SurveyMotion: What can we learn from sensor data about respondents' actions in mobile web surveys?

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Introduction I

- Mobile devices, such as smartphones, are increasingly used in self-administered web surveys.
- The reasons are twofold (Revilla et al., 2016):
  - *The number of smartphone owners has increased.*
  - *High-speed mobile Internet access has increased.*
- Smartphones allow to participate when-/wherever (Mavletova, 2013).
  - *No dependency on the situation/location.*

Introduction II

- Drawback: Mobile respondents are frequently distracted (Toninelli & Revilla, 2016).
- Zwarun and Hall (2014) differentiate between …
  - *environmental distractions (ED),*
  - *non-media multitasking (NMM),*
  - *and electronic-media multitasking (EMM).*

- EMM can be differentiated into multitasking on the same device or on different devices.

Introduction III

- EMM on the same device can be registered passively using paradata (Callegaro, 2013).
- Höhne et al. (2017), proposed the tool “SurveyFocus (SF)”.
  - *SF logs the in/activity of web survey pages.*
- Schlosser and Höhne (2017) show that EMM occurs for approx. 6% of smartphone respondents.
  - *Respondents leave the survey 1.2 times and for 21.7 sec.*
  - *They produce a higher amount of item-nonresponse.*

Sensor Data and SurveyMotion (SM) I

- A new way to observe respondents actions is to gather sensor data.
- Smartphones have sensors, such as accelerometers, to recognize respondents' actions.
  - *Gathering sensor data by means of JavaScript.*
- Hand and body movements spread to smartphone.
  - *Respondent-device link.*
  - *Differentiating respondents on the basis of their motions.*
  - *Possible detection of distractions and/or multitasking.*

Sensor Data and SurveyMotion (SM) II

- Movements occur as accelerations (a) on an x-, y-, and z-axis.
- International System unit for acceleration is m/s^2.
- The JavaScript tool SurveyMotion (SM)[1] gathers the total acceleration (TA):

$$TA = \sqrt{a_x^2 + a_y^2 + a_z^2}$$

[1] Höhne & Schlosser, under review

Sensor Data and SurveyMotion (SM) III

- SM uses an “application programming interface (API)”.
  - *DeviceMotionEvent*
- The API is accompanied by properties.
  - *.acceleration*
- The SM code can be implemented in the source code of web survey pages.
  - *For instance, as invisible, user-defined question.*
- SM operates on page level.
  - *TA data are stored together with the answers in the same dataset (see Schlosser, 2016).*

