# Innovating mixed methods:
# Merits and limits of open voice answers from smartphone surveys

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# Digitalization and Research Potential

- Global digitalization tendency
  - *Increase in internet use* (Pew Research Center 2016, 2019a)
  - *Increase in smartphone ownership* (Pew Research Center 2019b)

- New opportunities for researching (social) reality
  - *People leave traces and produce data in digital spheres* (Struminskaya et al. 2020)

- Transformation of social and behavioral sciences
  - *New conferences: BigSurv and Mobile Apps and Sensors in Surveys*
  - *New journals: Frontiers in Big Data and Journal of Computational Social Science*

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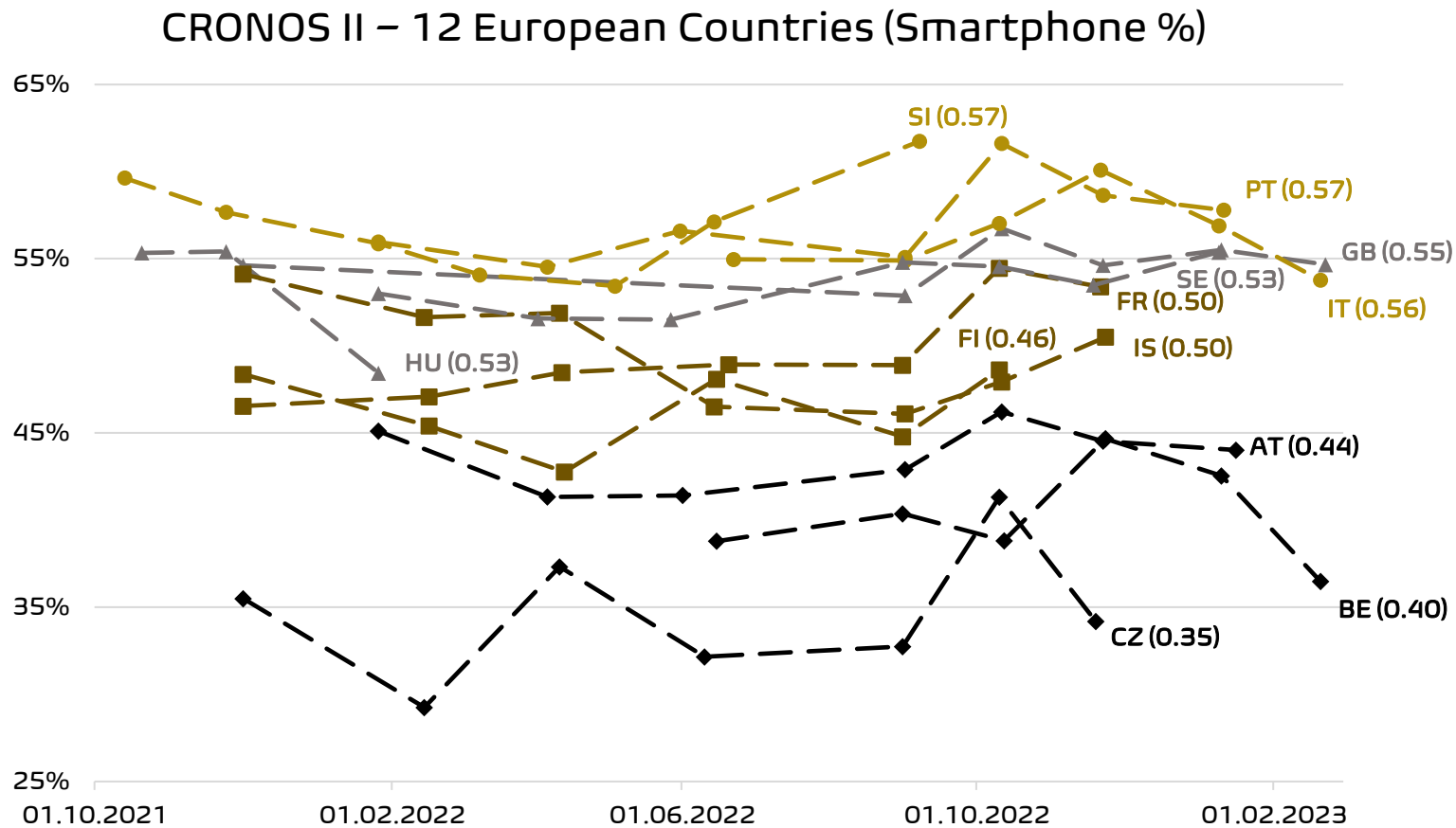
# Web Surveys and Digital Innovations

