Correlated change in memory complaints and memory performance across 12 years

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Abstract

The present study examines whether the relationship between memory complaints and memory performance is better assessed by analyzing the mutual development. Five hundred participants, averaging 62.9 years of age at first measurement, were measured three times over 12 years. After establishing partial strong factorial invariance, correlations between levels and between slopes of memory performance and memory complaints were estimated using second-order latent growth curve models. The relationship between slopes was found to be three times larger than the relationship between levels, indicating that assessing the commonality in change is more informative than assessing the relationship at a given time point.
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Correlated Change in Memory Complaints and Memory Performance Across 12 Years

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The present study examines whether the relationship between memory complaints and memory performance is better assessed by analyzing the mutual development. Five hundred participants, averaging 62.9 years of age at first measurement, were measured three times over 12 years. After establishing partial strong factorial invariance, correlations between levels and between slopes of memory performance and memory complaints were estimated using second-order latent growth curve models. The relationship between slopes was found to be three times larger than the relationship between levels, indicating that assessing the commonality in change is more informative than assessing the relationship at a given time point.

Keywords: memory complaints, memory performance, correlated change, aging

The nature of the relationship between memory complaints and actual memory performance poses an important issue in applied science. Several studies have demonstrated that memory performance decreases with age (e.g., Hess, 2005; Schaeie, 2005; Verhaeghen & Salhouse, 1997) whereas memory complaints increase with age (Commissaris, Ponds & Jolles, 1998; Mol, van Boxtel, Willems & Jolles, 2006). However, the relationships found between subjective and objective measures of memory are of moderate size (cf., Cavanaugh & Poon, 1989; Jorm, Christensen, Korten, Jacomb & Henderson, 2001; Valentijn et al., 2006). Several different ideas have been presented to explain this moderate association.

First, subjective judgments on memory performance might not be solely determined by actual memory performance but might also be strongly related to other variables. The extent of complaints has been found to be strongly related to affectsive state (e.g., depression, Mowla et al., 2007). Depression has also been found to be a major influence on self-reports of cognition (e.g., Metternich, Schmidtke & Hüll, 2009). Just as high levels in neuroticism have been proven to relate to the prevalence of major depression (Jylhä, Melartin & Isometsä, 2009), memory complaints might be influenced by the level of neuroticism in nondepressed aging samples (Mol, Rutter, Verhey, Dijkstra & Jolles, 2008; Wilhelm, Witthöft & Schipolowski, 2010). Lane and Zelinski (2003) investigated the relations between memory-functioning questionnaires and various personality variables and found levels of neuroticism to be related to evaluations of the seriousness and frequency of forgetting.

Second, while questionnaires and tests of memory performance are defined and validated by experts in the field, they are answered by lay people. Differences in the definitions of constructs intended by the creators and those understood by the participant might lead to different conclusions about memory performance. For example, differences between lay and expert definitions have been found in research on intelligence (Furnham, 2000). Similarly, different perceptions of memory performance might account for the small relationship between subjective and objective memory performance. Related to this argument, current theories in social psychology state that implicit theories that individuals hold about aging and memory influence responses on self-ratings (cf., Hertzog & Hultsch, 2000). Implicit theories are informal constructs held by individuals about specific psychological phenomena. According to Ross (1989), the manner in which individuals construe their own history is greatly influenced by socio-cultural conceptions of aging. In general, young and old adults tend to believe in cognitive decline in old age (Hertzog & Hultsch, 2000; Kite, Stockdale, Whitley & Johnson, 2005; McDonald-Miszczak, Hertzog & Hultsch, 1995). Although rather drawing the attention to short-term evaluation of performance in an upcoming memory test, Rabbitt and Abson (1990; 1991) found the levels of prediction to be associated with levels of self-confidence. Hence, self-reported cognitive decline might be amplified by people being primed to expect cognitive decline in old age.