Sensor Data and SurveyMotion (SM) IV

ww3.unipark.de/uc/SurveyMotion

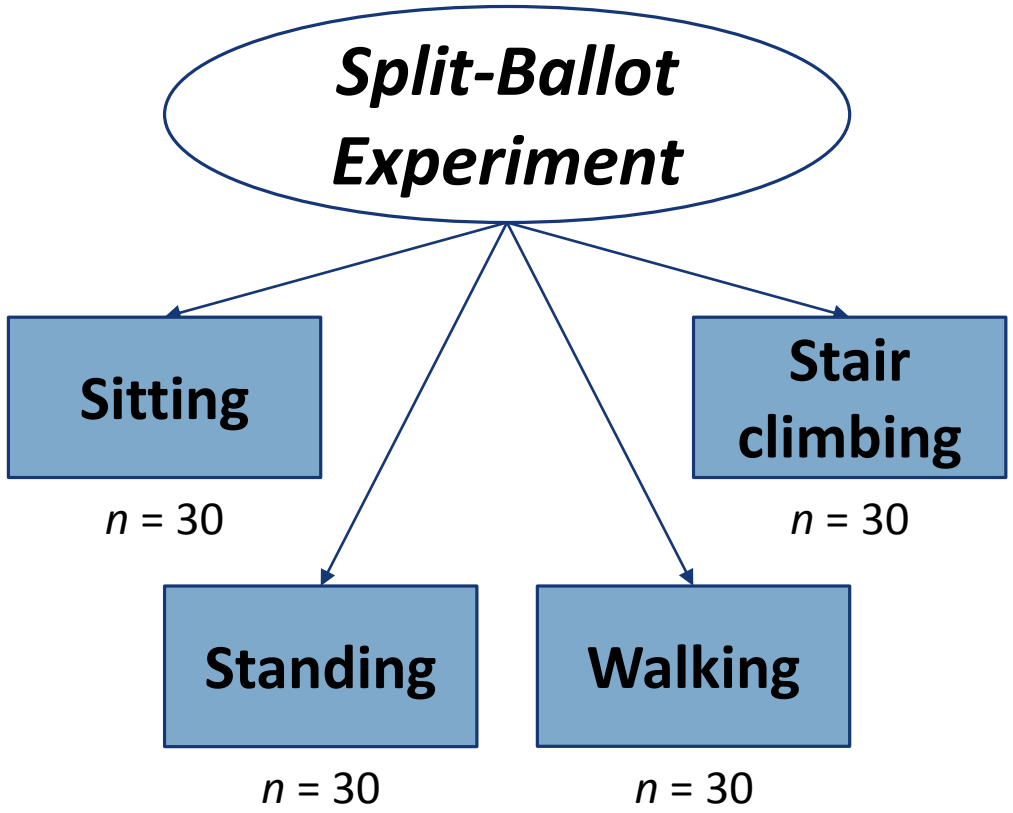
CC BY

Research Hypotheses

We expect that SM registers lower/higher TA values for respondents with a lower/higher motion level.

We expect the higher the motion level is, the higher the time to respond to the survey questions.

Methods: Study Design



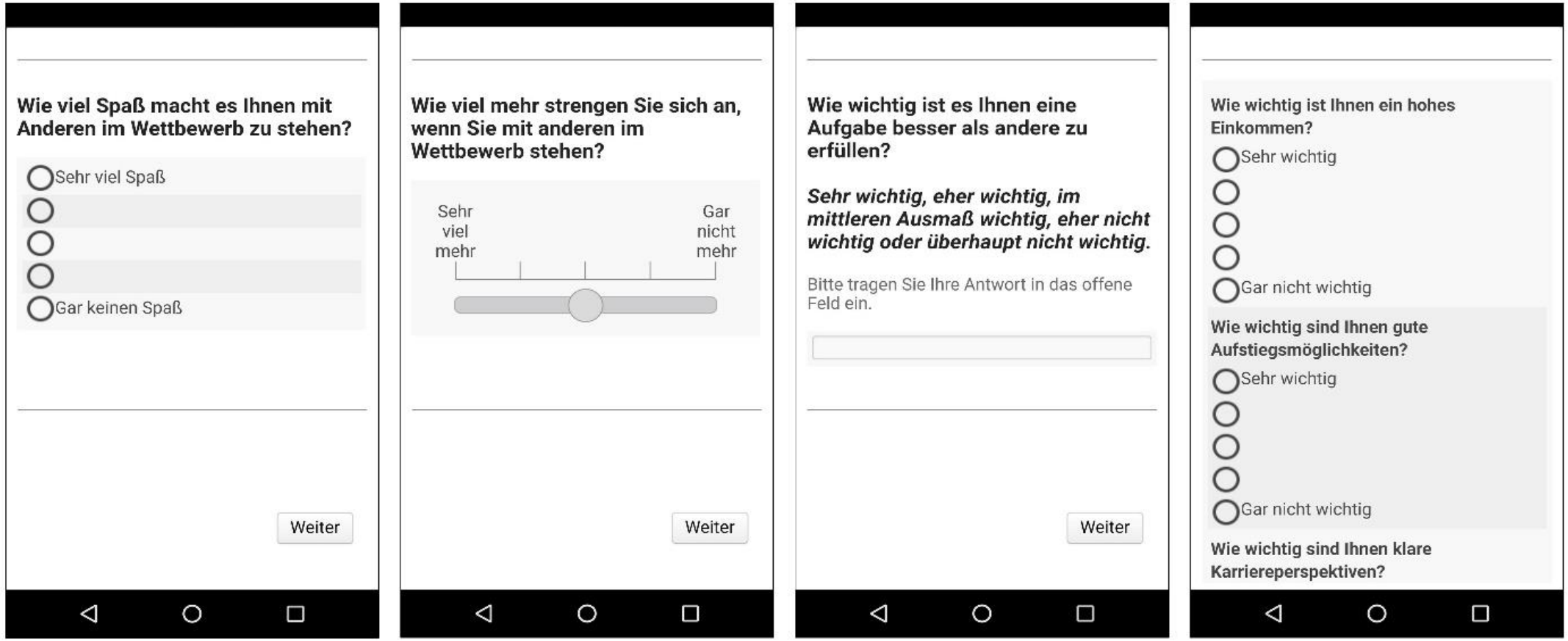
- The study was conducted at the University of Göttingen.
- We tested 3 single and 8 grid questions.
- One session lasted about 10 min.
- Respondents were debriefed.
- Exclusions:
  - *1 respondent had deactivated JavaScript.*
  - *2 respondents had difficulties with the Internet connection.*
  - *28 respondents had difficulties with the acquisition of SM → next slide!*