- Increase of web-based surveys
  - *Academia: ANES, CRONOS, EVS, GESIS Panel, GIP, HRS, LISS Panel etc.*
  - *Public/private sector: Facebook, Google, UNESCO, World Bank etc.*

- Increase of smartphone use in web-based surveys
  - *Mobile optimized layouts as default* (Revilla et al. 2016)

- Emergence of digital intersections
  - *Ex ante data linkage (e.g., sensors)* (Elevelt et al. 2021; Höhne & Schlosser 2019)
  - *Ex post data linkage (e.g., trace data)* (Pasek et al. 2020; Stier et al. 2020)

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# Devices in Web Surveys I

## GESIS Panel (GP)



## German Internet Panel (GIP)
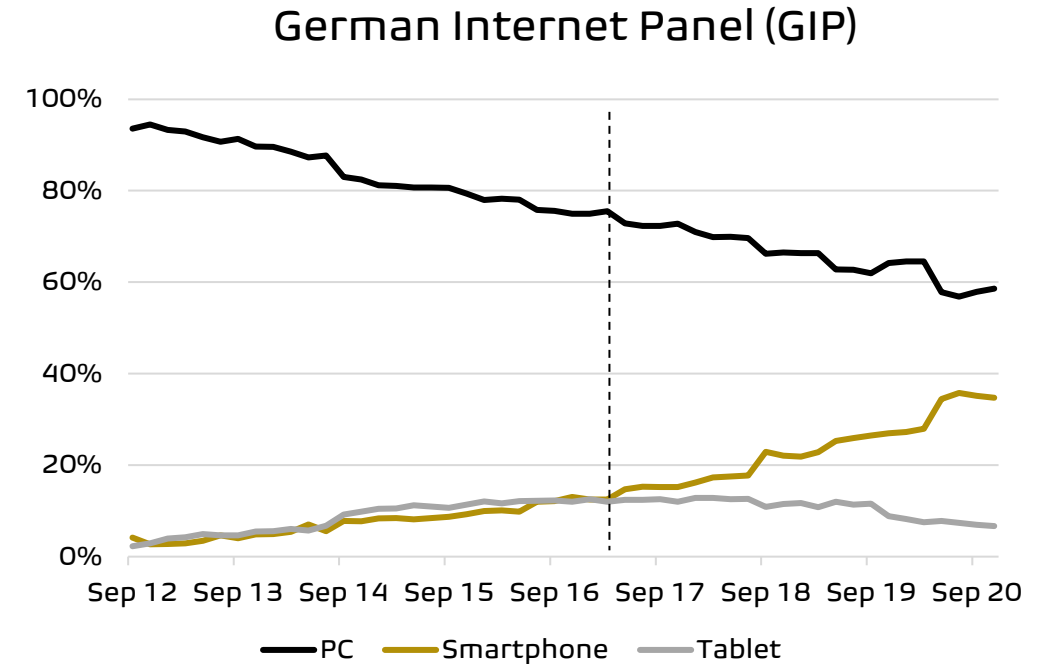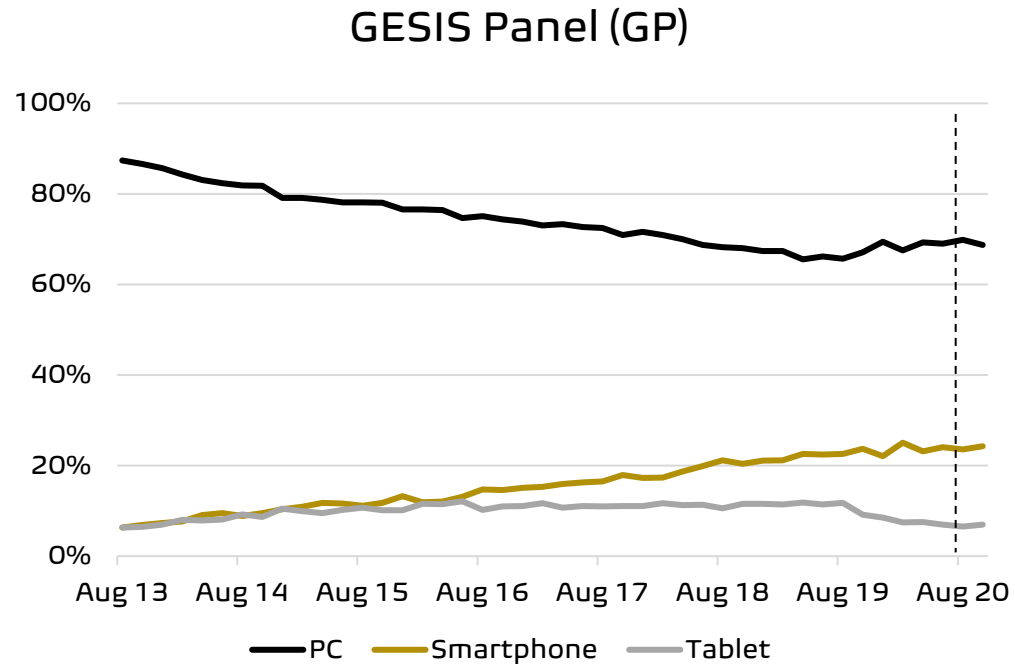


Country: Germany. Prob-based online panels. Vertical lines indicate the introduction of mobile-optimized layouts. Calculations: Gummer et al. (2023).

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# Devices in Web Surveys II

## CRONOS II – 12 European Countries (Smartphone %)



- Levels of smartphone participation
  - *Q4: SI, PT, IT*
  - *Q3: GB, SE, HU*
  - *Q2: FR, IS, FI*
  - *Q1: AT, BE, CZ*

Countries: AT = Austria, BE = Belgium, CZ = Czechia, FI= Finland, FR = France, GB = Great Britain, HU = Hungary, IS = Iceland, IT = Italy, PT = Portugal, SE = Sweden, SI = Slovenia. Calculations: Claassen et al. (under review).

# Smartphones and Voice Answers I

- New communication channels because of smartphones
  - *Linking established methods with technological innovations*

- Voice answer to (open) questions
  - *Closeness to daily conversation* (Tourangeau et al. 2000)
  - *Rich information due to narrations* (Gavras & Höhne 2022; Gavras et al. 2022)
  - *Little respondent burden – "just" clicking a recording button*

- Technological requirements of voice answers are met
  - *Even in web surveys with large N*

- General willingness for voice answers
  - *Between 40% and 60%* (Lenzner & Höhne 2022; Revilla et al. 2018)

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# Smartphones and Voice Answers II

- Voice answers (usually) require transcription before analysis
