Partnership and Cognitive Aging in Europe: Mediating Factors and Social Stratification

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Conflict of Interest

The authors declare no conflict of interest

Abstract

Objectives. Living in a partnership has been shown to benefit later life health in general and decrease the risk of cognitive impairment. Few studies have, however, examined whether different types of partnership transitions also differ with respect to their impact on cognitive trajectories, and whether financial resources, health behaviors, cognitive stimulation and social integration can explain these differences.

Methods. Data came from six waves of the Survey of Health, Ageing and Retirement in Europe, which is a representative panel for the population aged 50 years or older, and was collected between 2004 and 2017 in 20 European countries. Our sample includes 215,989 valid person-year observations from 78,984 persons. Mean age at baseline is 64 years, and individuals were observed on average 2.7 times. Cognitive functioning was assessed with measures of immediate and delayed recall on a memory test, and verbal fluency. Fixed-effects regression models were employed to exploit individual-level variation in partnership and simultaneous cognitive changes.

Results. Partnership status was stable in most respondents (around 90%). Compared to remaining partnered and after controlling for socio-demographic factors, transition to divorce was associated with a steeper decline in immediate and delayed recall. Exploring possible mechanisms, both financial resources and social integration explained these differences. Additional analyses suggested that effects were mostly driven by individuals with lower education.

Discussion. Partnership transitions remain infrequent events in later life, but our findings indicate that they can induce less favorable cognitive trajectories compared to partnered individuals, particularly for those with lower cognitive reserve.

Keywords

Health outcomes, Marriage, Bereavement, Life course analysis, Cognitive Functioning

Introduction

Family ties, and particularly partnership, constitute important resources for healthy ageing. In most Western societies, partnership relations have become the most important tie of an adult person (de Jong Gierveld, Broese van Groenou, Hoogendoorn, & Smit, 2009). Being married or cohabiting with a partner, even if unmarried, has shown to be protective for mortality (Johnson et al. 2000). With regard to protective effects for cognitive functioning, mid-life cohabitation with a spouse or partner as opposed to being divorced or widowed was highly protective against risk of cognitive impairment in a Finnish study with an average follow-up of 21 years (Håkansson et al., 2009). Similar protective effects of marriage for risk of dementia were found in a French longitudinal study (Helmer et al., 1999). However when it comes to differentiating between various partnership transitions, little research has yet been conducted. Some studies either compare being married vs. being non-married (van Gelder et al., 2006), whereas others focus on the transition to widowhood only (Vidarsdottir et al., 2014; Worn, Comijs, & Aartsen, 2020). One Finnish study investigating differential effects of being unpartnered, divorced or widowed on risk of cognitive impairment suggest a combination of different mechanisms between partnership status and cognitive functioning (Håkansson et al., 2009).

Few studies have investigated whether these effects of partnership status and transitions on cognitive aging are visible already in middle adulthood when cognitive decline can first be observed (Singh-Manoux et al., 2012). Further, there are no studies to date that explored whether social integration and cognitive stimulation or behavioral and economic factors can explain these differences between different partnership statuses and cognitive decline, even though there is compelling evidence that all these factors play a role for cognitive functioning in older age (Fratiglioni, Paillard-Borg, & Winblad, 2004; Kuiper et al., 2015; Kuiper et al., 2016). In order to address these questions, we employ a longitudinal research design that allows us to investigate effects of partnership statuses and transitions and test four different explanatory mechanisms.

Moreover, with the rise of "grey divorce", i.e., divorce among older couples (Brown & Lin, 2012), diversity of partnership forms in older ages has increased, including re-marriage and repartnering (Sassler, 2010). Still, there are few robust findings on what specific health consequences different partnership transitions, such as divorce and widowhood, but also re-marriage and repartnering, may entail (Berntsen & Kravdal, 2012). The few studies available on widowhood effects found complex relationships with health and well-being indicators (Vidarsdottir et al., 2014; Wilcox et al., 2003). Repartnered or remarried individuals face complex social networks of old and new partners, and the emotional valence of these social networks can impact different dimensions of well-being, e.g. through caregiver burden or conflicts with (ex-)partners (Litwin, Stoeckel, & Roll, 2014; Symoens, Colman, & Bracke, 2014).

The cognitive reserve framework

Cognitive functioning in older age reflects cognitive reserve that has been built up across the life course (Stern, 2002). However, a certain degree of cognitive decline is inevitable as one ages (Livingston et al., 2017). The relevant question is thus which factors enable the retention of cognitive abilities. Compelling evidence has been established for education (Foverskov et al., 2019; Glymour, Tzourio, & Dufouil, 2012; Lee, Kawachi, Berkman, & Grodstein, 2003), as well as occupational complexity (Andel, Silverstein, & Kareholt, 2015; Singh-Manoux et al., 2011) to increase so-called cognitive reserve, as these factors can influence cognitive abilities at older ages. Hence, education is often seen as a marker of cognitive reserve and should partly buffer against cognitive decline. Moreover, higher education is generally conceptualized as social determinant of health and associated with more favorable health behaviors (Cutler & Lleras-Muney, 2010), but it has also been argued to be a resource able to moderate the effect of psychological stress on cognitive performance (Ihle, Oris, Sauter, Rimmele, & Kliegel, 2018).

