.30	5.66	1.23	5.12	1.45	6.16	1.30	5.71	1.43	5.19	1.40
T2 MH	6.80	1.75	7.26	1.37	7.33	1.00	6.74	1.86	7.00	1.48	6.78	1.83	6.56	1.89

	Full Sample	Employment Status × Gender Subgroups					
	Full Sample	Emp Males	Emp2Ret Ret Males	Retired Males	Emp Females	Emp2Ret Females	Retired Females
	%	%	%	%	%	%	%
Gender							
Male	39.7	100	100	100	—	—	—
Female	60.3	—	—	—	100	100	100
Race							
White	85.1	85.1	79.6	89.4	80.1	78.3	86.4
Black	11.5	8.9	12.2	7.6	15.1	18.2	11.8
Other	3.4	5.9	8.2	3.1	4.9	3.5	1.8
Education							
<High school	13.8	8.4	11.2	17.6	7.0	15.4	15.8
HS Grad/GED	35.9	24.3	40.8	36.4	33.5	37.1	38.8
Some college	25.6	22.8	20.4	20.6	33.2	23.1	27.5
College and above	24.7	44.6	27.6	25.3	26.4	24.5	17.9
T1 marital status							
Married/partnered	59.4	80.7	79.6	72.6	57.2	49	45.1
Separated/divorced	14.5	11.9	10.2	10.2	22.1	21.7	13.9
Widowed	22.4	2.5	9.2	14.4	16.7	23.8	37.4
Never married	3.6	5.0	1.0	2.9	4.0	5.6	3.6

Table 1. *Continued*

	Full Sample	Employment Status × Gender Subgroups					
	Full Sample	Emp Males	Emp2Ret Ret Males	Retired Males	Emp Females	Emp2Ret Females	Retired Females
	%	%	%	%	%	%	%
T2 marital status							
Married/partnered	53.2	80.2	76.5	66.0	54.4	42.0	35.6
Separated/divorced	14.3	11.4	9.2	10.2	22.4	22.4	13.4
Widowed	28.7	4.5	13.3	20.6	18.3	30.8	47.2
Never married	3.8	4.0	1.0	3.1	4.9	4.9	3.8

Note. Descriptive statistics for study variables do not control for covariates. CA = chronological age; PA = psychological age proportional discrepancy; GH = general health; FH = functional health; PH = physical health; MH = mental health; HS = high school.

(i.e., the model with fewer degrees of freedom), whereas statistically nonsignificant differences ($p > .05$) meant that the data fit both models equally and thus the less parameterized model was retained because it is more parsimonious (Werner & Schermelleh-Engel, 2010). Overall model fit was additionally evaluated with alternative fit indices, including: the root mean square error of approximation (RMSEA; value of ≤0.05 indicates good fit; Steiger & Lind, 1980) and its 90% confidence interval (CI); the comparative fit index (CFI; Bentler, 1990) and Tucker-Lewis index (TLI; Bentler & Bonett, 1980), with values >0.95 indicating good fit; and the standardized root mean square residual (SRMR; Kline, 2005) with values ≤0.05 used to indicate good fit.

Initial Cross-Lagged Panel Model Testing

The magnitude and direction of over-time relationships between PA and health were initially evaluated for the full sample (N = 2,156) using a sequence of four cross-lagged panel path models with separate analyses performed for each facet of health. The sequence of models, which is graphically displayed in Figure 1 and summarized below, ranges from the most parameterized model (M4) to the least parameterized model (M1).

M4: Reciprocal paths; cross-lagged paths from PA to Health, Health to PA, and autoregressive paths

M3: PA → Health (Hypothesis 2 model); cross-lagged paths from PA to Health and autoregressive paths (nested in M4)

M2: Health → PA (Hypothesis 1 model); cross-lagged paths from Health to PA and autoregressive paths (nested in M4)

M1: Autoregressive only; no cross-lagged paths (nested in M4, M3, and M2)

As noted earlier, all models were tested using the residualized variables. Parameter estimates for the best fitting models are presented in Table 2, organized by health facet (see Supplementary Appendices D and E for correlation matrices and model fit statistics associated with these analyses). All model testing results are reported using standardized coefficients.

As expected, there were significant and substantial autoregressive effects in the final models for PA and all health facets. Standardized path coefficients for autoregressive paths ranged from .49 (MH model: PA T1→PA T2) to .87 (PH model: Health T1→Health T2). In addition, consistent with findings from past research, significant cross-lagged and intra-wave correlations between health and PA were negative for all health facets.