Third, a point of reference is necessary to judge a person’s performance. In a comprehensive review on the use of questionnaires for the assessment of memory performance, Herrmann (1982) pointed out the fact that content and format of ratings differ.
between questionnaires as well as individuals. Questionnaires might differ in the way that they assess forgetting, remembering or memory change across a time span of days, weeks or occasions. Additionally, individuals differ in what they use as a baseline for their ratings. Concerning cognitive functioning, people can either use social comparisons (e.g. Arnekless & Smith, 2000) or temporal comparisons (cf. Albert, 1977). Although temporal comparisons seem to be the most common in old age (e.g. Brown & Middendorf, 1996), this confounding aspect cannot be controlled for in cross-sectional research designs. Martin and Zimprich (2003) and Zimprich, Martin and Kliegel (2003) accounted for this problem applying longitudinal data analyses and latent change models. The relationship between the subjective and objective measurements of memory performance was then assessed via the degree of correlation between the changes in memory and complaints. In their study, Zimprich, Martin and Kliegel (2003) assessed memory complaints and memory performance in 202 older adults (mean age = 63 years) at two measurement occasions across four years. They found a nonsignificant relationship between memory complaints and cognitive performance at the initial measurement occasion. However, they found a correlation of \( r = -0.64 \) between changes in memory complaints and changes in actual memory performance. Somewhat contradictory evidence comes from a longitudinal study by Taylor, Miller and Tinklenberg (1992). In 30 older adults measured on three occasions over four years they found no relationship between subjective and objective memory change. However, this may be due to the small sample size. In a sample of 97 individuals aged between 30 and 81 Lane and Zelinski (2003) found inconsistent relationships between memory complaints and cognitive performance at the initial measurement occasion. Nevertheless, they found a correlation of \( r = -0.46 \) between changes in memory complaints and changes in actual memory performance. Somewhat contradictory evidence comes from a longitudinal study by Taylor, Miller and Tinklenberg (1992). In 30 older adults measured on three occasions over four years they found no relationship between subjective and objective memory change. However, this may be due to the small sample size. In a sample of 97 individuals aged between 30 and 81 Lane and Zelinski (2003) found inconsistent relationships between memory complaints and cognitive performance at the initial measurement occasion. Nevertheless, they found a correlation of \( r = -0.46 \) between changes in memory complaints and changes in actual memory performance. Somewhat contradictory evidence comes from a longitudinal study by Taylor, Miller and Tinklenberg (1992). In 30 older adults measured on three occasions over four years they found no relationship between subjective and objective memory change. However, this may be due to the small sample size. In a sample of 97 individuals aged between 30 and 81 Lane and Zelinski (2003) found inconsistent relationships between memory complaints and cognitive performance at the initial measurement occasion. Nevertheless, they found a correlation of \( r = -0.46 \) between changes in memory complaints and changes in actual memory performance.
models (Satorra & Bentler, 2001). Throughout the analyses we used SPSS 18 and Mplus version 3.0 (Muthén & Muthén, 2004).

**Modeling Description**

We begin analysis of the data with a first-order model for memory and memory complaints across three measurement occasions each. Because data for memory complaints were measured on an ordinal scale, we estimated thresholds between categories (Millas & Yun-Tein, 2004). The number of thresholds is equal to the number of categories minus one, resulting in three thresholds to be estimated. We used the theta parameterization and WLSM estimator for our analyses (Muthén & Asparouhov, 2002; Muthén & Muthén, 2004). Model parameterization and factor scaling of the configural invariance model were achieved by fixing the factor means to zero. Additional constraints were then imposed to test specific models. To scale the latent variables, factor loadings for Item 1 for memory complaints and the picture recall task were set to 1. For all six first-order factors, the means were set to 0 across the three time points. For the second-order models, one level factor and one slope factor were specified for each of memory and memory complaints. Because time intervals were four and eight years respectively, slope factor loadings were set to 0, 1, and 3, corresponding to linear growth.