Generally, a broad range of activities and resources (which will be outlined in detail below) can be evaluated towards their ability to provide cognitive stimulation and thus increase cognitive reserve (Scarmeas & Stern, 2003). Similarly, these activities and resources can also be linked to partnership status, respectively changes therein. Besides affecting financial resources via a second income in the household and health behaviors, being in a partnership may provide social integration, which has been shown to be associated with social networks and social activities (Bennett, 2005) and may thus provide cognitive stimulation (Håkansson et al., 2009). It is thus plausible to assume that the associated differential social, behavioral, and economic implications of partnership constitute different pathways which affect cognitive reserve and cognitive decline differently.

With regard to social integration, individuals who are married or living with a partner as opposed to individuals living alone have higher levels *of social integration* in and beyond the partnership. First, spouses and cohabiting partners are among the most important attachment figures in the second half of life and constitute a valuable resource for practical and emotional support (de Jong Gierveld et al., 2009). Second, the loss of a partner also goes in hand with a loss of social capital (Hollstein, 2002). Divorce, in particular, may affect the contact with adult children or may even lead to intergenerational conflicts (Daatland, 2007; Nazio & Saraceno, 2012), which – in turn – may reduce support potential and well-being. Widowhood, on the other hand, is likely to be preceded by spousal illness or disability, whereby solo spousal caregiving is quite frequent (blinded), and widowhood may both reflect cumulative strains due to caregiving (Uccheddu, Gauthier, Steverink, & Emery, 2019; Wagner & Brandt, 2018) and a relief from compassionate suffering after the death of the spouse (Monin & Schulz, 2009). At the extreme end of a lack of social integration, a number of studies have shown that socially isolated individuals perform worse with regards to cognitive health (Evans et al., 2018; Seeman, Lusignolo, Albert, & Berkman, 2001), whereas individuals with high quality social networks are protected better against cognitive decline (Luo, Edelsbrunner, Siebert, Martin, & Aschwanden, 2021). Social isolation has been confirmed as potentially modifiable risk factor that, if

eliminated, could prevent about 2% of all dementia cases, as comparison, elimination of genetic risk would prevent 7% of cases (Livingston et al., 2017).

Moreover, partnership status and changes therein go along with differential engagement in socially productive leisure activities (McMunn, Nazroo, Wahrendorf, Breeze, & Zaninotto, 2009). Activities such as reading or doing quizzes have been argued to be *cognitively stimulating*, in the sense that they help maintaining cognitive reserve, and have been found to be related to cognitive reserve and delay onset of dementia (Hall et al., 2009) and can be assumed to be as protective against dementia and Alzheimer's disease as physical workout (Fratiglioni et al., 2004). A high engagement in cognitive but also particularly social leisure activities was more predictive of cognitive health at older ages than midlife occupational complexity (Andel et al., 2015).

Living in a partnership is also associated with better *health behaviors* (Wood, McMunn, Webb, & Stafford, 2019), such as physical activity and alcohol consumption, which are in turn associated with better cardio-vascular health and better cognitive functioning at older ages. There are strong links between intervening on cardiovascular risk factors and brain health (Livingston et al., 2017). Regular vigorous workout is associated with a lower risk of both Alzheimer's disease and Parkinson (Marques, Peralta, Sarmento, Martins, & Gonzalez Valeiro, 2018). Unhealthy behaviors, especially excessive consumption of alcohol, have been found to increase risk of cognitive impairment (Lee et al., 2010).

Both losing a partner or repartnering is often accompanied by a change in *financial resources*. Living as a couple comes along with economic advantages, since two sources of income can be pooled (Vandecasteele, 2010) to share expenses and afford a higher living standard. Consequentially, when partners split up, the risk for poverty increases particularly for women (Hogendorm, Leopold, & Bol, 2019), whereas men's risk of unemployment and decline of occupational status increases (Kalmijn, 2005). Higher financial resources, moreover, may facilitate a healthier lifestyle, such as a balanced diet and sports activities (Øvrum, Gustavsen, & Rickertsen, 2014).

[Figure 1 about here]

Partnership transitions may thus be linked to social, health behavior-related and economic implications that are suggested to mediate effects on cognitive functioning at older ages (see Figure 1). All in all, it is plausible to assume that those who transition to divorce and widowhood are thereafter are financially less well-off, less socially integrated, receive less cognitive stimulation and are less frequently engaging in healthy behavior than individuals who remain partnered. However, partnership transitions can take different directions, and many individuals remain stably partnered or unpartnered. We can thus distinguish between three distinct partnership transitions, namely, divorcing, becoming widowed, and repartnering, and two stable partnership statuses, namely remaining partnered (i.e., married or cohabiting) and remaining unmarried (i.e., never married). Theoretically, late first marriages are thinkable, but they do not occur very often. In later middle adulthood and older ages, when cognitive aging has already started (Singh-Manoux et al. 2012), we thus expect that *individuals who transition to divorce or bereavement show steeper cognitive decline than individuals who remain partnered (H1a). For individuals who experience a transition to re-partnering, we expect that their decline trajectory is not significantly different to those individuals who remain stably partnered (H1b).* Having identified four explanatory mechanisms, we assume that *these effects of partnership transitions are mediated by social integration, cognitive stimulation, health behavior and financial resources (H2)*.

Methods

Data came from the Survey of Health, Ageing and Retirement in Europe (SHARE). SHARE is a panel study which was conducted for the first time in 2004 in eleven European countries, and features 28 countries (including Israel) in the last wave, which was conducted in 2017 (Börsch-Supan, 2019; Börsch-Supan et al., 2013). Since not all countries participated in SHARE from beginning and there is only one wave available for a number of countries, our sample is limited to 20 countries: Austria,

Belgium, Switzerland, Czech Republic, Germany, Denmark, Estonia, Spain, France Greece, Croatia, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Poland, Portugal, Slovenia and Sweden.

