IHF Bayerisches Staatsinstitut für Hochschulforschung und Hochschulplanung

Which study experiences can improve self-leadership in higher education graduates?

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Bavarian Graduate Survey

- **What is BAS**
  - **Annual large scale survey for past year graduates**
  - **BAS 2020:**
    - over 8000 participants
    - Year of graduation 2018/2019
    - 14 different universities
    - performed during Covid-19 pandemic

- **Surveyed variables BAS 2020:**
  - **Self-Leadership**
  - **Organizational support by university**
  - **Preparation for digitized working world**
  - **E-learning experience**
  - **Overall rating of studies**
  - **GPA**
  - **Field of study, university location**
  - **Year of graduation**
  - **Type of university (FH vs. Uni)**
  - **Details about occupation**
  - **Migration background**
  - **Demographics**

Self-leadership

„The self-influence process through which people achieve the self-direction and self-motivation to perform.“

- **Self-influence through diverse strategies:**
  - **Self-reward**
  - **Self-cueing**
  - **Self-goal setting**
  - **Identification of counter productive thought patterns**
- **Corresponds with <u>better affective responses</u> and <u>increased work performance</u>**

(Müller & Niessen, 2019; Steward et al. 2011)

Self-leadership in a large scale graduate survey

Zunächst interessieren wir uns dafür, wie Sie mit Zielen und Aufgaben umgehen.

Wenn Sie an Ihre verpflichtenden Tätigkeiten aber auch an Ihre Freizeitaktivitäten denken, inwiefern treffen folgende Aussagen auf Sie zu?

	1 stimme überhaupt nicht zu	2	3	4	5 stimme vollkommen zu
Ich lege konkrete Ziele für meine eigene Leistung fest.	○	○	○	○	○
Ich lege Wert darauf, zu verfolgen, wie gut ich mich bei der Arbeit mache.	○	○	○	○	○
Ich arbeite auf bestimmte Ziele hin, die ich mir selbst gesetzt habe.	○	○	○	○	○
Ich stelle mir vor, dass ich eine Aufgabe erfolgreich ausführe, bevor ich sie erledige.	○	○	○	○	○
Manchmal stelle ich mir eine erfolgreiche Leistung vor, bevor ich eine tatsächlich Aufgabe erledige.	○	○	○	○	○
Wenn ich eine Aufgabe erfolgreich abgeschlossen habe, belohne ich mich oft mit etwas, das mir gefällt.	○	○	○	○	○
Manchmal führe ich Selbstgespräche (laut oder in meinem Kopf), um schwierige Situationen durchzuarbeiten.	○	○	○	○	○
Ich versuche, die Richtigkeit meiner eigenen Überzeugungen über Situationen, mit denen ich Probleme habe, mental zu bewerten.	○	○	○	○	○
Ich denke über meine eigenen Überzeugungen und Annahmen nach, wann immer ich mich in einer schwierigen Situation befinde.	○	○	○	○	○

(Houghton et al., 2012)

Methodological assumptions for survey scales

- **Aim: find variable behind questionnaire items**
- **Problems with measurement:**
  - **Items may differ in agreeableness**
  - **Items may differ in informative value**
  - **Effect of extreme responses**
  - **Effect of neutral responses**

→ **Make assumptions about items and item categories**

- **Problem with assumptions:**
  - **Assumptions may not hold for data set**

  → **If assumptions don't hold: questionnaire may not measure valid variable**

  → **If assumptions do hold: indication for questionnaire's validity**

What if the assumptions do not hold for the data?

- **One possible problem: Differential Item Functioning (DIF)**
  - → **Items may work differently for different subgroups**
  - → **Results are inaccurate because group affiliation not considered**

Idea:

→ **split sample up in groups in which items work equally for all group members**