**Results**

Different degrees of measurement invariance (MI) were tested. The configurational invariance model achieved an acceptable fit (adjusted \( \chi^2 = 1040.7, df = 302, p < .01, \text{CFI} = 0.96, \text{RMSEA} = 0.070 \)), indicating that the same manifest indicators underlie the latent constructs across time. Weak MI, that is, constraining the factor loadings to be equal across time, did not change the model fit significantly (adjusted \( \chi^2 = 1029.93, df = 316, p < .01, \text{CFI} = 0.96, \text{RMSEA} = 0.067 \); Satorra-Bentler scaled [S-B] \( \Delta \chi^2 = 17.74, \Delta df = 14, ns \), indicating that the manifest indicators assessed the latent factors in the same way at each time point. Strong MI did not hold (adjusted \( \chi^2 = 1652.57, df = 351, p < .01, \text{CFI} = 0.93, \text{RMSEA} = 0.085; \text{S-B} \Delta \chi^2 = 905.01, \Delta df = 35, p < .01 \)). We then tested for partial measurement invariance (see Byrne, Shavelson, and Muthén, 1989). Inspection revealed that the intercept for memory that caused the largest decrease was for delayed picture recall. The items representing immediate recall could be constrained to be equal across time, indicating that delayed recall behaves differently than immediate recall. For the memory complaints items a comparable picture emerged. Items 2, 3, and 6 could be constrained to be equal across time where Items 1, 4, and 5 could not. The former items target specific episodic memory problems whereas the latter depict rather general difficulties in concentration. Although compared to the weak measurement invariance model, the partial strong measurement invariance model fit the data statistically significantly worse according to the chi-square difference test (S-B \( \Delta \chi^2 = 65.25, \Delta df = 14, p < .01 \)), we accepted this model for conceptual reasons (discussion below).

Analyses continued using a second-order latent growth curve model. In this model, memory and memory complaints each were provided factors for level and slope across the 12 years. The factor loadings of the second-order level factors were set to 1, their means set to zero, and their variances freely estimated. Covariances between the memory level factor and the complaints level factor as well as between the memory slope factor and the complaints slope factor were freely estimated. According to model fit criteria, in this model the data fitted the data of the present study well (adjusted \( \chi^2 = 1133, df = 343, p < .01, \text{CFI} = 0.95, \text{RMSEA} = 0.068 \)), hence we accepted it as our final model (see Figure 1).

The skew of the distribution of memory complaints data did not change substantially over time. Taken together, for all items the general distribution remained the same with the highest weight on the first threshold and decreasing weight on threshold two and three. Variance for the level factors were 1.197 (Standard error (SE) 0.19) for memory complaints and 0.209 (SE 0.036) for memory performance. Variance for the slope factors were 0.066 (SE 0.036) for memory complaints and 0.029 (SE 0.01) for memory performance. Unstandardized means for the slope factors were \(-.158 (p < .05)\) for memory complaints and \(-.169 (p < .05)\) for memory performance. According to Byrne et al. (1989) means on latent level are interpretable even without full strong measurement invariance. Note, however, that if constraining intercepts of the memory complaints items that aim at difficulties in concentration, the mean-level change in memory complaints is nonsignificant anymore (see discussion below).

The covariance between the level factors was 0.116, \( p < .05 \), whereas the covariance between the slope factors was 0.015, \( p < .05 \). We also tested the covariance between the slope factors against a zero slope-slope covariance using a LR test (Hertzog, von Oertzen, Ghisletta, & Lindenberger, 2008). This led to a significant decrease in model fit (S-B \( \Delta \chi^2 = 8.16, \Delta df = 1, p < .01 \)). To test whether the covariances between levels and slopes differed significantly, we constrained them to be equal and refitted the model. This also led to a significant decrease in model fit (S-B \( \Delta \chi^2 = 6.93, \Delta df = 1, p < .01 \)). We conclude that the relationship between the slope factors was significantly different from zero and larger than the relationship between the level factors. In terms of effect-sizes, the relationship between memory and memory complaints at T1, was \( r = .23, p < .05 \). The correlation between the slopes of the two constructs was \( r = .39, p < .05 \). Correlations between the level and slope factors within the constructs were not significant \( r = -.16, ns \) for memory complaints and \( r = -.03, ns \) for memory performance). The correlations remained unaffected by the different degrees of partial measurement invariance.

**Discussion**

In the present study we examined whether the relationship between memory complaints and memory performance could be assessed more precisely by analyzing the commonality in change between the two constructs.