Methods: Excursion – Applicability of SM

- We conducted a usability study with n = 1,452 smartphone respondents.
- The study contains data from:
  - *29 smartphone manufacturers,*
  - *208 smartphone models,*
  - *13 Internet browsers.*
- Only for 2.8% (n = 41) of the respondents no acceleration could be gathered.
- Reasons: Inactivated JavaScript, device-/browser-related issues.

Schlosser & Höhne, forthcoming

Methods: Survey Questions



Note. Presentation order: (1) radio buttons, (2) horizontal slider, (3) answer field, and (4) grid presentation approach for smartphones, respectively. We used an optimized survey layout for smartphones to avoid horizontal scrolling.

Methods: Participants

The study was conducted in the research lab of the Center of Methods in Social Sciences in August 2017.

Final sample size:	N = 89 University students
Gender:	55% female
Age:	Mean = 24.5 (SD = 4.4)
Survey participation:	85% participated previously in a web survey
Internet usage:	96% use the Internet on a daily basis
Smartphone usage:	99% use the smartphone on a daily basis
Mother tongue:	93% German native speakers

Note. There are no significant differences between the groups regarding age, gender, survey participation, Internet usage, smartphone usage, and mother tongue.

Methods: Analytical Strategy I

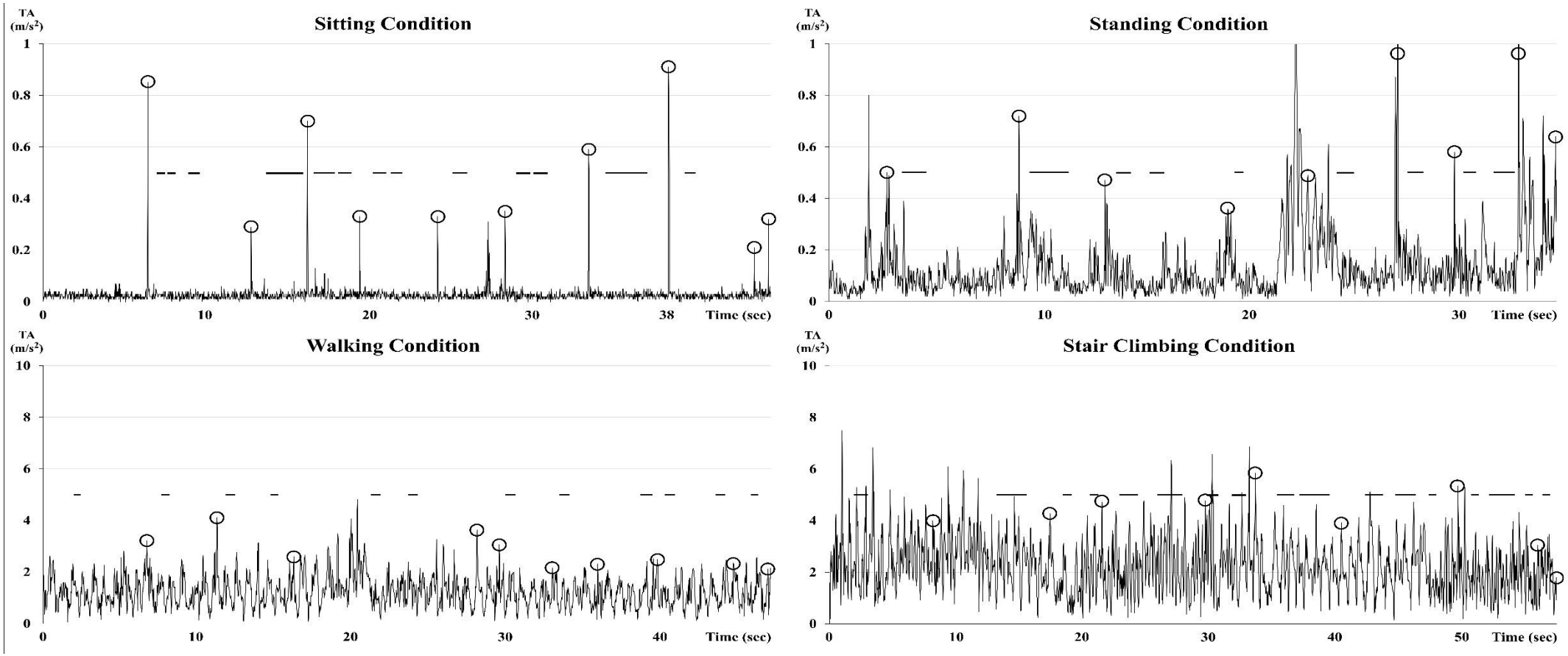
- SM data (total acceleration; TA):
  - *The average sampling rate was 53 Hertz.*
  - *Aggregation level: Averaged TA per person and page.*
  - *No exclusion of comparatively low/high values.*
- Response times:
  - *We replaced values beyond the lower/upper 5th percentile with the lower/upper 5th percentile (see Yan & Tourangeau, 2008).*
  - *No differences between log and non-log transformed data. We report the untreated solution.*
  - *No adjustment for baseline reading speed (Couper & Kreuter, 2013).*