  - *Human transcription is burdensome and time consuming*
  - *Automatic Speech Recognition (ASR) systems may not be ready*

- Voice answers produce higher rates of missing data than text answers
  - *Dropout rate of about 50%* (Gavras & Höhne 2022; Lütters et al. 2018)
  - *Item-nonresponse varies between 25% and 60%* (Gavras et al. 2022; Revilla & Couper 2021; Revilla et al. 2020)

- However, voice answers have data quality benefits (compared to text answers)
  - *Longer in terms of words and characters* (Gavras et al. 2022; Revilla et al. 2020)
  - *Consist of more topics* (Gavras et al. 2022; Höhne et al. in press)
  - *Produce higher criterion validity* (Gavras & Höhne 2022)
  - *Shorter response times* (Lütters et al. 2018; Revilla et al. 2020)

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*Höhne, Lenzner, & Claassen (revise & resubmit). Automatic speech-to-text transcription: evidence from a smartphone survey with voice answers. International Journal of Social Research Methodology*

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# Research Questions (RQs)

- RQ1: What is the transcription quality of ASR systems?

- RQ2: What types of errors occur in ASR transcription?

- RQ3: How long does transcription by ASR and humans take?

# Method: Study Design



- Cross-quota sample
  - *Age and gender (3x2) plus education (3)*

- 2 questions plus probes
  - *Relationships between citizens and state (ISSP 2013, 2014)*
  - *Comprehension probes*

- No recording time restrictions
  - *Overall, we have 609 voice answers for analysis*
  - *These answers vary between 1 and 295 seconds*

- Extended replication study (Lenzner & Neuert 2017)

# Method: Collecting Voice Data



See https://github.com/JKHoehne/SVoice/tree/v1.0.0

- SurveyVoice (SVoice) tool (Höhne et al. 2021)

- Open-Source
  - *Apache 2.0 license*

- JavaScript, CSS, HTML, and PHP

- Implementable in browser-based smartphone surveys

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# Method: Sample

- Smartphone survey conducted in the Forsa Omninet Panel in Germany in November 2021