The waves are conducted bi-annually, with a larger gap between waves 2 (collected in 2006, but not used here) and 4 (collected in 2011). Wave 3 (collected in 2008) is not used here, because it was purely retrospective, and only assessed life histories (SHARELIFE). In the standard survey, SHARE assessed information about their cognitive, physical, and mental health, their employment and partnership status, activities, social support, economic conditions, and health behavior for each participant. Hence no information on the cognitive health status of the respondents was recorded in wave 3. Similarly, wave 7, which was conducted in 2017, was a hybrid: it consisted of a "normal" panel wave for all respondents who had already participated in the SHARELIFE interview of wave 3 (about 20 per cent of all respondents in wave 7), all other respondents were administered the SHARELIFE interview for the first time in this wave (for an overview, see Börsch-Supan et al., 2013). For this study, we used all person-year observations in which the standard survey was conducted, totaling six out of seven waves (waves 1, 2, 4, 5, 6 and partly also 7).

Our analytical sample consists of individuals aged 50 years or older who are living in a private household and who participated at least in two subsequent SHARE waves (in order to make use of the longitudinal nature of the data). Their partners, if they were age-eligible and agreed to participate, were also included in the sample. These conditions apply to 82,239 respondents. We further excluded measurements of those participants who reported a doctor's diagnosis of Alzheimer's Disease or brain cancer at the wave at which the diagnosis were first reported and all waves after that. We also excluded participants with missing observations on the dependent and independent variables. The total sample consisted of n=81,814 respondents with n=213,023 valid person-year observations. On average, we observe our participants 2.6 times. The sample consists of 55.17% women, and the average age at baseline was 63.86 years.

Dependent variables

Cognitive functioning was assessed with three cognitive tests (Dewey & Prince, 2005). Immediate and delayed word recall were assessed with a memory task, for which the respondents were asked to recall a ten-word list read out loud to them immediately afterwards (immediate recall) and after a standardized delay (delayed recall). Starting with wave four, four different sets of word lists were used which were alternated in the following waves for the panel participants in order to avoid learning effects.

On average, respondents remembered 5.24 words at immediate recall (standard deviation: 1.77) and 3.86 words at delayed recall (standard deviation: 2.14). A third test assessed executive functioning, more specifically, verbal fluency. Here, respondents were asked to name as many animals as possible within one minute. The performance on this scale ranges between 0 and 100 animals named, the mean being 20 animals (20.12) named within one minute (standard deviation: 7.67). For the analyses in a regression framework, these three dependent variables will be z standardized (which means that they will have a mean of zero and standard deviation of one) at first assessment to make the effects sizes comparable across models.

Explanatory variables

Partnership statuses and transitions. Based on repeated assessment of self-reported variables pertaining to civil status and household composition, as well as items on marriage and divorce history, a multitude of possible partnership statuses can be distinguished. For each person-year, respondents were categorized into the respective status that applied for each wave. Thus, possible transitions between partnership statuses can be identified. This leads to a time-varying categorical variable with five separate partnership statuses: *Partnered* respondents live together with their spouse or cohabit with their partner; this includes registered partnerships of the same gender. *Repartnered* individuals have experienced a divorce, separation, or widowhood earlier and cohabit with a new partner or spouse at the time of the interview. *Unpartnered* respondents were never

married and are currently not living together with a partner. *Divorced* respondents are divorced from their partner, unregistered from their partnership, or live in separation from their previous spouse or partner, but they do not with a new partner. *Widowed* respondents have been bereaved and do not cohabit with a new partner.

Social integration, i.e., the availability of social network contacts beyond one's partner, was measured using four variables, specifically, the numbers of own children and grandchildren, and two dichotomous variables indicating whether the respondents had provided respectively received support or care to/from someone outside their own household in the last 12 months.

Cognitive stimulation was measured with two dichotomous variables indicating whether the respondents had engaged in social activities (such as volunteering or engaging in an association) or educational activities (such as reading, playing games or doing quizzes) in the last month.

Health behaviors. Two self-reported variables assessed alcohol consumption and regular exercise. Alcohol consumption was assessed as a categorical variable in share and was recoded into three dummies of "moderate" drinking (less than 4 times per week but at least once a month), "regular drinking" (at least 4 times per week), and "(almost) never drinking (less than once a month or never), the latter being dropped from the models in order to serve as the reference category. Regular exercise is measured with two dummy variables for physical activities with "moderate" or "vigorous" effort at least weekly.

Financial resources were assessed by household income, which was a dummy indicating whether the annual gross household income was among the bottom two quintiles of the respective country- and year-specific household income distribution of the analytical sample. Second, we included a dummy variable indicating whether one is a homeowner.

The highest level of education attained is a time-constant variable and thus absorbed in the fixed-effects regressions. To investigate the potentially differential links between partnership status and cognitive trajectories depending on educational level, we estimated three separate models by

educational groups. For this purpose, information on respondents' education through the International Standard Classification of Education (ISCED 1997) was recategorized into up to lower secondary education, upper secondary education, and post-secondary or tertiary education.

Control variables. Age was categorized into five approximately equally large groups to adjust both for unequal starting points of our observation of the cognitive aging trajectory and unequal risk of experiencing a divorce or widowhood by age group. To rule out possible effects of frailty on cognitive aging, we also control for the number of physical health limitations (measured as the addition of self-reported number of ADL limitations and mobility limitations). We controlled for self-reported employment status measured with three categories: employed or self-employed, retired, or inactive (including home-making and not being able to work due to illness or disability). Finally, since we can assume all participants to exhibit cognitive decline over time, we include in every model a time effect, i.e., a variable which indicating the count of the respective observation of that participant (first, second, etc.).