Hypotheses 1 and 2: SCT and SET temporal ordering

As seen in Supplementary Appendix E, support for H1 and H2 was not uniform across health facets. Consistent with SCT theorizing, Hypothesis 1 predicted that health would be an antecedent to PA, indicated when the aforementioned M2 emerged as the model to best fit the data. Support for this hypothesis was observed when health was assessed in terms of PH. Hypothesis 2, predicated on SET theorizing, predicted the opposite temporal ordering, such that PA is an antecedent to health. Support for this hypothesis was evidenced when M3 best fit the data. This was the case for two health facets: FH and MH. Finally, we observed that a reciprocal model with significant cross-lagged paths from PA to health and from health to PA best fit the data for GH. Although there were significant ($p < .001$) cross-lagged paths between PA and health for all four facets of health, the standardized path coefficients were small in magnitude, ranging from −.07 to −.10, as seen in Table 2.

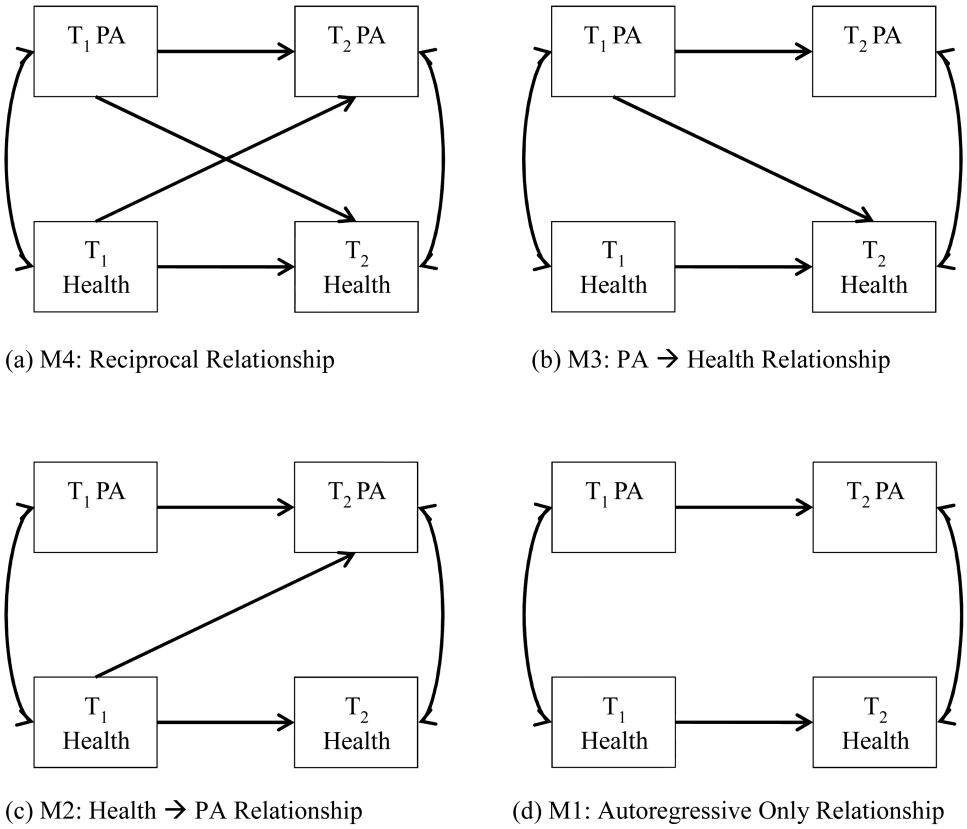

Figure 1. Depiction of nested cross-lagged models tested. PA = psychological age proportional discrepancy. Each facet of health was tested separately.