Methods: Analytical Strategy II

- We compared the groups regarding …
  - *Electronic-media multitasking (EMM),*
  - *orientation changes,*
  - *scrolling count and time,*
  - *and screen taps.*

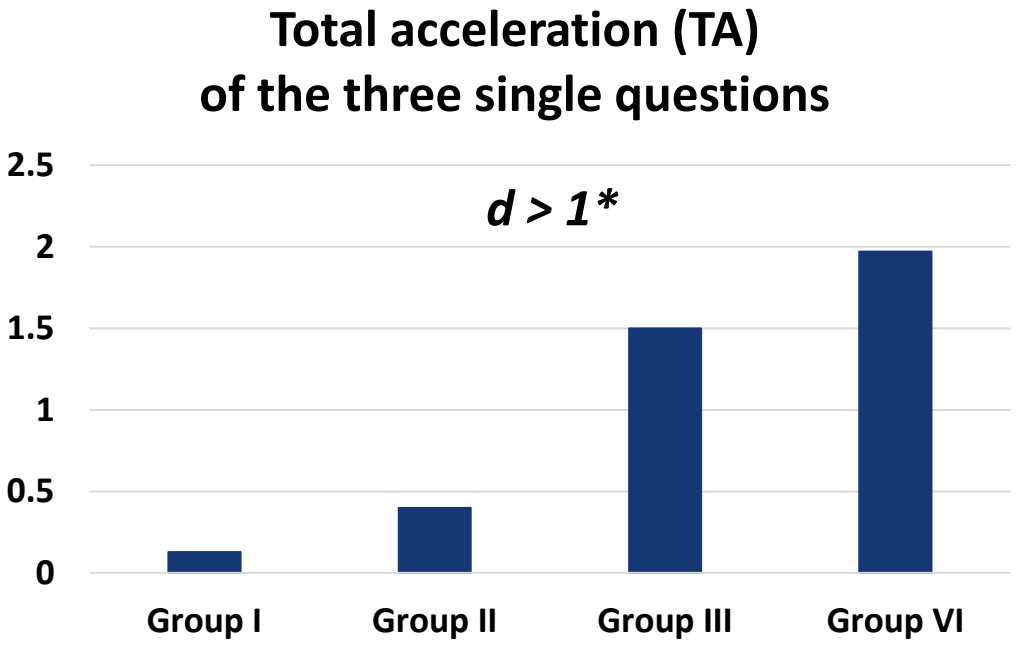
  → *No significant differences.*
- We conducted the analyses for the 3 single and 8 grid questions separately.
- We used R version 3.4.0 for the data preparation/analyses.