Analytical strategy

We estimate Fixed Effects Models (Allison, 2009) that allow us to hold constant all time-stable individual traits, such as cognitive reserve, genetic pre-dispositions, personality, and socio-economic status. The exposures of interest, partnership transitions, and possible mediating factors such as social integration, cognitive stimulation, health behavior, and financial resources, on the other hand, vary over time. Fixed effects models allow us to investigate whether changes in the dependent between two time points measured within the same individual co-occur with changes in the explanatory variables between the same two time points. Following that logic, individuals who do not experience a change in their partnership status should also not affect the coefficients, which should be driven alone by changers (Brüderl, 2010). However, as Mummolo and Peterson (2018) and Strumpf et al. (2017) point out, if controlling for time-effects (i.e. interview years, or waves) in a

model where the dependent variable exhibits a clear time trend (i.e., cognitive decline), different groups of non-changers (e.g., stable divorced individuals), too, may contribute to the respective coefficients. This could complicate the interpretation of the coefficients, which is why such a potential influence should be cautiously assessed. Nevertheless the Fixed effects framework is preferred over, for instance, a Latent Growth modelling strategy, which requests a larger number of time points per individual.

The multivariate models are estimated in several steps: In a first step, we only look at effects of partnership status while controlling for time effects only. In a second step, we include socio-demographic control variables, namely, age, physical health, and employment status, as these may influence the likelihood of experiencing certain partnership transitions. In a third step, we test the mediating mechanisms: first each separately and then all simultaneously. Fourth, separate models are estimated stratified according to educational level to detect differences in the links between partnership status and cognitive trajectories for different educational groups. All models are calculated with robust standard errors clustered at the country level which yields more conservative estimates of the standard errors, as the country context can influence the likelihood of experiencing certain trajectories or transitions. It thus considers heterogeneity in life expectancy and divorce rates between the countries sampled in SHARE.

To test the robustness of the findings, we calculated a model with only changers in order to identify whether non-changers, too, contribute to the effects (Mummolo & Peterson, 2018; Strumpf et al., 2017) (Table A4 in the Appendix). We also ran Random Effects models and conducted Hausman tests. In fact, for all models, the Hausman tests suggested that the Fixed Effects model should be preferred over the Random Effects model as the latter would yield inconsistent estimates ($p<0.001$).

Results

Descriptive results

Figure 2 (left panel) indicates the average change in cognitive functioning from one the first to the second, from the second to the third observation, etc. Performance in all three measures of cognitive functioning generally declines slightly across observations, with some improvements in delayed recall between first and second observation, in line with practice effects observed in other studies (Weuve et al., 2015). From the second to the third observation, verbal fluency declines more sharply compared to other assessments, probably due to the larger time gap between the second and the fourth wave as the majority of respondents entered in the first wave and the third wave assessed life histories

[Figure 2 about here]

Partnership transitions were infrequent events, as about nine in ten of the respondents did not experience changes in partnership status across waves (see Table A1 in the Appendix). Given the large sample, our analyses on changers are still based on a large number of observations, though (n=23,295 person-year observations nested in 7,584 respondents). Unadjusted for any confounders, average cognitive decline from one person-year observation to another was steeper for respondents who remained divorced, widowed or unpartnered, or who experienced transition out of a partnership than for those who remained stably partnered (Figure 2, right panel). Generally, we can observe decline in cognitive functioning over the time that participants remain in the panel, particularly after the second observation (Figure 2, left panel).

Multivariate results

Table 1 displays the full set of coefficients from the models with the unadjusted effect ("raw") and the full model with all variables entered simultaneously ("full"). In unadjusted models which only control for time effects, divorced and widowed individuals showed steeper decline compared to individuals who remain stably partnered. This holds for all the cognitive measures. These

associations however vanished after adjusting for the four mediating mechanisms, in line with our expectations.

Figure 3 displays the changes of the coefficients for partnership across the seven models: including first separately, then simultaneously the controls and the assumed mediation mechanisms (for coefficients see Table A2 in the Appendix). These effects are significant if the confidence interval of a coefficient does not overlap the reference line at zero. The more negative slopes found for divorce for all three cognitive measures were completely explained (i.e. rendered insignificant) by socio-demographic confounders, similarly, the negative slope for widowhood was completely explained by the sociodemographic confounders for delayed recall and verbal fluency (see the plots with the grey hollow triangles in the middle and right panel in Figure 3). Additional analyses suggested that this was driven by including age, which is a strong predictor for cognitive decline. Hence, a partnership effect that is independent of age can only be found for widowhood and immediate recall (H1a). This widowhood effect on immediate recall was completely explained by social integration (hollow squares, Figure 3) or financial resources (filled triangles, Figure 3), as well as when adjusting for all four mediating mechanisms simultaneously (black dots, Figure 3).

No effects of partnership on cognitive trajectories were observed for individuals who repartner as compared to stably partnered individuals (*n.s.*). This is in line with our expectations (H1b). Overall, there is only partial evidence to confirm H1. Similarly, we only found support for H2 for one of the three cognitive measures (immediate recall), where we could observe a significant effect net of socio-demographic controls.

