Final assignment FM9 - Psychological Methods

**Author:**

L i n u s W i d m e r

**Final Assignment**:

Differential stability and development of conscientiousness over the lifespan

Degree: M.Sc. Psychology

Email: *widmerli@student.hu-berlin.de*

Matriculation Number: *627542*

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## Introduction & Theoretical Background

The question of how personality traits develop across the lifespan has been in the focus of psychology for a notable time: The godfather of empiric psychology William James already stated that personality would stabilize with age and is set like a plaster at the age of 30 (James, 1985). Since these first deliberations much advancement has been made in the empirical study of personality traits:

Firstly it is important to clarify what we actually mean when we talk about personality. While in our day to day life we find ourselves referring to someone as friendly or serene talking about someone personality, psychological research has found its own way of categorizing personality traits. One of the most established models for personality in psychology is the BIG-5 model (Ferguson, 2010), which has been improved over the last century. It divides an individuums into five structurally independent traits: extraversion, openness, conscientioiusness, agreeableness and neuroticism. Many questionnaires of different length have been created to assess these dimenesions and shown to provide reliably measures.

Furthermore research on the development of personality traits befits from large panel studies. These are superior to purely cross sectional studies, as they assess individuals multiple times and allow us to better understand the individual development. One of these panel studies is the German Socio Economic Panel Study (GSOEP) (Panel, 2022) a representative study of Germans that is conducted since the 90s.

The focal paper of this research project is a study by Lucas and Donnellan (2011) who conducted their analysis on the development personality traits on the GSOEP dataset. Their goal was to identify trends of change and stability in the BIG-5 personality traits across the life span. Previous research had produced mixed results, as numerous research suggested a peak in differential stability of the BIG-5 at the age of 30 (McCrae & Costa, 2003; Terracciano, Costa Jr, & McCrae, 2006) ). However there have been also reports suggesting that it peaks not until 50 (Ardelt, 2000). By using the personality assessments of the BIG-5, which at that time included two waves in 2005 and 2009, Lucas and Donnellan were able to provide further insight. Firstly they were able to determine an increase in the differential stability during the transition from adolescence to age 30 or 40. However the differential stability was still increasing after that point and only peaking at ages 60 and 70. As a novel finding (since they were one of the few research groups to also include subjects above 70 years of age) they were able to observe a radical decline of differential stability from the age 70s.

Generally their findings seem to support the body of research that the personality structure crystallizes for a great part at the ages 30 to 40 but then still sees a consistent tiny increase until the 60s and 70s. The investigation of subjects beyond 70 years of age suggests the notion of an inverted U-shape pattern for differential stability in personality, which has already been suggested by Ardelt (2000).

## Research Question

This research projects aims to extend and improve the analysis by Lucas and Donnellan in two ways: Firstly it is possible to draw from more time points for the analysis as the BIG-5 were assessed in 2005, 2009 and additionally in 2012/2013, 2017, 2019. As Lucas and Donellan also discuss two wave designs are limited in how they can inform you about longitudinal change. These criticism of two wave design goes back to Rogosa and Saner (1995) who described that individual change can only be linear in these study designs and it remains to debate if this is adequate.

Secondly major advancements in the statistical analysis of longitudinal research have been made: While Lucas and Donnell provide an impressive proof of measurement invariance between the age groups (that this research project may not provide) continuous time structural equation models have been introduced (Driver, Oud, & Voelkle, 2017) and made accessible in R. These provide many advantages, as they allow for a more realistic representation of time as being continuous rather than discrete. Furthermore, they allow dynamic models to incorporate complex effects like autoregressive coefficients, moving averages etc..

The current research project will only focus on the trait conscientiousness to investigate differential stability across the lifespan.

## Method

As already stated above this anlaysis will focus on setting up a continuous time structrual equation model to investigate the differential stability of conscientiousness across the life span.