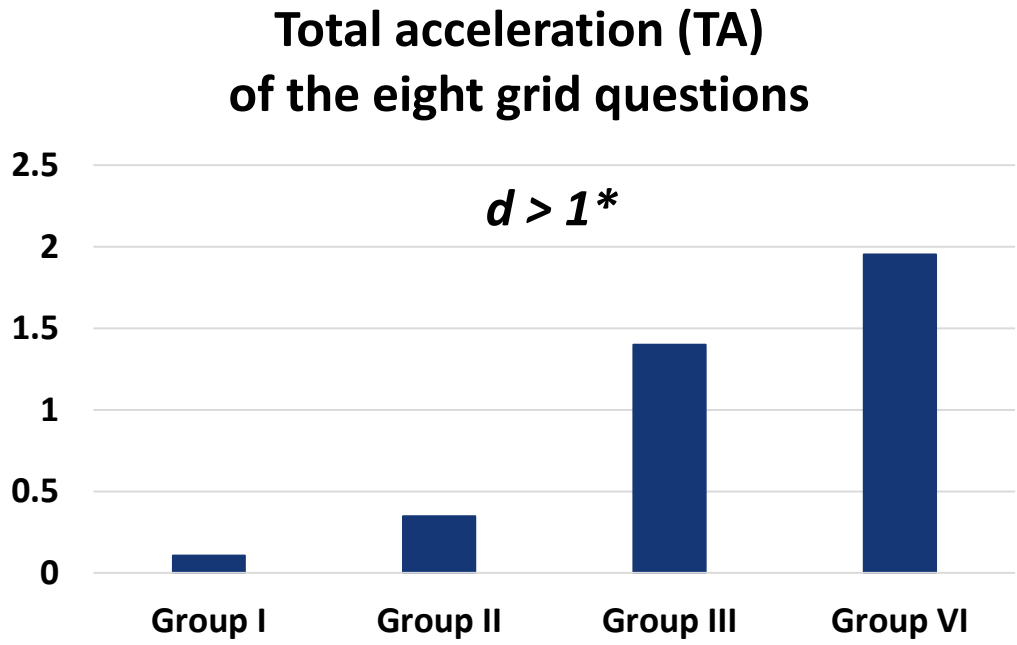
Results: Total Acceleration Data I



Note. We adapted the scale range of the y-axis to improve the visual comparability between the groups. Each line chart represents a different respondent. The circles indicate finger taps on the screen and the horizontal lines indicate scrolling events (the length of the lines is proportional to the scrolling time).