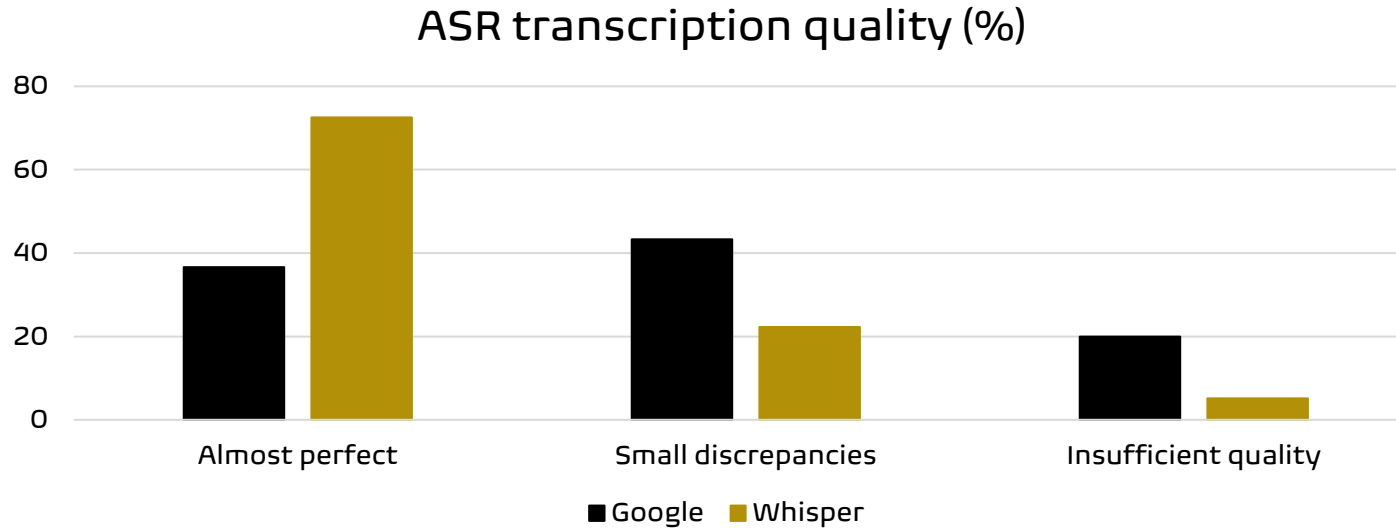| | |
|---|---|
| **Sample size:** | N = 501 |
| **Mean age:** | 48 years |
| **Gender:** | 50% females |
| **Education:** | 31% lower secondary school |
| | 43% intermediate secondary school |
| | 26% at least college preparatory secondary school |

# Method: Analytical Strategy

- We used one commercial and one open-source ASR systems
  - *Google "Cloud Speech-to-Text" API – costs: $0.024 per minute (without data logging – standard)*
  - *OpenAI's Whisper using the model "Large"*
  - *Language code was set to German (both ASRs)*
  - *Transcriptions took place in February 2024*

- Transcription quality
  - *1 Almost perfect, 2 small discrepancies (minor errors), and 3 insufficient quality (major errors)*
  - *Intercoder reliability: Agreement > 90% (Kappa > 0.84)*

- Transcription error types
  - *1 No mistakes, 2 misspellings, 3 word separation error, 4 word transcription error, 5 missing words, 6 incorrect grammatic, 7 words added by mistake, and 8 words replaced by numbers*
  - *Intercoder reliability: Agreement > 82% (Kappa > 0.78)*

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# Results: Research Question 1



**ASR transcription quality (%)**

Bar chart comparing Google (black) and Whisper (gold) across three categories:
- Almost perfect: Google ~37, Whisper ~73
- Small discrepancies: Google ~43, Whisper ~22
- Insufficient quality: Google ~20, Whisper ~5

■ Google ■ Whisper

We have less than 1% of poor-quality recordings that cannot be transcribed by ASR and humans

# Results: Research Question 1

## Almost perfect

ja Weltbürger wäre dass ich mich überall zu Hause fühlen würde das oder so ähnlich

ich finde den Begriff zivile Ungehorsam doof und ich habe es auch dreimal gelesen um es einigermaßen zu verstehen aber ich will keine Beispiele nennen aber ich denke einfach dass wir anderer Meinung sind also die Menschen da anderer Meinung sind und schon deshalb einfach Ungehorsam aber der Begriff ziviler Ungehorsam der gehört hier nicht her widerstrebt mir finde ich auch nicht gut

## Small discrepancies

ein Weltbürger ist quasi überall auf der Welt zu Hause vielleicht auch nirgendwo zu 100% zu Hause und ja kann man sich nicht an eine bestimmte Kultur oder Herkunft ist offen für er alle möglichen Kulturen und auch ich freue mich flexibel also möglichst viel gereist und hat auch ja einen großen Teil seines Lebens vielleicht im Ausland verbracht und dort gelebt