Multigroup Invariance Testing

In order to determine if the over-time relationships between PA and health are moderated by group membership, multigroup invariance testing was performed separately for each of the four health facets. This was done for each proposed moderator-based subgrouping (i.e., employment status: employed, employed to retired, and retired subgroups; gender: male and female subgroups; and the interaction between employment status and gender: employed male, employed female, employed to retired males, employed to retired females, retired male, and retired female subgroups). Following guidelines from Kenny (2011), multigroup invariance testing was conducted with the most parameterized model (M4) using the unstandardized residual values for each variable (i.e., values that represent variance unaccounted for after controlling for influence of covariates). The following series of nested models was applied separately to each facet of health:

a. Configural model: all paths freely estimated across groups; used as comparison model
b. Invariance of paths
    1. Autoregressive paths only constrained to be equal across groups (nested in model a)
    2. Both autoregressive and cross-lagged paths constrained to be equal across groups (nested in model b1)
c. Invariance of intercepts (i.e., intercepts constrained to be equal across groups; nested in model b2)
d. Invariance of error variances (i.e., error variance constrained to be equal across groups; nested in model c)
e. Invariance of correlations (i.e., intra-wave correlations constrained to be equal; nested in model d)

Chi-square difference testing was performed on each nested model (Bentler & Bonnett, 1980). Statistically significant differences ($p < .05$) in models provides evidence that the grouping variable (employment status, gender, and employment status by gender, respectively) affects parameters in the model, and separate models should be estimated for each subgroup.

Complete results of multiple groups invariance testing can be seen in Supplementary Appendix F. Significant differences were found during invariance testing for all four health facets for the three employment status groups (employed, employed to retired, and retired), providing evidence that employment status influences features of the PA–health relationship, consistent with Hypothesis 3. Likewise, model fit decreased significantly for all four health facets when parameters in the model were constrained to be equal for the two gender subgroups, providing evidence that gender moderates relationships between PA and health (providing partial support for Hypothesis 4). Finally, tests of multiple groups invariance among the six subgroups formed by the interaction between employment status and gender indicated that there were between-group differences in model parameters for the PA–health relationship for all four facets of health, supporting the

Table 2. Standardized Path Coefficients for all Participants ($N = 2,156$) by Health Facet

Health Facet	Autoregressive Paths		Cross-Lagged Paths		Intra-Wave Correlations		R^2	
	$PA_{T1} \rightarrow PA_{T2}$	$Health_{T1} \rightarrow Health_{T2}$	$PA_{T1} \rightarrow Health_{T2}$	$Health_{T1} \rightarrow PA_{T2}$	$PA_{T1} \leftrightarrow Health_{T1}$	$PA_{T2} \leftrightarrow Health_{T2}$	PA_{T2}	$Health_{T2}$
General health (M4)	.49** (.02)	.59** (.03)	−.07** (.02)	−.10** (.02)	−.25** (.02)	−.15** (.02)	.28	.38
Functional health (M3)	.51** (.02)	.61** (.01)	−.07** (.02)	—	−.20** (.02)	−.15** (.02)	.27	.39
Physical health (M2)	.51** (.02)	.87** (.01)	—	−.07** (.02)	−.13** (.02)	−.04* (.02)	.27	.76
Mental health (M3)	.52** (.02)	.47** (.02)	−.07** (.02)	—	−.22** (.02)	−.14** (.02)	.27	.24

Note. All coefficients are standardized and presented with standard error estimates. PA = psychological age proportional discrepancy; M2 = Health → PA; M3 = PA → Health; M4 = Reciprocal paths. Statistically significant *p*-values denoted as $^*p < .05$ and $^{**}p < .001$.

position that the joint relationship between employment status and gender affects the nature of over-time relationships between PA and health, consistent with Hypothesis 5. In light of evidence for an interaction between employment status and gender with respect to model parameters, separate models were estimated for each of the six employment status by gender subgroups in subsequent cross-lagged panel model testing for all four facets of health. (Models were also estimated separately for each of the three employment status subgroups and for each of the two gender subgroups. Descriptive statistics, unstandardized residual correlation matrices and results of model-testing for employment status subgroups and gender subgroups can be seen in Supplementary Appendices G, H, I, and J. In the interest of parsimony, we focused on presentation and interpretation of results for the six unique employment status by gender subgroups.)

The six subgroups produced by the employment status and gender interaction are: employed males, employed to retired males, retired males, employed females, employed to retired females, and retired females. Model estimation and selection of a best-fitting model for each subgroup proceeded in the same fashion as described previously for the full sample. As noted earlier, all models were estimated using the residualized variables. Parameter estimates for the best fitting models are presented in Table 3, organized by moderator subgroup within each heath facet (see Supplementary Appendices K and L for the correlation matrices and model fit statistics).

There were significant and substantial autoregressive effects in the final models for all subgroups. Standardized path coefficients for autoregressive paths ranged from .29 (PH: PA T1/T2 for employed to retired males) to .88 (PH: Health T1/T2 for employed males and retired females). Likewise, consistent with findings from past research, all significant cross-lagged and intra-wave correlations between PA and health were negative for all groups.