Before the author was able to setup and compute the model in R, a few deliberations/choices had to be made *Auto effects:* First and foremost we are interested in the stability of conscientiousness over the life span. This reflects in the auto effect of the model, which can be included by letting the model freely estimate the effect of Y_0 on Y_1 i.e in the drift matrix. the effect of time point zero onto time point one. For this research question we have to go one step further and compute the auto-effect (drift coefficient) dependent on the age of the person. We expect that the stability of the process increases when people get older. We can do so by changing the *model$pars$indvarying[3]* to *TRUE*.

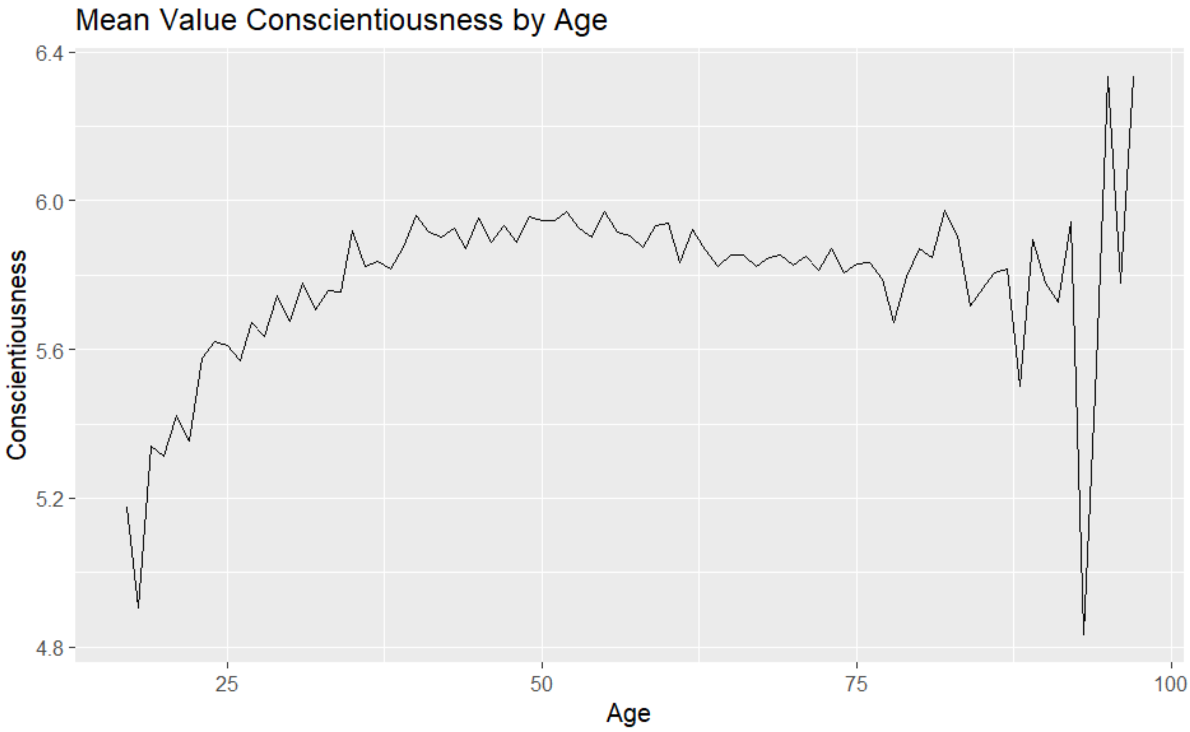
*Accounting for unobserved heterogeneity:* Unobserved heterogenity refers to stable differences in the trait we are investigating. "Fitting a model that fails to account for it will result in parameter estimates that will not reflect the processes of individual subjects, but will mix between and within-person information". In our example it is very reasonable that there are stable differences between our subjects in the conscientiousness score. In Ctsem we can account for unobserved heterogeneity by setting the model attribute *TRAITVAR = AUTO*

*Positioning of time:* We are confronted with the decision which time point we want to choose as the time independent predictor. For example we could choose whether to use the first measurement for each person as a point of reference or we could compute the mean age for all measument occasions and use this as a time independent predictor. For the author it seemed logical to use the age of the participant at the first measurement occasion as the time independent predictor, since we are interested in how the auto regression changes with an increasing age.

