# *The impact of motion instructions on smartphone acceleration, completion times, and response quality in a mobile web survey*

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# *Introduction I*

- Smartphones contain built-in sensors (e.g., accelerometer, compass, and GPS).
- Such sensors produce data that can be passively collected.
  - *These sensor data inform about physiological states (e.g., movements and speed).*
- Specifically, acceleration data seem to be useful for investigating completion behavior.
  - *"Respondent-device" link: Acceleration of smartphones informs about respondents' motions (Höhne & Schlosser, under review).*

# *Introduction II*

- There are only few studies using acceleration data for mobile web survey research.
  - *Little body of empirical evidence on possible applications.*
- This study pursues the following goals:
  - *Exploring the compliance of motion instructions.*
  - *Exploring the impact of motion levels on completion times and response quality.*

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# *Acceleration and SurveyMotion (SM)*

- SM by Höhne and Schlosser (under review) collects the acceleration of smartphones.
  - *It uses an application programming interface (API): "DeviceMotionEvent".*
  - *This API is accompanied by the ".acceleration" property.*
- The SM code can be implemented in the source code of web survey pages.
- SM gathers the total acceleration: $\mathbf{TA} = \sqrt{\mathbf{a_x^2} + \mathbf{a_y^2} + \mathbf{a_z^2}}$

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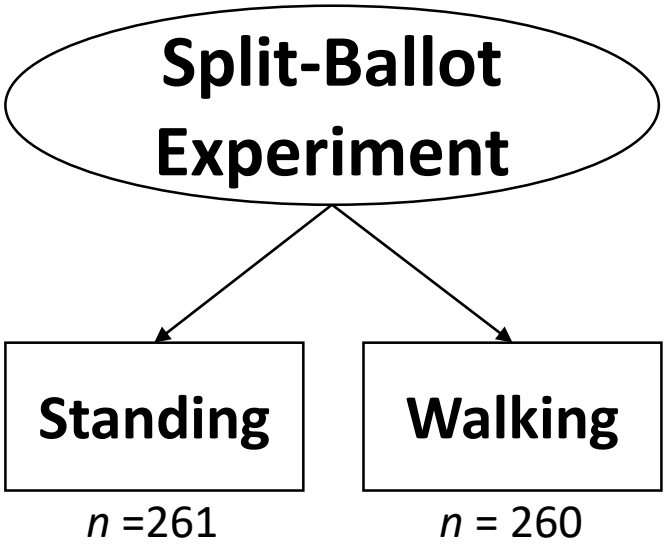
# *Study Design and Descriptions I*




- The study was conducted by the Netquest online fieldwork company in Spain.
- Field time: October 2 to 6, 2018
- One session lasted about 5 min.
- Respondent characteristics:

  *Age in years: Mean = 44 (SD = 12).*

  *Gender: 58% female.*
- Exclusions:

  *4 respondents had difficulties with the acquisition of acceleration.*

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# *Study Design and Description II*

- The study was placed right after a client survey.
  - *Country of interest was Spain.*
- The 5 test questions dealt with survey satisfaction.
  - *Single presentation with optimized survey design.*
- Only smartphone respondents were invited.
- Before the motion instruction respondents were asked about their position (e.g., sitting).
- After the 5 test questions respondents could come back to their previous position.

# *Analytical Strategy I*

- Respondents‘ compliance:
  - Respondents could refuse to follow the instruction by stating a reason.
- Total acceleration (see slide 3):
  - *Sampling rate: Acceleration was measured every 150 milliseconds.*
  - *Averaged total acceleration per person/page.*
  - *No exclusion of comparatively low/high values.*
- Completion times:
  - *Two-step outlier definition:*
    - *SurveyFocus (Höhne & Schlosser, 2018).*
    - *Completion time distribution-based definition by Hoaglin et al. (2000).*

# *Analytical Strategy II*

- Response quality indicators (response styles):
  - *Primacy effects,*
  - *recency effects,*
  - *error of central tendency,*
  - *extreme response style,*
  - *item non-response.*
- All analyzes were conducted with R version 3.5.1.

# *Results: Respondents' Compliance*

***Table 1. Percentage (frequency) of respondents following the instruction.***

| Standing *Low motion* | Walking *High motion* | Difference |
|---|---|---|
| 96.2% | 89.6% | 6.6%* |
| (251) | (233) | (18) |

***Note. *p < 0.05. We conducted chi-square and Fisher's exact tests.***

***Compliance differs across motion instructions.***

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# *Results: Acceleration Data*

***Table 2. Mean acceleration across the two motion groups.***

| | Standing | Walking | |
|---|---|---|---|
| Question | *Low motion* | *High motion* | Effect size |
| 1 | 0.30 | 0.60 | > 0.50* |
| 2 | 0.26 | 0.51 | > 0.50* |
| 3 | 0.26 | 0.46 | > 0.50* |
| 4 | 0.26 | 0.43 | > 0.50* |
| 5 | 0.26 | 0.42 | > 0.50* |
| *All* | *0.27* | *0.49* | *> 0.50** |