Hypotheses 1 and 2: SCT and SET temporal ordering

Six tests were conducted for each health facet to determine support for these hypotheses, and a summary of their results is depicted in Table 4. Results are presented by health facet and indicate which of the subgroups supported each hypothesis.

Consistent with SCT theorizing, Hypothesis 1 predicted that health would be an antecedent to PA. Overall, support for this hypothesis was found for 11 of the 24 cross-lagged tests (46%). However, as seen in Table 4, there was little in the way of consistency across either health facets or moderator subgroups. Beginning with GH, two of the six final models, those for retired males and for employed females, supported H1. Two of the final FH models also supported H1: those for employed to retired males and for employed females. Likewise, MH had two subgroups for which the final model provided support for H1, namely, employed to retired males and employed females. On the other hand, five of the six final models for PH supported H1. Specifically, H1 was supported for the following subgroups: employed males, employed to retired males, retired males, employed females, and employed to retired females. If we turn to a consideration of subgroups, it is notable that only one of the subgroups, employed females, supported H1 for all four of the health facets. Support for H1 was also found for three of the four health facets for employed to retired males. On the other hand, one subgroup, retired females, did not support H1 for any health facets. The remaining categories were more mixed, dividing their support between H1 and H2.

Table 3. Standardized Coefficients (With Standard Errors) for the Final Model for Each Heath Facet Reported by Group Categories