*Linear and quadratic predictors:* As Lucas and Donnellan suggests the stability of conscientiousness should increase until 30/40 years of age and then remain stable until the 70 when it starts decreasing again. Thus we may rather expect an asymptotic function for our auto effect, that reaches sort of a plateau with higher age. Both, a model with a linear and a linear + quadratic factor will be computed and compared later

*Standardization of the predictor:* When running the *ctStanFit* function, many problems with the quadratic factor were encountered, as the function would never finish the optimization step. This might be due to large values in the quadratic time independent predictor, so I chose to standardize both the linear and the quadratic time independent predictor.

## Results & Discussion




The figure above shows the aggregated means for conscientiousness across across all participants and waves to illustrate the development of conscientiousness over the lifespan. Although this aggregation is neglecting the longitudinal design that our data contains, it already nicely shows the expected development in conscientiousness until the 30s and 40s (to be more precise a rise in the trait) and then a very stable process until the age 60/70. After 70 years old there are not so many participants anymore, thus the random pattern.

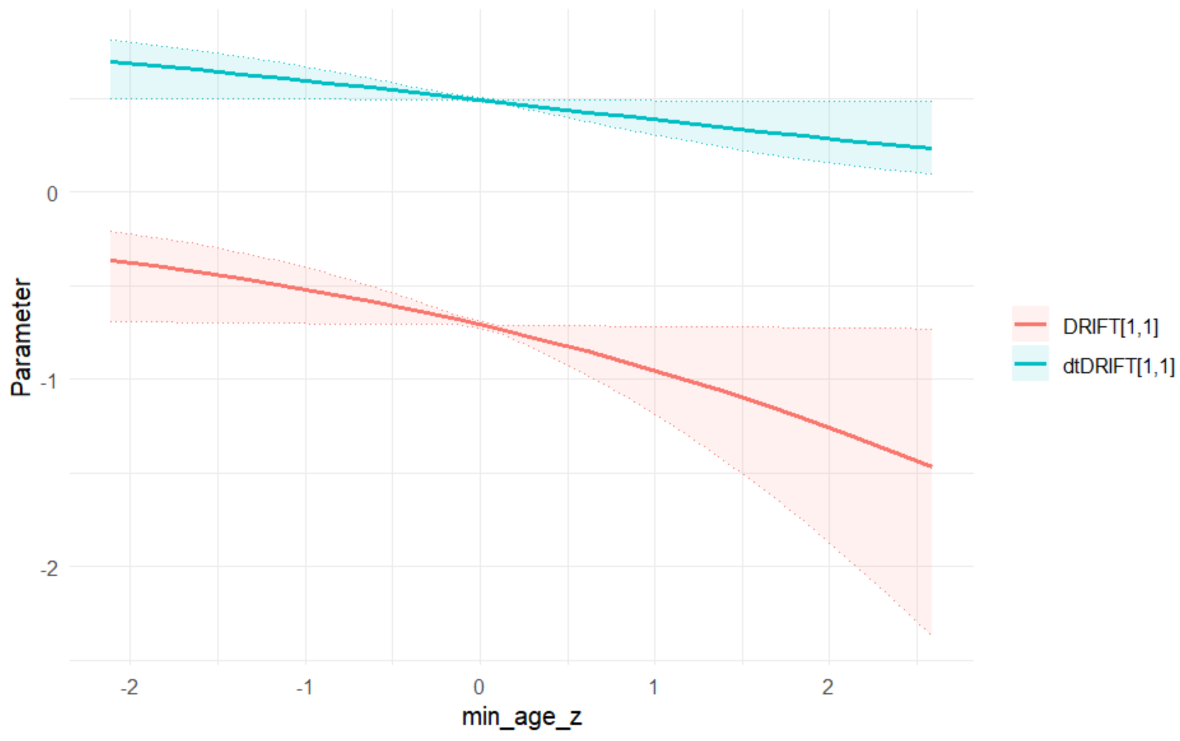
We translate our hypothesis into a continuous time structural equation model we get two models: one with only a linear time independent predictor and one with a linear and a quadratic one.