→ **find groups for which our assumptions hold**

- **But: what if we don't know in what groups to split the data up?**

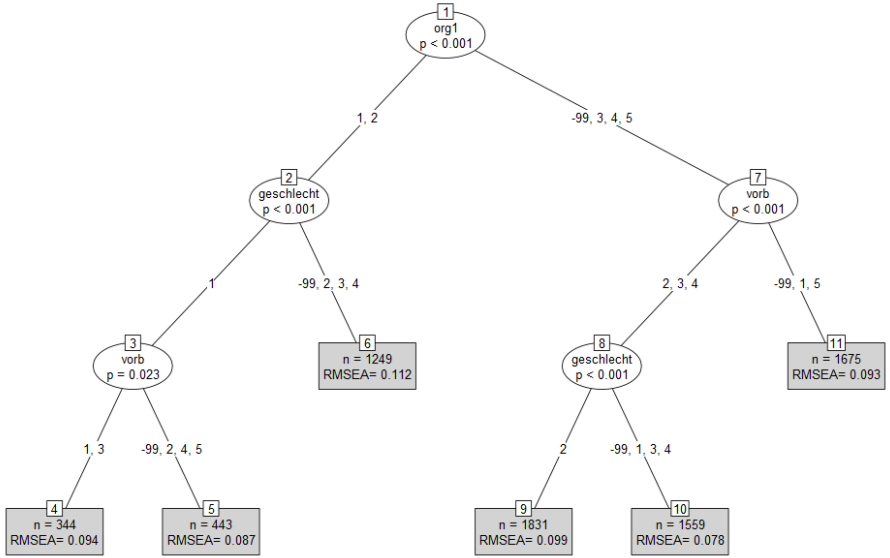
Goals

1. Formulate assumptions to deal with common measurement problems
2. Create method that automatically searches for subgroups in which
    1. items work in the same way for every group member
    2. assumptions hold for the data

Tree-based machine learning

- **Data driven method to find relevant subgroups**

1. **Recursively partition data set to control for DIF *(tree)***
2. **Repeat process with variation at every iteration *(forest)***
3. **Save information about relevant subgroups**



Survey Scale Forest

- **Application: Assumptions fit for men with GPA over 2.0**

Decision Rule	Tree	Node	n	RMSEA	lower C.I. RMSEA	upper C.I. RMSEA	p-value χ^2-test
$R_1 := \{\{\texttt{p\_mig\_selb} = 0\} \cap \{\texttt{geschlecht} \in \{1,3,4\}\} \cap \{\texttt{vorb} \in \{1,5\}\} \cap \{\texttt{s\_note} > 2\}\}$	137	8	258	0	0	0.032	0.812
$R_2 := \{\{\texttt{geschlecht} \in \{1,3,4\} \cap \{\texttt{s\_note} > 2\} \cap \{\texttt{vorb} \in \{1,5\}\}\}$	118	9	290	0.017	0	0.052	0.351
$R_3 := \{\{\texttt{vorb} \in \{1,5\}\} \cap \{\texttt{geschlecht} \in \{1,3,-99\}\} \cap \{\texttt{alter} \leq 27\}\}$	125	7	264	0.037	0	0.066	0.115
$R_4 := \{\{\texttt{geschlecht} \in \{1,3,4\}\} \cap \{\texttt{s\_abs} \in \{-99,1\}\} \cap \{\texttt{vorb} \in \{1,5\}\}\}$	187	8	399	0.039	0.012	0.061	0.032
$R_5 := \{\{\texttt{s\_bew} \in \{-99,2,3,4,5\}\} \cap \{\{\texttt{org1} \in \{-99,1,2\}\} \cap \{\texttt{geschlecht} = 1\}\}$	33	7	271	0.040	0	0.068	0.077
$R_6 := \{\{\texttt{p\_mig\_selb} = 0\} \cap \{\texttt{vorb} \in \{1,5\}\}\{\texttt{elearn} \in \{-99,1,5\}\}\}$	289	7	430	0.046	0.024	0.066	0.005
$R_7 := \{\{\texttt{geschlecht} \in \{1,3,4\}\} \cap \{\texttt{vorb} \in \{1,5\}\} \cap \{\texttt{alter} \leq 27\}\}$	294	8	273	0.047	0.013	0.073	0.033
$R_8 := \{\{\texttt{org1} \in \{1,2\}\} \cap \{\texttt{ws\_jn} \in \{2,3\}\} \cap \{\texttt{geschlecht} \in \{1,3,4\}\}\}$	188	5	324	0.055	0.031	0.078	0.003
$R_9 := \{\{\texttt{geschlecht} \in \{1,3,4\}\} \cap \{\texttt{s\_prom} \in \{-99,2,3\}\} \cap \{\texttt{s\_komp1} = 1\}\}$	185	14	313	0.056	0.032	0.079	0.003
$R_{10} := \{\{\texttt{p\_andstaatsang} = 0\} \cap \{\texttt{hsart} = 2\} \cap \{\texttt{geschlecht} \in \{1,3,4\}\} \cap \{\texttt{s\_komp1} \in \{2,3\}\} \cap \{\texttt{org1} \in \{1,2,5\}\}\}$	161	19	386	0.056	0.036	0.077	0.001
$R_{11} := \{\{\texttt{s\_komp1} \in \{-99,2,3\}\} \cap \{\texttt{geschlecht} = 1\} \cap \{\texttt{org1} \in \{1,2\}\}\}$	192	4	484	0.057	0.040	0.075	3.33e-5
$R_{12} := \{\{\texttt{geschlecht} \in \{1,3,4\} \cap \{\texttt{s\_bew1} \in \{-99,2,3,4\}\} \cap \{\texttt{s\_abs} = 1\}\}$	160	15	1425	0.058	0.049	0.067	0
$R_{13} := \{\{\texttt{geschlecht} \in \{1,3,4\} \cap \{\texttt{vorb} \in \{1,5\}\}\}$	sev.	sev.	615	0.060	0.045	0.075	2.34e-7