	General Health							
	Autoregressive Paths		Cross-Lagged Paths		Intra-Wave Correlations		R^2	
Group/Subgroup	$PA_{T1} \rightarrow PA_{T2}$	$GH_{T1} \rightarrow GH_{T2}$	$PA_{T1} \rightarrow GH_{T2}$	$GH_{T1} \rightarrow PA_{T2}$	$PA_{T1} \leftrightarrow GH_{T1}$	$PA_{T2} \leftrightarrow GH_{T2}$	PA_{T2}	GH_{T2}
Employed male (M1)	.50*** (.05)	.67*** (.04)	—	—	−.13 *ns* (07)	−.26*** (.07)	.25	.44
Employed to retired males (M1)	.34*** (.09)	.69*** (.05)	—	—	−.39*** (.09)	.04 *ns* (.10)	.11	.47
Retired male (M2)	.40*** (.04)	.58*** (.03)	—	−.12** (.04)	−.29*** (.04)	−.17*** (.04)	.20	.34
Employed female (M2)	.45*** (.04)	.60*** (.03)	—	−.17*** (.05)	−.21*** (.05)	−.21*** (.05)	.26	.36
Employed to retired female (M3)	.63*** (.05)	.62*** (.05)	−.14* (.06)	—	−.18* (.08)	−.10 *ns* (.08)	.40	.43
Retired female (M4)	.54*** (.03)	.58*** (.03)	.08** (.03)	−.09** (.03)	−.27*** (.03)	−.12*** (.04)	.33	.37
	Functional Health							
	Autoregressive Paths		Cross-Lagged Paths		Intra-Wave Correlations		R^2	
Group/Subgroup	$PA_{T1} \rightarrow PA_{T2}$	$FH_{T1} \rightarrow FH_{T2}$	$PA_{T1} \rightarrow FH_{T2}$	$FH_{T1} \rightarrow PA_{T2}$	$PA_{T1} \leftrightarrow FH_{T1}$	$PA_{T2} \leftrightarrow FH_{T2}$	PA_{T2}	FH_{T2}
Employed male (M3)	.51*** (.05)	.63*** (.04)	−.10 *ns* (.05)	—	−.17* (07)	−.04 *ns* (.07)	.26	.42
Employed to retired males (M2)	.39*** (.09)	.73*** (.05)		.16 *ns* (.10)	−.28** (.09)	.17 *ns* (.10)	.14	.54
Retired male (M3)	.44*** (.03)	.52*** (.03)	−.06 *ns* (.04)	—	−.22*** (.04)	−.17*** (.04)	.19	.28
Employed female (M2)	.46*** (.04)	.65*** (.03)	—	−.13** (.05)	−.27*** (.05)	−.12* (.05)	.26	.42
Employed to retired female (M3)	.63*** (.05)	.60*** (.06)	−.17** (.06)	—	−.15 *ns* (.08)	−.20* (.08)	.40	.42
Retired female (M3)	.56*** (.02)	.65*** (.02)	−.06* (.03)	—	−.18*** (.03)	−.15*** (.04)	.32	.43
	Physical Health							
	Autoregressive Paths		Cross-Lagged Paths		Intra-Wave Correlations		R^2	
Group/Subgroup	$PA_{T1} \rightarrow PA_{T2}$	$PH_{T1} \rightarrow PH_{T2}$	$PA_{T1} \rightarrow PH_{T2}$	$PH_{T1} \rightarrow PA_{T2}$	$PA_{T1} \leftrightarrow PH_{T1}$	$PA_{T2} \leftrightarrow PH_{T2}$	PA_{T2}	PH_{T2}
Employed male (M2)	.49*** (.05)	.88*** (.02)	—	−.09 *ns* (.06)	−.20*** (07)	−.03 *ns* (.07)	.27	.77
Employed to retired males (M2)	.29*** (.09)	.80*** (.04)	—	−.22* (.09)	−.20* (.10)	.04 *ns* (.10)	.01	.55
Retired male (M2)	.43*** (.04)	.86*** (.01)	—	−05 *ns* (.04)	−.15*** (.04)	−.13** (.04)	.19	.77
Employed female (M2)	.49*** (.04)	.86*** (.01)	—	−.13** (.04)	−.08 *ns* (.05)	−.06 *ns* (.05)	.26	.75
Employed to retired female (M2)	.67*** (.05)	.85*** (.02)	—	−.07 *ns* (.07)	−.07 *ns* (.08)	−.02 *ns* (.08)	.41	.72
Retired female (M1)	.56*** (.02)	.88*** (.01)	—	—	−.11** (.04)	.01 *ns* (.04)	.32	.77
	Mental Health							
	Autoregressive Paths		Cross-Lagged Paths		Intra-Wave Correlations		R^2	
Group/Subgroup	$PA_{T1} \rightarrow PA_{T2}$	$MH_{T1} \rightarrow MH_{T2}$	$PA_{T1} \rightarrow MH_{T2}$	$MH_{T1} \rightarrow PA_{T2}$	$PA_{T1} \leftrightarrow MH_{T1}$	$PA_{T2} \leftrightarrow MH_{T2}$	PA_{T2}	MH_{T2}
Employed male (M3)	.51*** (.05)	.48*** (.05)	−.09 *ns* (.06)	—	.00 *ns* (07)	−.03 *ns* (.07)	.26	.24
Employed to retired males (M2)	.32*** (.09)	.46*** (.08)	—	−.10 *ns* (.10)	−.22* (.10)	−.06 *ns* (.10)	.13	.21
Retired male (M3)	.44*** (.03)	.56*** (.03)	−.09* (.04)	—	−.25*** (.04)	−.12** (.04)	.19	.35
Employed female (M2)	.47*** (.04)	.41*** (.04)	—	−.09* (.05)	−.30*** (.05)	−.26*** (.05)	.26	.17
Employed to retired female (M4)	.62*** (.05)	.42*** (.07)	−.13* (.06)	−.15* (.07)	−.10 *ns* (.08)	−.14 *ns* (.08)	.42	.21
Retired female (M3)	.56*** (.02)	.46*** (.03)	−.06 *ns* (.03)	—	−.23*** (.03)	−.14*** (.04)	.32	.23

Note. All coefficients are standardized and presented with standard error estimates. PA = psychological age proportional discrepancy; GH = general health; FH = functional health; PH = physical health; MH = mental health; M1 = Autoregressive only; M2 = Health → PA; M3 = PA → Health; M4 = Reciprocal paths.
Statistically significant *p*-values indicated as follows: $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Hypothesis 2, predicated on SET theorizing, predicted the opposite directional ordering, such that PA is an antecedent to health. Support for this hypothesis was evidenced when M3 best fit the data. This was the case for 8 of the 24 tests (33%). As with H1, support was not uniform across health facets. Only one of the six GH final models supported H2, the model for employed to retired females. The health facet to show the greatest endorsement for H2 was FH. For FH, support was indicated by final models for four of the six subgroups: employed males, retired males, employed to retired females, and retired females. In stark contrast, H2 was not supported in any of the subgroups for