### Model comparison

We can compare the fit of the two models using a Chi-Square test on the (2log)likelihood of the models. This Chi-Square test returned to be highly significant, indicating that the more complex model (the model including the linear and quadratic predictor) fits the data significantly better. At this point it may be mentioned that the Chi-Square test may not be the most appropriate test to compare models, as we are dealing with a very large sample size (almost 5000 participants). With very large sample sizes, the Chi-Square test will very very likely be significant when adding new parameters.

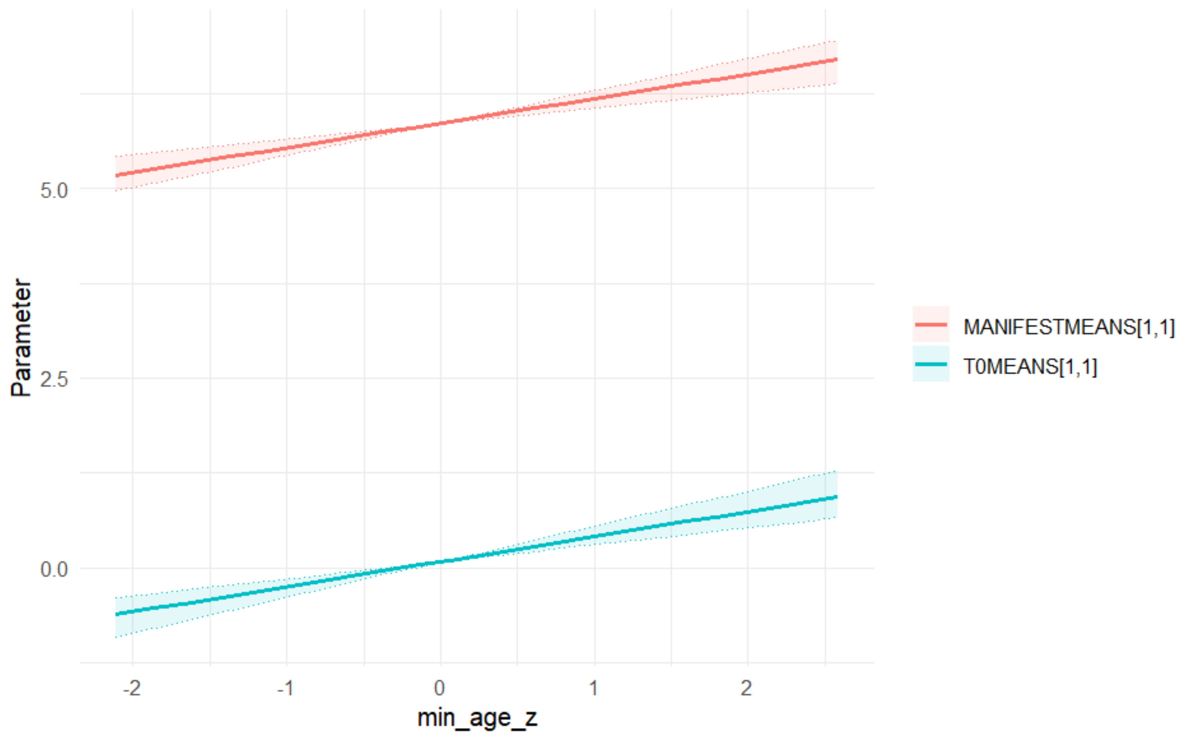
### Model interpretation

The most interesting coefficient of our model is the drift coefficient which estimates the stability of our latent variable over time. We can plot this coefficient in dependency of our predictor age in the figure below. We get two curves one for the continuous time