[Figure 3 about here]

Considering the high rate of respondents with stable partnership status which potentially may influence the coefficients, we also estimated models with changers only (Table A4). The comparison of the coefficients with the standard sample allows us to identify whether non-changers, too, might influence the coefficients. The findings indicate that, for the most part, excluding the trajectories of

those who remain stable divorced, widowed and repartnered, produces very similar effect sizes and significance levels as compared to the coefficients estimated for all respondents (changers and non-changers).

[Table 1 about here]

In the next step, we estimated stratified models for respondents with up to lower secondary education, upper secondary education, and post-secondary or tertiary education (Table 2, for the full set of coefficients, see Table A3 in the Appendix). When looking at the full models (adjusting for all controls and mediating mechanisms), only lower-educated individuals seem to benefit from a stable marriage or cohabiting partnership in terms of cognitive decline. In this group, repartnered individuals decline more strongly in delayed recall, whereas divorced individuals show stronger decline in immediate and delayed recall and widowed have lower immediate recall.

[Table 2 about here]

While in comparison with models assessing cumulative impact of partnership statuses, for example, with regression approaches, the effect sizes seem quite small, one needs to consider that they refer to the average decline between two waves (or about two years) only. Moreover, the dependent variables are z-standardized, which means that the coefficients represent change measured in standard deviations and not the original metric. For immediate memory, one standard deviation corresponds to about 1.77 words and for delayed recall, one standard deviation corresponds to about 2.14 words on a 10-word scale. With regard to verbal fluency, one standard deviation even corresponds to about 7.67 words on a scale which in our sample ranges from 0 to 100. Thus, an effect size of -0.083*** (for widowhood and immediate recall) multiplied by 1.77 translates into a "loss" of 0.15 words more between the two waves between which the transition happens (additional to the "average" loss of 0.14 words for those who remain partnered as indicated by the constant). Since the faster decline around the loss of a partner does not seem to slow down substantially (no substantial differences between the models with and without changers), the

average “loss” in cognitive functioning for those who lose a partner can be assumed to progress over time, for those individuals who remain exposed to the status of being divorced or widowed. Related to this, the negative effect of repartnering on delayed recall in the changers suggests that the process of unpartnering, which had happened before, may extend beyond the phase of being unpartnered into the phase during which repartnering occurs.

Discussion

The aim of this article was to systematically investigate the effects of different partnership transitions on cognitive trajectories as well as the factors which mediate the influence of partnership transitions on cognitive decline. With its analytical focus and design, it contributes to the literature in several ways. First, our findings extend earlier results of a Finnish study (Håkansson et al., 2009) that found divorced and bereaved individuals at risk of cognitive impairment two decades later, by demonstrating that effects of partnership status on cognitive performance are visible already in late mid-adulthood and early old age. Second, by distinguishing five different partnership statuses and four potential transitions between these statuses, our approach allows to investigate differential effects of these distinct life course transitions. Theoretically, we link the different nature of being in one of these partnership statuses to four types of resources respectively behaviors and investigate their mediating role. Finally, we account for potentially stratified effects by looking at three different educational groups.

Based on a large sample of 20 European countries over a follow-up period of up to thirteen years, with a potentially high generalizability of the findings, we find only few consistent effects of partnership on three distinct measures of cognitive functioning. When adjusting for socio-demographic controls such as age, physical health, and employment status, only individuals who experience a divorce show more unfavorable cognitive decline in line with the hypotheses. In all three measures, repartnered individuals do not differ from partnered individuals in their cognitive

trajectories, which strengthens the assumption about protective effects of a new partnership. Additional analyses (not reported here) suggested no significant differences by duration between loss of partner and repartnering, however the overall small number of repartnered individuals made it difficult to arrive at robust conclusions. As expected, the negative effects of divorce could be explained by reference to social integration and financial resources (but not health behavior or cognitive stimulation through leisure activities), which is again in line with the hypotheses. Bereavement was not associated significantly with more unfavorable concurrent cognitive trajectories overall, which was counter our expectations. Earlier studies on bereavement had shown shorter-term cognitive decline directly after bereavement but also recovery effects after few years (Vidarsdottir et al., 2014; Worn et al., 2020). Our study, with assessment intervals of at least two years, may have missed this U-shaped association of bereavement with cognitive functioning.

Additional analyses with changers only suggested that our results extend on stable partnerless (i.e. divorced or widowed) individuals. They suggested a similarly steep cognitive decline *after* as compared to *around* the transition into divorce and widowhood. Previous research investigating the potentially negative cognitive consequences of partnership transitions is more closely linked to a critical life events perspective (see, e.g., Kessler, 1997). Our findings suggest that the (prolonged) absence of a stable partnership after divorcing or becoming widowed may continue to negatively affect older-age cognitive health. Repartnering, on the other hand, has shown to exhibit a protective effect against unfavorable cognitive trajectories.

Subgroup analyses by education suggest that most effects of partnership were found in lower-educated individuals, for which, compared to stably partnered individuals, repartnered individuals performed worse than partnered on delayed recall, those who divorced performed worse on immediate recall, and bereaved individuals performed worse on immediate and delayed recall. This points to a generalized negative effect of not being in a stable partnership on cognitive trajectories in lower-educated individuals, extending earlier findings (van Gelder et al., 2006). In the high-educated group, divorced individuals performed worse than partnered individuals in verbal fluency.

The finding that only verbal fluency was impacted in high-educated individuals, may be due to verbal fluency being the most sensitive of the three measures to processes of aging (Mazzonna & Peracchi, 2013). The fact that most effects of partnership on cognitive decline are observed in the group of lower-educated individuals fits with the observation that educational attainment generally is a marker for cognitive reserve (Foverskov et al., 2019), which may offset the negative effects of losing a partner. It also concurs with the findings that the lower educated have on average fewer social support and smaller networks (Fischer & Beresford, 2015), but also fewer financial resources and less healthy behavior. Lower-educated individuals, having lower cognitive reserve to buffer aging-related brain changes and exhibiting an earlier decline (Glymour et al., 2012), may thus be more dependent on concurrent resources associated with living in a stable partnership.