Table 4. Summary of Results for Hypotheses 1 and 2 by Health Facet and Group

	General Health		Functional Health		Physical Health		Mental Health		# Supported	
Employment Status × Gender Subgroups	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2
Males										
Employed male (n = 202)	—	—	—	X	X	—	—	X	1	2
Employed to retired male (n = 98)	—	—	X	—	X	—	X	—	3	0
Retired male (n = 556)	X	—	—	X	X	—	—	X	2	2
Females										
Employed female (n = 371)	X	—	X	—	X	—	X	—	4	0
Employed to retired female (n = 143)	—	X	—	X	X	—	[R]	[R]	1	2
Retired female (n = 786)	[R]	[R]	—	X	—	—	—	X	0	2
Totals	2	1	2	4	5	0	2	3	11	8

Note. H1 = Health→ PA (SCT); H2 = PA → Health (SET). Xs indicates support for the hypothesis. [R] indicates reciprocal model.

the PH facet of health. Finally, three of the six MH final models supported H2, specifically for subgroups employed males, retired males, and retired females.

Also worth noting, the reciprocal model (with significant cross-lagged paths in both directions, from Health → PA and from PA → Health) was the best fitting model for retired females for GH, and was likewise the best fitting model for employed to retired females for MH.

Perusal of Table 3, which displays the standardized path coefficients for the best-fitting models estimated for each subgroup, shows that the magnitude of cross-lagged paths in models that included those paths was generally small. Cross-lagged paths that were significantly greater than 0 ranged from −.06 (PA → FH for retired females) to −.22 (PH → PA for employed to retired males).

Hypotheses 3, 4 and 5: Employment Status and Gender

Hypotheses 3, 4 and 5 pertained to the moderating effects of employment status, gender, and the joint influence of employment status and gender, as well as their impact on the magnitude of PA–health relationships. Initial support for employment status (H3) and gender (H4) as moderators of relationships between PA and health was signaled from the previously described invariance testing procedures. Nonetheless, as seen in Table 4, and described in the previous section, the pattern of results regarding temporal ordering and support for H1 versus H2 is dependent on the joint relationship between employment status and gender (consistent with H5). The relative preponderance of support for H1 (SCT) versus H2 (SET) is quite similar across the three male subgroups and the three female subgroups, with support hinging on both health facet and employment status. Turning to employment status, both of the subgroups that were employed at T1 tended to favor H1, while the subgroup of participants who were retired at T1 and T2 tended to favor H2, but again both health facet and gender played a role in the outcome of model testing. The most consistent findings regarding H1 were observed for two subgroups that differed with respect to both employment status and gender. First, all three models with significant cross-lagged paths between PA and health for employed to retired males supported H1 (SCT); this was seen for FH, PH, and MH. In contrast, all four models estimated for employed females supported H2 (SET); this was seen for GH, FH, PH, and MH. For the remaining subgroups, support for H1 and H2 was mixed and showed different between-group patterns across health facets.

Hypothesis 4 further predicted that the PA–health relationship would be stronger for women than men and Hypothesis 5 predicted that the joint influence of the retired employment status and being female would result in the strongest relationship between health and PA among all subgroups. When the values of cross-lagged paths present for both genders' final models are scrutinized (as seen in Table 3, which displays the standardized coefficients for paths in the final model for subgroups that include women and subgroups that include men), we see that results for these hypotheses are not supported. Inspection of these paths does not show a pattern of stronger relationships (in either direction) for women than for men or for particular subgroups of women.

DISCUSSION

In this study, the HRS data set provided a unique opportunity to examine two-wave relationships between four facets of health and psychological interpretations of age for adults who are at a stage in the aging process where health, age, and employment/retirement status are all likely to represent salient variables. The primary goal of this study was to expand the field of research by exploring the causal relationships between PA and four facets of health from two competing theoretical perspectives, and by considering whether and how employment status (specifically employed vs. retired), gender, and their joint influence may moderate the direction and magnitude of relationships between the two constructs.

As expected, and consistent with the bulk of work that has examined relationships between PA and health, PA was negatively correlated with health. Furthermore, similar to other recent longitudinal work (Petery, 2015), the over-time relationships that we observed did not uniformly manifest for all facets of health, and the effect sizes for relationships that did display were small. Overall, our findings did not systematically favor either of the two theoretically based positions on causal ordering that were presented, namely SCT and SET (H1 and H2, respectively; see Table 4). Further, it appears that employment status and gender may in fact modify these relationships, although the relationship was not systematically stronger for women compared to males as we expected. Nonetheless, it is noteworthy that support was provided for both SCT and SET explanations for temporal

relationships between PA and health in this sample of older adults. Also worthy of note is the consistency of temporal findings for the PH facet of health, for which the preponderance of evidence supported an SCT explanation (health → PA) for 5 of the 6 subgroups and no support for an SET (PA → health) explanation.