(DRIFT) predictor and one for discrete time. (dtDRIFT) These can be transformed into each other, but for interpretation it is easier to look at the discrete drift coefficient. The drift coefficent gets smaller with larger (z-)values of our age. The closer the drift coefficient to 0 the more stable is a process. This is thus in-line with the hypothesis that the differential stability increases with age. It is also not a linear function, as we can see that the extent to which the coefficient diminishes declines. However it is hard at this point to interpret if this change adequately represents the extent to which the differential stability increases. To do so one would need to plot a function for the autoregression (maybe for different discrete age values) and interpret this. However the author was not able to achieve this.

In the next plot we will look at the mean of conscientiousness over the lifespan. This plot shows us that we see a linear increase in the conscientiousness over the life span




until high age. This does not fit the data descriptively very well, as we saw in the first figure that our parameter shows rather few increase after the age of 40. It remains open here, why the model is not abe to capture that trajectory, although a quadratic factor for age was included.

## Conclusion

As what may be evident from the results session, the model shows kind of the hypothesized change differential stability of conscientiousness over the life span. However it remains open whether this really reflects the data or if there have been mistakes when specifying the model. An indicaton for a misspecification (or missing specification) is that the development of the mean of conscientiousness does not really reflect the actual data. The author attempted to resolve this issue by including a measurement model, but the parameters seemed to make even less sense. Another possible reason might be that the accounting for unobserved heterogeneity did not work. In the documentation for ctSEM the authors describe that the TRAITVAR = "auto" is only for ctSEM of omx type and not stan. However the author of this paper was not able to come up with a solution to this. as Driver et al. (2017) state though, not accounting for unobserved heterogeneity may lead to completely different results in their example on Leisure and Happiness.

To conclude and maybe shift again to a bit more of the positive side of the analysis, the author thinks he got somewhat close to the "true model" that is underlying this process. CtSEM is a very powerful tool in analyzing longitudinal data but with great power does not only come great responsibility but in this case also great complexity. Many of the parameters we obtain from the model are very abstract and it is hard to reason what they inform us about. For completeness a list of many model parameters can be found in the appendix. But while this study purely observed the development of conscientiousness over the life span, it would be super interesting to also take a look at what actually causes the development and the increase in differential stability that we see. Some theories that try to explain this reason that with growing age our environment becomes more and more stable and thus we see less change in personality traits like conscientiousness. Or is it the other way around and we choose more stable environments because our personality stabilizes? Only longitudinal studies and their associated methods will enable us to answer these questions on causality.

References

Ardelt, M. (2000). Still stable after all these years? personality stability theory revisited. *Social Psychology Quarterly,* 392–405.

Driver, C. C., Oud, J. H., & Voelkle, M. C. (2017). Continuous time structural equation modeling with r package ctsem. *Journal of Statistical Software, 77,* 1–35.

Ferguson, C. J. (2010). A meta-analysis of normal and disordered personality across the life span. *Journal of personality and social psychology, 98*(4), 659.

James, W. (1985). *Psychology: Briefer course (works of william james, vol. 12).* Cambridge: Harvard University Press.(Original publicado en 1892).

Lucas, R. E., & Donnellan, M. B. (2011). Personality development across the life span: longitudinal analyses with a national sample from germany. *Journal of personality and social psychology, 101*(4), 847.

McCrae, R. R., & Costa, P. T. (2003). *Personality in adulthood: A five-factor theory perspective.* Guilford Press.

Panel, S.-E. (2022). Data for years 1984–2020. *SOEP-Core v37, EU Edition, 10,* .