In principle, earlier research suggests not only age but also cohort differences in measures of cognitive functioning (Hessel, Kinge, Skirbekk, & Staudinger, 2018; Thorvaldsson, Karlsson, Skoog, Skoog, & Johansson, 2017). However, despite covering birth cohorts over six decades in our sample, cohort variation beyond age was not substantial enough to exploit in our study.

While this study has various strengths, it also comes with some limitations which offer directions for future research. We extend previous studies on long-term effects of midlife partner status on cognitive outcomes (Håkansson et al., 2009; Vidarsdottir et al., 2014) by demonstrating immediate effects of partnership status on cognitive performance, they also suggest that partnership status effects on cognitive functioning are also contingent on age and education. This suggests that individuals from different social strata are not experiencing the same consequences of, e.g., a loss of a partner, and partnership status may come with different risks of cognitive decline for different strata. Second, with our analytical design, not only effects of partnership status (i.e., cross-sectional analyses which are prone to selection bias) but also transitions between statuses on simultaneous changes in cognitive functioning were investigated. However, partnership transitions in the sample were rare, and results were partly also driven by non-changers due to controlling for period effects.

Thus, possible bias due to selection into partnership status (e.g., characteristics or innate cognitive abilities that would increase risk of divorce or not finding a partner) cannot be fully ruled out.

This study suggests that becoming unpartnered due to divorce or bereavement are associated with less favorable cognitive trajectories. With unimpaired cognitive health being a prerequisite to living independently without care needs, policies should offer support to maintain cognitive functioning at older ages, and the present study may offer some insights in this regard. Regarding encouraging favorable partnership decisions, in many developed countries across the world, marriage during working age is already promoted through various policy stimuli such as labor tax advantages. Since older-age repartnering has a positive influence on cognitive trajectories, too, future policy-making could aim at de-penalizing unmarried cohabitation in older age to offer individuals the benefits of partnership at older ages. Divorce or bereavement at later ages, in contrast, may only to a very limited extent be preventable through policies. In line with findings of this study, policies promoting a cognitively and physically active, health-favorable lifestyle might be able to buffer the negative cognitive effects of living without partner, divorce, or bereavement.

To conclude, bereaved and divorced individuals showed less favorable cognitive trajectories compared to individuals in a stable partnership. These could be explained by differences in socio-demographic factors for widowed individuals, and differences in social integration, cognitive stimulation, health behavior and financial resources for divorced individuals. This underlines the comprehensive effects of partnership transitions on a broad set of resources that are linked to cognitive ageing. Our findings contribute to a better understanding of the life-course and social risk as well as protective factors for cognitive health in later life.

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Tables

Table 1: Partnership transitions and cognitive functioning (Fixed Effects Linear Regression Models)

	Immediate recall		Delayed recall		Verbal Fluency	
	Raw	Full	Raw	Full	Raw	Full
	b	b	b	b	b	b
	(SE)	(SE)	(SE)	(SE)	(SE)	(SE)
Partnered (ref.)						
Repartnered	-0.041	-0.028	-0.057	-0.039	-0.034	-0.018
	(0.028)	(0.027)	(0.031)	(0.031)	(0.036)	(0.034)
Unpartnered	-0.094	-0.073	-0.070	-0.057	-0.119	-0.104
	(0.081)	(0.081)	(0.065)	(0.063)	(0.077)	(0.077)
Divorced	-0.054**	-0.018	-0.038*	-0.004	-0.074*	-0.042
	(0.017)	(0.016)	(0.017)	(0.016)	(0.029)	(0.027)
Widowed	-0.083***	-0.033	-0.061*	-0.009	-0.045*	-0.002
	(0.021)	(0.021)	(0.023)	(0.022)	(0.016)	(0.016)
1st observation (ref.)						
2nd	0.026*	0.030**	0.063***	0.063***	-0.002	0.016
	(0.009)	(0.009)	(0.011)	(0.012)	(0.018)	(0.023)
3rd	-0.007	0.008	0.046	0.051	-0.063	-0.018

	(0.023)	(0.017)	(0.028)	(0.025)	(0.032)	(0.029)
4th	-0.017	0.010	0.031	0.043	-0.076	-0.005
	(0.028)	(0.031)	(0.034)	(0.036)	(0.041)	(0.044)
5th	-0.043	-0.007	0.009	0.027	-0.071	0.018
	(0.030)	(0.037)	(0.033)	(0.043)	(0.048)	(0.069)
(continued)						
6th	-0.105**	-0.054	-0.069	-0.038	-0.078	0.037
	(0.035)	(0.040)	(0.038)	(0.047)	(0.045)	(0.077)
Social integration						
# children		0.004		-0.009		-0.003
		(0.005)		(0.006)		(0.004)
# grandchildren		0.007**		0.008**		0.002
		(0.002)		(0.003)		(0.003)
Given help		0.023**		0.026**		0.012
		(0.007)		(0.008)		(0.008)
Received help		-0.018*		-0.012		-0.030**
		(0.006)		(0.006)		(0.008)
Cognitive stimulation						