In comparison to similar research (i.e., Petery, 2015 and Spuling et al., 2013), our results mirror prior findings for FH (PA → health, SET; Petery, 2015; Spuling et al., 2013) and MH (PA → health, SET, Petery, 2015), but only for our employed male subgroup. The most notable difference between our findings and previous research is the presence of support for health → PA (SCT), which appeared for all four health facets among employed females, for MH among employed males, and for PH among all subgroups with the exception of retired females.

To put such differences into perspective, we need to consider some of the ways that our study features diverged from those of the previously reported work. Although we measured the same facets of health in this study that were used by Petery (2015) and Spuling et al. (2013), with the exception of GH there were differences in the ways the facets were operationalized for each study. Likewise, participant characteristics were a differentiating feature between our study and Petery's (2015) work. Notably, the HRS sample that we used as the basis for our study consisted of adults, primarily women, employed in a wide variety of industries and explicitly included individuals who were retired from full-time employment. In contrast, Petery's findings were based solely on participants, mainly men, employed full-time in medium-sized manufacturing companies. These differences in measurement and participant characteristics may account for some of the contrasting findings between studies.

Furthermore, examination of Table 4 with a focus on patterns of relationships that are exhibited for employment status and gender subgroups makes it clear that examining one characteristic without consideration of levels of the other masks interactive effects of these two variables on the relationship between PA and health. Differences in our findings for the other facets of health compared to prior research may be explained, in part, by the inclusion of the employment status × gender interaction. These findings demonstrate that both employment status and gender are relevant to understanding the nature of the relationship between health and PA.

In summary, findings from our analysis of HRS data regarding the nature and direction of relationships between health and PA suggest that the interplay between these two variables is not simple, nor is it consistent across various aspects of health. Nonetheless, they do reinforce the value of jointly considering employment status and gender as we attempt to understand how and when changes in PA are likely to manifest in health behaviors and outcomes, and vice versa. Likewise, they reinforce the importance of carefully considering what aspects of health are relevant to our questions about relationships aging and health.

Theoretical and Applied Contributions

Two opposing theoretical positions were offered to explain the primary causal flow between PA and health. Our findings did not provide consistent support for one theory over the other, namely SCT nor SET. Instead, the relationship is more nuanced and may be contingent on other factors, such as gender and employment status, as well as the particular facet of health under consideration. Furthermore, both theories provide partial explanations for the reciprocal relationship observed for GH and MH in some of our subgroups (notably, both of the reciprocal models were observed for females who transitioned from employment to retirement or who were consistently retired).

To put our findings into context, three of the 24 models for the employment status x gender subgroup analyses conducted for four health facets (13%) favored an autoregressive only relationship. Of the remaining 21 models, 11 (46%) favored a SCT explanation, 8 (33%) favored a SET explanation, and 2 (8%) favored a reciprocal relationship. It is plausible that the SCT and SET mechanisms work in tandem, which would explain the reciprocal relationships we and others have observed, but the two-wave data we examined do not allow us to directly explore this possibility. Although there is not clear support for one theoretical position over another, the current study moves us beyond cross-sectional examinations of these relationships. When considered over time, there appear to be boundary conditions that affect these relationships, which may include (a) gender, (b) employment status, (c) health facet, and, as noted by Petery's (2015) research (d) age.

In light of the consistently small magnitude of relationships between PA and health, which we observed for all four facets of health and with all subgroups for which we modeled these relationships, it would be premature and likely misleading to offer specific recommendations for policy or organizational practice. With those caveats firmly in mind, we nonetheless offer the following thoughts about practical directions that we believe are worthy of consideration by organizations and policy makers, in consideration of the findings from this study.

First, we speculate that organizations concerned with extending the healthy, productive working lives of their aging workers might do well to pay particular attention to these findings for women in their workforce. For employed women in our sample, all four facets of health contributed to PA. At a societal level, aging is viewed in a particularly negative way for women (Roxburgh, 1996), which may influence the attention older women pay to both health and the assessment of age (Saucier, 2004). Interventions aimed at supporting the health of older women may have the beneficial consequence of contributing to self-assessments of age that reflect negative PA–CA discrepancies. This is desirable because feeling younger than one's CA has been shown to be associated with important work outcomes, such as organizational commitment and performance and has been linked to retirement timing and retirement intentions (Barak & Stern, 1986; Cleveland & Shore, 1997; Kunze, Raes, & Bruch, 2015).