Conclusion

- **Combination of psychometrics and machine learning**

→ **Possible to find subgroups for which assumptions regarding a survey scale are likely to be valid**

- **Machine learning methods to be considered as tools to produce insights with underexploited data**

References

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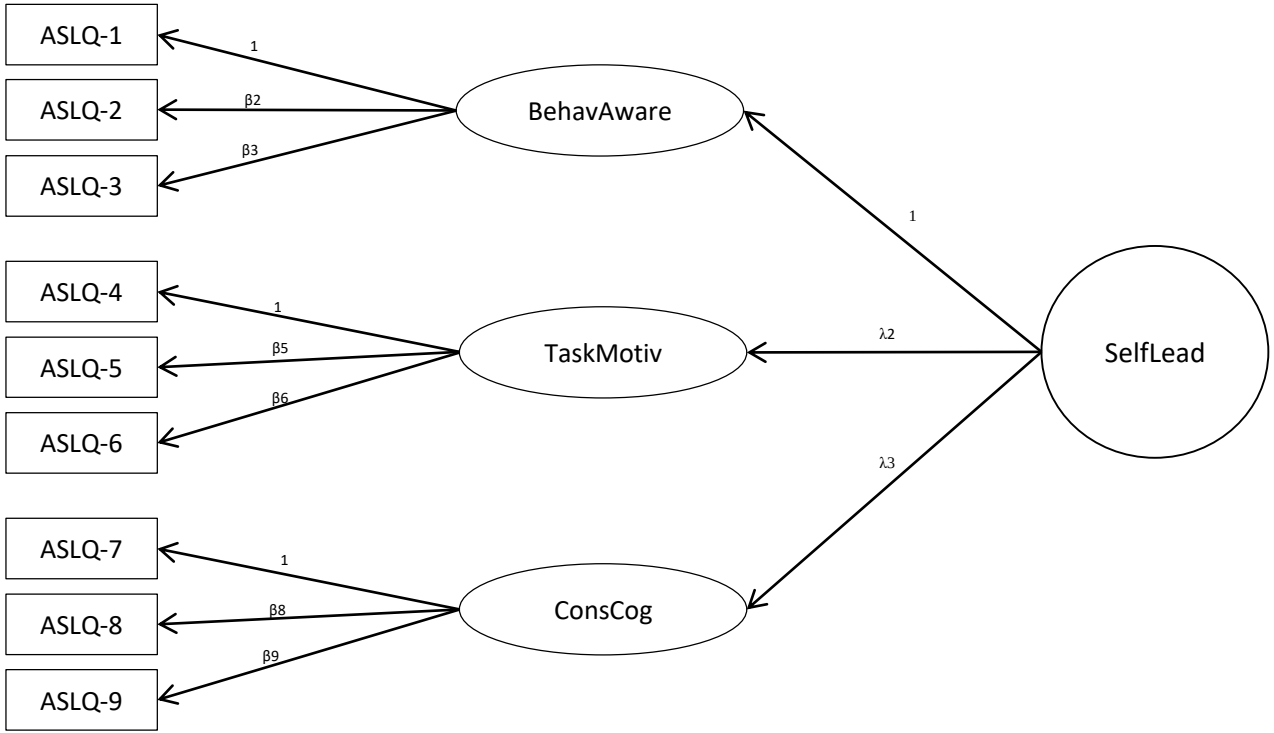
Appendix

München, 17.09.2021

Measurement Model



How do we measure self-leadership?