Social activities	0.030**	0.031**	0.044***
	(0.008)	(0.009)	(0.006)
Educational activities	0.027*	0.031*	0.040*
	(0.010)	(0.013)	(0.015)
Health behavior			
Never drinking (ref.)			
Moderate drinking	0.021*	0.016	-0.006
	(0.009)	(0.009)	(0.016)
Regular drinking	-0.006	-0.006	-0.006
	(0.014)	(0.016)	(0.018)
Vigorous physical	0.023**	0.033***	0.027***
	(0.007)	(0.007)	(0.007)
Moderate physical	0.053***	0.024	0.087***
(continued)			
	(0.010)	(0.015)	(0.014)
Financial resources			
Low income	-0.015	-0.012	-0.014*
	(0.009)	(0.010)	(0.005)

Homeowner	0.034**	0.036*	0.016
	(0.011)	(0.013)	(0.013)
Control variables			
Employed (ref.)			
Retired	0.006	0.032**	-0.014
	(0.009)	(0.010)	(0.013)
Inactive	-0.008	-0.009	-0.014
	0.006	0.032**	-0.014
Age: 50-54 years (ref.)			
55-59	0.072**	0.072*	0.037
	(0.025)	(0.028)	(0.033)
60-64	0.106*	0.118*	0.038
	(0.047)	(0.054)	(0.066)
65-69	0.104	0.126	0.019
	(0.063)	(0.077)	(0.092)
70-74	0.069	0.094	-0.039
	(0.077)	(0.093)	(0.118)
75-84	-0.018	-0.022	-0.157

		(0.088)		(0.104)		(0.142)
85 years or older		-0.201		-0.198		-0.341*
		(0.107)		(0.121)		(0.162)
(continued)						
# Functional health limitations		-0.019***		-0.016***		-0.019***
		(0.002)		(0.003)		(0.002)
Constant	0.081***	-0.084	0.072***	-0.075	0.070***	0.001
	(0.012)	(0.052)	(0.014)	(0.065)	(0.017)	(0.077)
n (person-years)	213,023	213,023	213,023	213,023	213,023	213,023

Source: SHARE Release 7.0.0, Individuals aged 50 years or older. All dependent variables are z standardized. Fixed Effects linear regression models. Raw models include only the effect of partnership and the controls for time effects. Full models include all covariates, entered simultaneously. Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 2: Models stratified by Education (Coefficients and Standard Errors of the Fixed Effects Linear Regression Models)

	Immediate Recall		Delayed Recall		Verbal Fluency	
	Raw	Full	Raw	Full	Raw	Full
	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)	b (SE)
Lower Education (Up to Lower Secondary Education)						
Partnered (ref.)						
Repartnered	-0.059	-0.035	-0.117*	-0.089*	-0.011	0.017
	(0.047)	(0.046)	(0.041)	(0.040)	(0.056)	(0.055)
Unpartnered	-0.114	-0.085	-0.006	0.013	-0.226*	-0.206
	(0.119)	(0.120)	(0.064)	(0.057)	(0.097)	(0.098)
Divorced	-0.088***	-0.045**	-0.084**	-0.042*	-0.102	-0.057
	(0.014)	(0.014)	(0.022)	(0.018)	(0.049)	(0.046)
Widowed	-0.085***	-0.040*	-0.073**	-0.028	-0.049*	-0.005
	(0.014)	(0.015)	(0.019)	(0.020)	(0.020)	(0.020)
n (person-years)	89,589	89,589	89,589	89,589	89,589	89,589
Medium Education (Upper Secondary Education)						

Partnered (ref.)						
Repartnered	-0.032	-0.023	-0.065	-0.054	-0.053	-0.045
	(0.050)	(0.051)	(0.039)	(0.041)	(0.032)	(0.032)
Unpartnered	-0.069	-0.052	-0.124	-0.114	-0.061	-0.049
	(0.103)	(0.105)	(0.126)	(0.123)	(0.092)	(0.093)
Divorced	-0.039	-0.012	0.010	0.032	-0.038	-0.018
	(0.033)	(0.031)	(0.036)	(0.035)	(0.032)	(0.034)
Widowed	-0.067	-0.023	-0.008	0.035	-0.039	-0.003
	(0.033)	(0.034)	(0.040)	(0.041)	(0.030)	(0.032)
n (person-years)	77,164	77,164	77,164	77,164	77,164	77,164

Higher Education (Post-secondary and Tertiary Education)

Partnered (ref.)						
Repartnered	-0.013	-0.015	0.078	0.076	-0.011	-0.008
	(0.058)	(0.059)	(0.063)	(0.063)	(0.056)	(0.052)
Unpartnered	-0.122	-0.111	-0.051	-0.047	-0.056	-0.057
	(0.128)	(0.125)	(0.143)	(0.136)	(0.148)	(0.144)
Divorced	-0.011	0.022	-0.006	0.020	-0.071*	-0.052

	(0.043)	(0.042)	(0.040)	(0.044)	(0.030)	(0.029)
Widowed	-0.086	-0.024	-0.067	-0.004	-0.027	0.014
	(0.047)	(0.048)	(0.047)	(0.044)	(0.048)	(0.046)
n (person-years)	44,987	44,987	44,987	44,987	44,987	44,987

Source: SHARE Release 7.0.0, Individuals aged 50 years or older. All dependent variables are z standardized. Fixed Effects linear regression models. Raw models include only controls for time effects. Full models include all covariates from Table 1, entered simultaneously. For the full set of coefficients, please see Table A3 in the Appendix. Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Figures

Figure 1: Mediating Mechanisms and Contextual Moderators of the Effect of Partnership on Cognitive Functioning

Own illustration

Figure 2: Cognitive decline by survey participation and (change in) partnership status

Source: SHARE Release 7.0.0, waves 1, 2, 4, 5, 6 and 7. Individuals aged 50 years or older, without a diagnosis of Alzheimer's disease or brain cancer, with at least two observations and valid observations on all dependent and independent variables from Table 1. Average change score since the last wave. n= 133,700 person-year observations. Please note that for the first observation of each person, a change score cannot be computed, hence case numbers deviate from Table 1.