In thinking about how to support health, organizations should recognize that the workday often does not end when women and men clock out from their jobs, and this is particularly true for women. It is well documented that women tend to take on caregiving roles and bear the brunt of household duties to a greater extent than men, and that these extra responsibilities are associated with increased stress, which can exacerbate health problems (Fisher et al., 2016; Roxburgh, 1996). Furthermore, recent work by Dembe and Yao (2016) showed working long hours (>40 hr per week) is associated with an increased risk of developing chronic diseases (e.g., heart disease, non-skin cancers, diabetes, and hypertension), and that women are more affected by the longer work hours, which may be compounded by the "second shift" (Hochschild, & Machung, 2012) of home and family related work. Therefore, an intervention strategy that organizations might consider is providing caregiving resources to their employees to help mitigate

the stress that results from this added responsibility, and limiting workweeks to 40 hr or less. Besides the obvious payoffs of better health for women, one of the downstream consequences may be a more youthful PA, which is a feature of healthy aging (Westerhof & Barrett, 2005; Zacher, 2015).

For other groups, such as employed men, a focus on supporting health is most likely to pay benefits in the form of a "younger" PA if the emphasis is on modifications to PH. Likewise, the question of whether it is possible to influence *health* by modifying conditions that contribute to PA may depend on which facet of health is under consideration. Our data suggest that this may be more viable for MH and FH than it is for PH or GH; they also suggest that this approach is more likely to support the health of those who are currently transitioning to a retirement role or those who are already in a retirement role.

Limitations and Recommendations for Future Research

There are some constraints in the HRS data set that present limitations to our study. Because of the schedule on which HRS collects some of the measures that were critical to the study (i.e., the administration of the psychosocial questionnaire every 4 years), we were only able to examine over-time relationships for two points in time, over a period of 4 years. A fully longitudinal design with three or more data points would provide additional data to examine the over-time direction of influence for PA and health, respectively, and would provide an opportunity to better examine the apparent reciprocal relationships between health and PA that were reported for GH, particularly among women. We also recognize that some of the changes that occur in health and in PA may take place at a rate that will not be adequately reflected in intermeasurement intervals of 4 years, which may limit our ability to detect some of these relationships.

Furthermore, we recognize that it is not only occupying an employment role that is likely to impact the salience of various facets of health for an employee, but also the nature of the work that one carries out (e.g., the physical, cognitive, and emotional demands of work). Future research that directly addresses this issue is likely to have implications for which aspects of health are most amenable to influence from organizational attempts to modify worker health via programs that emphasize positive views of the aging process.

Finally, a limitation in our study relative to understanding the impact of employment status among older adults was created by practical decisions that we made about inclusion/exclusion from the analysis sample in our study. In particular, sample size requirements for carrying out the cross-lagged panel path analysis on which our findings are based constrained us to defining employment status as a grouping variable that only examined those individuals who were fully employed or fully retired during both waves of data collection or who transitioned from fully employed to fully retired from the first wave to the second. This ignores other important kinds of employment role statuses that older adults occupy, including unemployed, partially retired, and so forth.

Additional work that specifically focuses on role transition questions is needed: that is, how do relationships between psychological health and age change as workers transition from employment roles to other roles (including partial and full retirement). We were able to include groups of men and women who transitioned from a full employment role to a full retirement role in our analyses, albeit with a relatively limited sample size. Findings for these groups did not replicate those for either the consistently employed groups or the consistently retired groups, and there were gender differences in the patterns of PA–health relationships for male and female transition subgroups. The differences that we observed between groups of participants who were fully employed during the study, those who were fully retired during the study, and those who transitioned from fully employed to fully retired during the study suggest that specifically focusing on within-group differences associated with a role transition (e.g., transition from employed to retired, employed to bridge employment, retired to employed) are a logical next step in understanding how work and retirement roles relate to the way older men and women view their personal age and their health, and the dynamic influence these variables have on each other.

SUPPLEMENTARY MATERIAL

Supplementary data is available at *Work, Aging, and Retirement* online.

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