- **Use of short survey scales → No self-leadership variable**
- **Aim: Find latent ability behind questionnaire**

- **Measurement problems:**
  - **Items may have different difficulties**
  - **Items may not discriminate equally well**
  - **Within-item-difficulty differences may not be equal**

- **Solution: Item Response Theory model**

$$P(Y_i \geq k_i \mid \boldsymbol{\xi}) = \Phi(\boldsymbol{\beta}_i' \boldsymbol{\xi} - \alpha_{ik}).$$

Ability (Ability) — Discrimination — Difficulty

(Samejima et al., 1969)

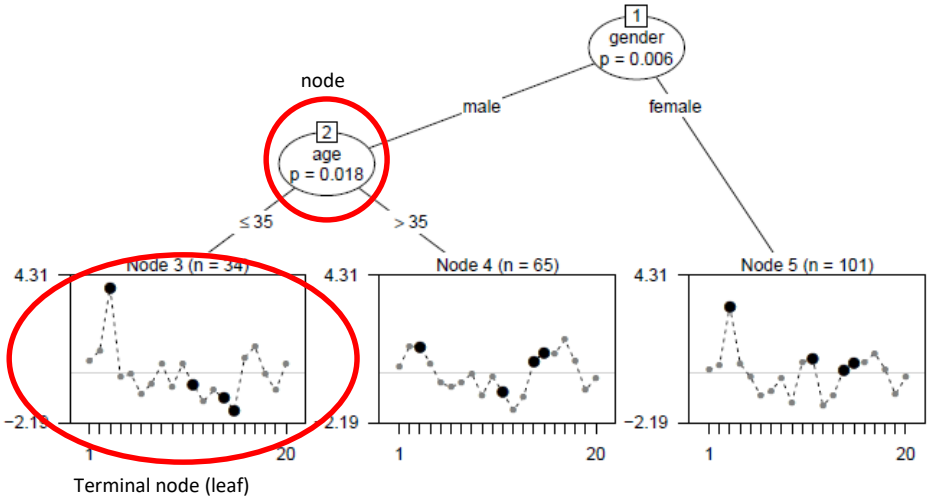
Model Based Recursive Partitioning (DIF)

- Data-driven method to detect DIF
- Recursive partitioning of sample to minimize parameter instability
- Model's parameter estimates saved in terminal nodes

→ MOB builds *decision trees*

- Problem of MOB: single tree very vulnerable to changes in data

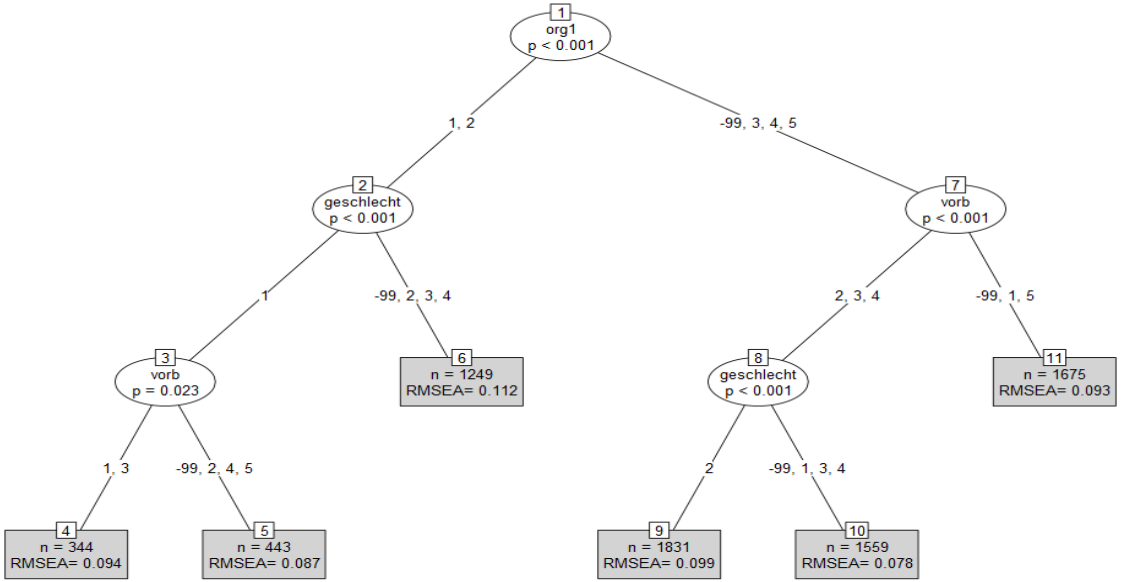
Example: DIF with regard to item difficulties



(Strobl et al., 2015)

Survey Scale Tree

- **MOB for multidimensional IRT models**
- **Application: Parameter instability due to sex and attitude towards *preparation for digitized work* and *organizational support* of university during covid**



Ensemble learning

- **Ensemble of many decision trees *(forest)***

- **Every tree built differently**
  - ***Random split selection:*** **selection of random subsample of partitioning variables at every tree node → split at partitioning variable with greatest parameter instability → tree diversity**

→ **Results cumulated across all trees**

- **Great performance when high number of partitioning variables**

(Kern et al., 2019)