Figure 3: Partnership effects - subsequently adjusting for explanatory variables

Source: SHARE, Release 7.0.0, waves 1, 2, 4, 5, 6 and 7. Individuals aged 50 years or older, without a diagnosis of Alzheimer's disease or brain cancer, with at least two observations and valid observations on all dependent and independent variables from Table 1. Predictive margins from different models (see Table A2 in the Appendix for full set of coefficients).

Figure 1

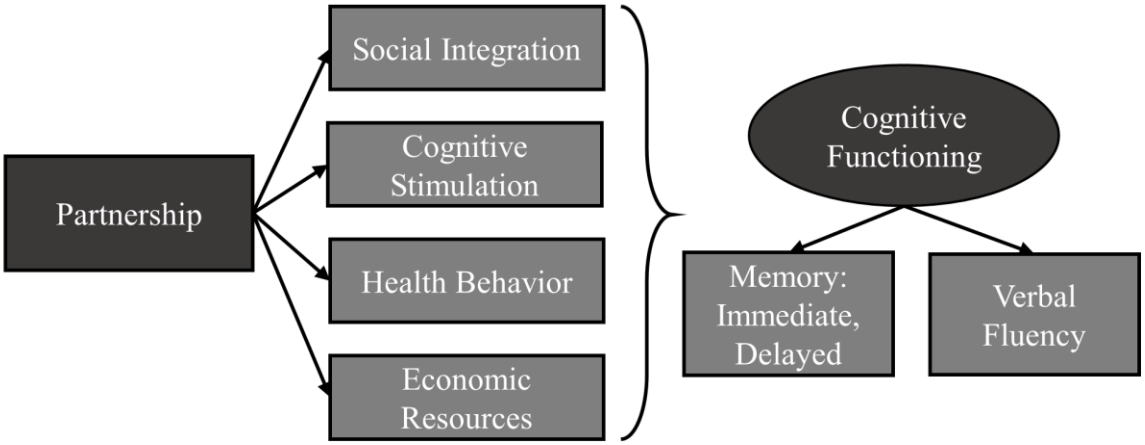

Figure 2

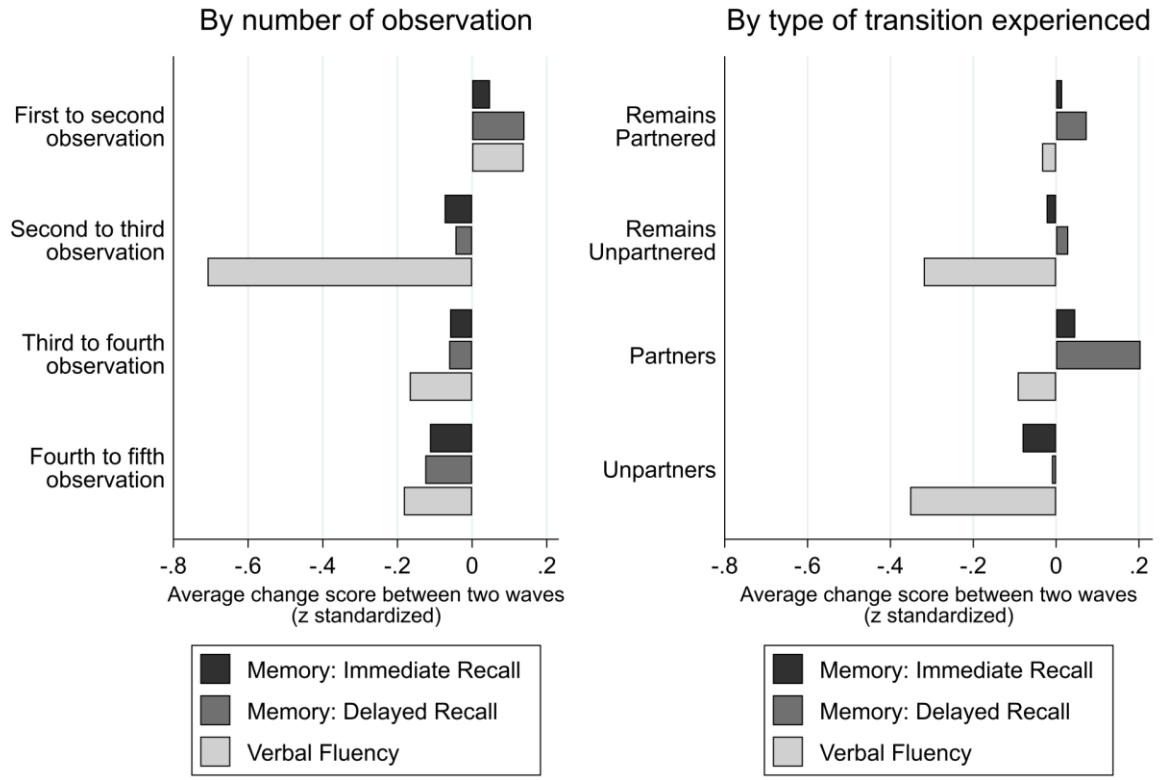

Figure 3