***Note. *p < 0.05. Effect size is based on Cohen's d. We conduced F-tests with Games-Howell post-hoc correction for unequal variances.***

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# *Results: Completion Times*

***Table 3. Mean completion times across the two motion groups.***

| Question | Standing *Low motion* | Walking *High motion* | Effect size |
|---|---|---|---|
| 1 | 9.82 | 9.58 | < 0.20 |
| 2 | 7.79 | 7.60 | < 0.20 |
| 3 | 7.70 | 8.02 | < 0.20 |
| 4 | 8.21 | 8.37 | < 0.20 |
| 5 | 8.44 | 8.19 | < 0.20 |
| *All* | *8.50* | *8.42* | *< 0.20* |

***Note. Effect size is based on Cohen's d. We conduced F-tests with Bonferroni post-hoc correction for equal variances.***

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# *Results: Response Quality*

***Table 4. Extent of response styles across the two motion groups.***

| Response styles | Standing *Low motion* | Walking *High motion* | Effect size |
|---|---|---|---|
| Primacy | 2.34 | 2.44 | < 0.20 |
| Recency | 0.51 | 0.41 | < 0.20 |
| Middle | 1.41 | 1.28 | < 0.20 |
| Extreme | 0.81 | 0.98 | < 0.20 |

***Note. Effect size is based on Cohen's d. We conduced F-tests with Bonferroni post-hoc correction for equal variances.***

***Item non-response did not occur for the 5 test questions.***

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# *Summary & Conclusion*

- Compliance differs across motion instructions.
- Respondents' motion levels manifest themselves in the acceleration of smartphones.
  - *Respondent-device link.*
  - *Distinguishing respondents on the basis of motions.*
- Proper measurement of acceleration.
- Insights on the completion conditions in mobile web surveys.
- Collecting acceleration data is in its infancy.

# *Limitations*

- Connection to completion times and response quality.
- Reasons for refusing participation in the task.
  - *Analyses are still pending.*
- Limited number of questions.
  - *Only single questions.*
- Question topic.
  - *Survey evaluations.*

# *Future Research Perspectives*

- Determining the usefulness of further sensor data.
- Personalized feedback in mobile web surveys.
- Recognizing respondents' operation signatures.
  - *Supplement to identification codes.*
- Predictive analyses.
  - *Using data from lab and field experiments.*

# Many thanks for your attention!

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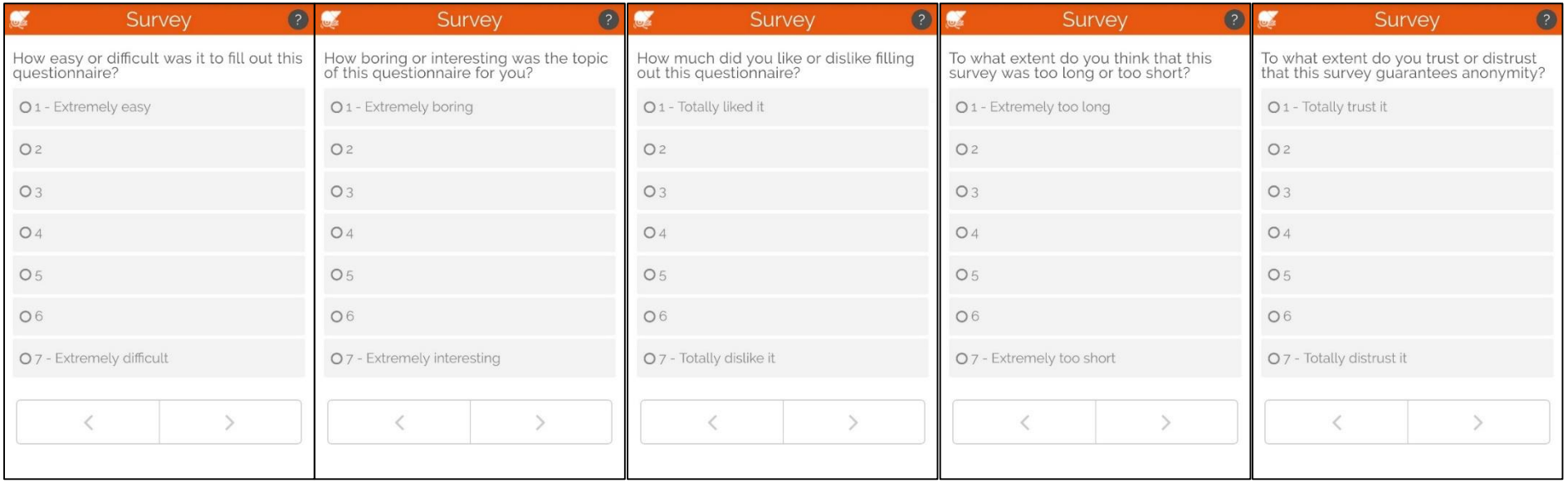
# *Appendix: Screenshots of Questions*

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