Rogosa, D., & Saner, H. (1995). Longitudinal data analysis examples with random coefficient models. *Journal of educational and behavioral statistics, 20*(2), 149–170.

Terracciano, A., Costa Jr, P. T., & McCrae, R. R. (2006). Personality plasticity after age 30. *Personality and social psychology bulletin, 32*(8), 999–1009.

## Declaration of Independence

I hereby guarantee that I have written this essay autonomously and have not used any other than the provided auxilliary means and references.

Berlin, 22. July 2023

# Appendix

| | mean <dbl> | sd <dbl> | 2.5% <dbl> | 50% <dbl> | 97.5% <dbl> | z <dbl> |
|---|---|---|---|---|---|---|
| drift_eta1__T0m_eta1 | 0.0896 | 0.0364 | 0.0183 | 0.0901 | 0.1602 | 2.4595 |
| mm_consc__T0m_eta1 | -0.0722 | 0.0196 | -0.1090 | -0.0731 | -0.0343 | -3.6922 |
| mm_consc__drift_eta1 | -0.6616 | 0.0389 | -0.7283 | -0.6633 | -0.5810 | -17.0232 |

| | mean <dbl> | sd <dbl> | 2.5% <dbl> | 50% <dbl> | 97.5% <dbl> | z <dbl> |
|---|---|---|---|---|---|---|
| tip_min_age_z_T0m_eta1 | 0.3336 | 0.0570 | 0.2207 | 0.3315 | 0.4428 | 5.8551 |
| tip_min_age_z_diff_eta1 | 0.0347 | 0.0448 | -0.0531 | 0.0345 | 0.1235 | 0.7735 |
| tip_min_age_z_drift_eta1 | -0.2019 | 0.1083 | -0.4052 | -0.2004 | 0.0164 | -1.8644 |
| tip_min_age_z_mm_consc | 0.3230 | 0.0581 | 0.2125 | 0.3249 | 0.4345 | 5.5637 |
| tip_min_agesq_z_T0m_eta1 | -0.2479 | 0.0568 | -0.3548 | -0.2470 | -0.1351 | -4.3620 |
| tip_min_agesq_z_diff_eta1 | 0.0052 | 0.0484 | -0.0914 | 0.0044 | 0.0978 | 0.1079 |
| tip_min_agesq_z_drift_eta1 | 0.1731 | 0.1159 | -0.0537 | 0.1714 | 0.4086 | 1.4936 |
| tip_min_agesq_z_mm_consc | -0.2962 | 0.0576 | -0.4061 | -0.2975 | -0.1823 | -5.1397 |

| | matrix <chr> | row <int> | col <int> | Mean <dbl> | sd <dbl> | 2.5% <dbl> | 50% <dbl> | 97.5% <dbl> |
|---|---|---|---|---|---|---|---|---|
| 1 | T0MEANS | 1 | 1 | 0.0820 | 0.0098 | 0.0638 | 0.0819 | 0.1015 |
| 2 | LAMBDA | 1 | 1 | 1.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 |
| 3 | DRIFT | 1 | 1 | -0.7102 | 0.0331 | -0.7754 | -0.7099 | -0.6467 |
| 5 | MANIFESTMEANS | 1 | 1 | 5.8576 | 0.0100 | 5.8385 | 5.8578 | 5.8764 |
| 6 | CINT | 1 | 1 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 8 | asymCINT | 1 | 1 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 9 | asymDIFFUSIONcov | 1 | 1 | 0.3498 | 0.0060 | 0.3383 | 0.3498 | 0.3617 |
| 10 | DIFFUSIONcov | 1 | 1 | 0.4965 | 0.0189 | 0.4605 | 0.4968 | 0.5330 |
| 11 | MANIFESTcov | 1 | 1 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| 12 | T0cov | 1 | 1 | 0.4087 | 0.0106 | 0.3889 | 0.4086 | 0.4300 |