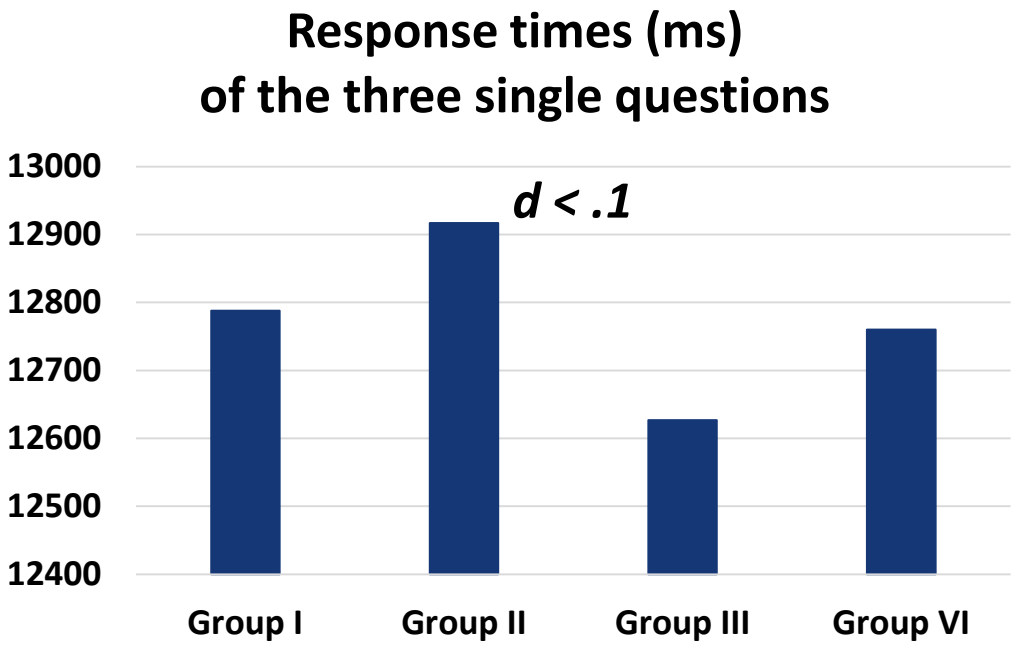
Results: Total Acceleration Data II

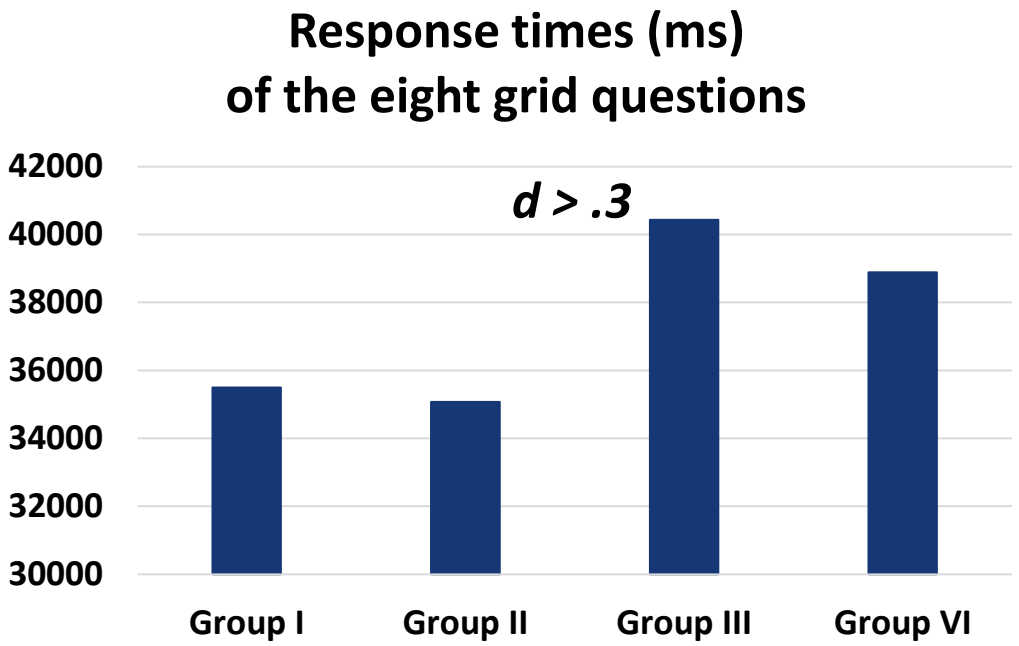




*Note. *p < .001. Cohen's d states the effect size. We conduced a F-test with Games-Howell post-hoc correction. Group I: sitting; Group II: standing; Group III: walking; Group IV: stair climbing.*

Results: Response Times





Note. Cohen's d states the effect size. We conduced a F-test with Bonferroni post-hoc correction. Group I: sitting; Group II: standing; Group III: walking; Group IV: stair climbing.

Limitations

- Connection to response times and data quality.
- Sample: University students.
  - *High smartphone usage.*
  - *Experienced respondents.*
- Limited number of questions.
- Limited ecological validity.
  - *Artificial lab setting.*

Summary & Conclusion

- Respondents' motion levels manifest themselves in TAs of smartphones.
  - *Respondent-device link.*
  - *Distinguishing respondents on the basis of motions.*
- Proper measurement of SM.
- Insights on the completion conditions.
  - *Distractions and/or multitasking.*
- Collecting sensor data is in its infancy.
  - *SM is just a very first step.*
  - *More future research is necessary.*

Future Research Perspectives

- Sensor data collection by means of apps and JavaScript.
- Determining the usefulness of further sensor data.
- Recognizing respondents' operation signatures (Mehrnezhad et al., 2016).
  - *Supplement to identification codes.*
- Personalized feedback in mobile web surveys.
- Obtaining informed consent.

Many thanks for your attention!

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Appendix: Survey Questions I

1) Single question with radio buttons

How much do you enjoy being in competition with other people? *1 very much – 5 not at all*

2) Single question with a horizontal slider

How much harder do you try when you compete with other people? *1 very much harder – 5 not at all harder*

3) Single question with an answer field

How important is it to you to accomplish a task better than other people? *1 very important, 2 fairly important, 3 somewhat important, 4 hardly important, 5 not at all important*

Appendix: Survey Questions II

4) Eight questions with grid presentation mode

How important is a job with a high income to you?

How important is a job with good promotion prospects to you?

How important is a job with clear career perspectives to you?

How important is a job that you can work autonomously on?

How important is a job that allows you to make use of your skills and talents?

How important is a job where you have responsibilities for specific tasks?

How important is a job that allows you to implement your own ideas?

How important is a job with regular working hours to you?

1 very important – 5 not at all important