First, we examined different degrees of measurement invariance. Strong factorial invariance did not hold. The pattern that emerged for partial strong factorial invariance indicated invariance for those memory items measuring immediate recall but not for

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1 We also tested strong measurement invariance using continuous item factor analysis and parcels. However, both ways of structuring the data lead to similar results.
those measuring delayed recall. For the memory complaints items, invariance was shown to be tenable for those items measuring memory complaints in specific episodic memory tasks (i.e., remembering names and numbers) but not for the items measuring global memory changes (e.g., difficulties in concentration). The results indicate that changes in immediate recall can be accounted for by the latent memory factor, whereas changes in delayed recall remain partly unexplained by the memory factor. The same is true for the memory complaints items: while changes in the specific episodic memory complaints can be accounted for by the latent factor, changes in the items assessing complaints about more global concentration cannot. We have the following explanation for this: concentration is a less specific measure for memory. It seems plausible that these less-specific aspects of self-assessment are more difficult to evaluate, and therefore more strongly influenced by mediating variables such as affect or stereotypes about age. Just as affect has been shown to influence memory self-evaluation (e.g., Metternich et al., 2009), the different invariance characteristics of the items can be interpreted as representing the specific influence of affective variables on aspects of self-evaluation of memory complaints. A related explanation seems plausible for the memory performance items. From the literature it is known that memory performance is influenced by perceived self-efficacy (e.g., Bandura, 1989). Although these effects are small, it seems plausible that the delayed recall is more prone to affective influences than is the immediate recall. In the deliberate process of recalling information after a delay, it seems reasonable that affective influences are more distinct. However, more detailed future research is needed to provide support for this explanation.

On the latent level we find a decrease in memory performance and an increase in memory complaints. This result is expected from the literature (e.g., Commissaris et al., 1998; Hess, 2005). Note, however, that in the present study the significance of the mean-level changes in memory complaints depended on the choice

Figure 1. Final second-order latent growth curve model. Note. adjusted $\chi^2 = 1133, df = 343, p < .01, \text{CFI} = 0.95, \text{RMSEA} = 0.068.$ WR = Word recall; PR = Picture recall; DP = Delayed picture recall; 1–6 = Memory complaints Items 1 to 6; T1 = first measurement occasion; T2 = second measurement occasion; T3 = third measurement occasion; Numbers denote fixed parameters for model specification; Numbers in bold indicate correlations between levels and slopes; Means of complaints and memory first-order factors are set to zero.
of items that were constrained to equality across time. Constraining the specific memory complaints items (Item 2, 3, 6) led to significant mean-level changes, whereas constraining the less specific items (Items 1, 4, 5) to be equal led to a nonsignificant mean-level change. A reasonable interpretation of this result is that items that are possibly influenced more strongly by affective variables could mask the change in mean-level. Hence, differences on intercept level that are not completely mediated by the common factor but are rather confounded with specific additive influences result in the possibility that changes are masked (for extensive discussion see Gregorich, 2006; Meredith & Teresi, 2006).

Analyses then focused on examining correlated change in memory performance and memory complaints. In terms of \( r^2 \) we found the relationship to be three times stronger between the slopes than the levels. Although the effect size is only moderate for the change correlation, the results imply that development is dynamic rather than static, and that in order to assess the relationship between the development of two constructs, the dynamic nature of development must be represented methodologically as well. The relationship between memory and memory complaints is therefore described more precisely in the analysis of mutual development than in the analysis of static structure. From a conceptual point of view, the results of the present study indicate that individuals are sensitive to their own memory performance in the way that they notice changes. One limitation of the present study is that the overall correlation between the change parameters is only moderate. This resembles results from previous studies mentioned in the introduction (e.g., Jorm et al., 2001). Two possible explanations seem plausible. First, prior research has suggested that perceived age differences are ability specific (Lachman & Jelalian, 1984). In the present study, memory performance was assessed using word list and picture memory tasks whereas the items for memory complaints additionally aimed at concentration and everyday performance. Second, although points of reference were assumed to be stable across time, this might not be true for a time span as long as 12 years. It is possible that individuals periodically adjust their reference point and compare themselves to "the person I was a few years ago." Despite these limitations, the significant difference between the level correlation and the slope correlation supports the conclusion that analyzing the commonality in change is highly informative.

What do the results of the present study tell us about the relationship between memory complaints and memory performance? First, across 12 years memory performance decreases while memory complaints increase. Second, items that measure memory performance in a less specific way seem to be more prone to outside influences. Possible mediating variables are affective variables; however, future research is needed to clarify this point. Third, assessing the commonalities in change is more informative than examining static values at a given time point.

### References


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