Beispiel ich bin zivil und gehorche nicht in Medien und Politik

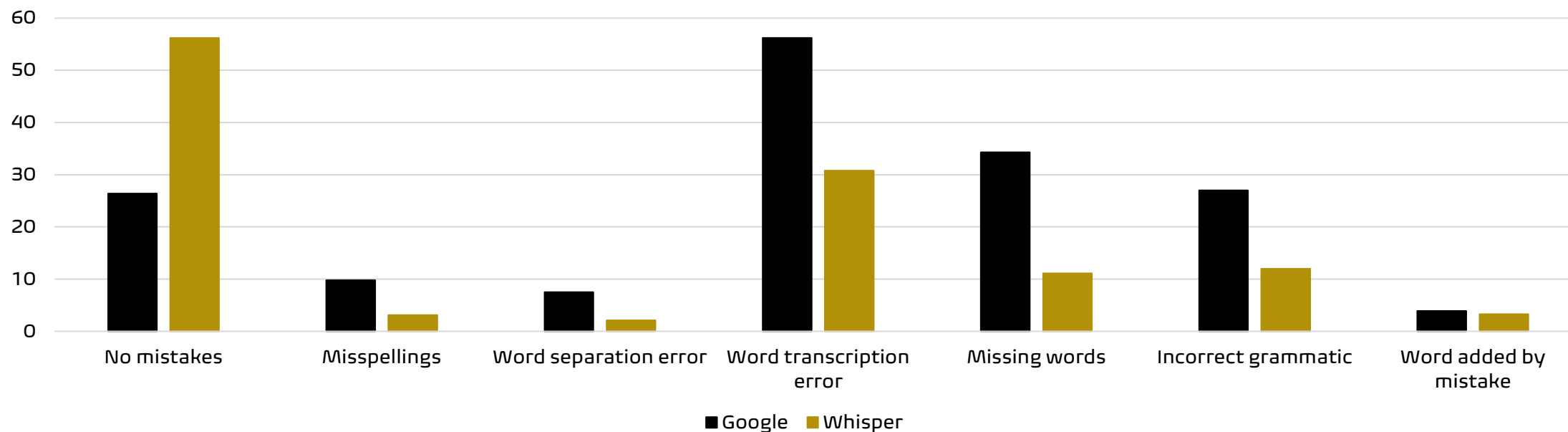## Insufficient quality

es ist eine schöne und mein schöner Garten Schüler glaube oder sonst du für Weltbürger ist letztendlich wird die Mehrheit der Menschheit immer erst zum 80. somit auch auf ihr eigenes Land und werde snap macht der geh zu Grunde dafür gibt genügend Beispiele in der Geschichte

ja heute kleine Aufkleber wie ging das System also sich nicht an alles halten was die einem vorschreiben möchten weil es kann ja nicht sein dass das da das ist zwar die Meinungsfreiheit los heute beginnt jetzt immer Kasperl und so entscheiden 19 Zoll für dich richtig ist aber naja und das Badezimmer zwei Leute hatten da ich glaube ich würde hier die auch mal besprechen

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# Results: Research Question 2



ASR transcription error types (%)

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# Results: Research Question 3

| Transcript | File number | Coder 1 time (20%) | Coder 2 time (20%) | Mean time (20%) | Total time (100%) |
|---|---|---|---|---|---|
| Human | 123 | 106 min | 106 min | 106 min | 530 min |
| Google | 618 | --- | --- | --- | 73 min |
| Whisper | 618 | --- | --- | --- | 509 min |

Google "Cloud Speech-to-Text" API needs about 40 seconds for transcribing 1 min voice input. It is faster than humans and Whisper.

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# Discussion and Conclusion

- Whisper makes a great job in 70% of the files (or voice answers)
  - *Google performs only poorly with less than 40% of almost perfect transcripts*

- There are various error types
  - *Word transcription error, missing words, and incorrect grammatic are most prominent*
  - *Error patterns are similar between both ASR systems*
  - *All error types are less common for Whisper*

- Google is about 7 times faster than humans and Whisper
  - *Differences between Google and Whisper may be due to computing power*
  - *Important: Whisper runs locally on the user's computer*

- Take home message
  - *Whisper is a promising solution for transcribing voice answers*
  - *Combining Whisper and human coders may be best to ensure a high-quality transcription*

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*Salvatore & Höhne (in press). Explaining item-nonresponse in open questions with requests for voice responses. Conference Preceding of the Italian Statistical Society*

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# Research Questions (RQs)

- RQ1: What is the share of responders and non-responders on a survey level?

- RQ2: Do responders and non-responders differ from the full sample?

- RQ3: What demographic characteristics, technological skills, and survey-related aspects drive item-nonresponse?

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# Method: Study Design



- Cross-quota sample
  - *Age and gender (3x2) plus education (3)*

- 8 questions on various topics
  - *For example, working women and media reporting*

- Respondents could skip questions by clicking "Next"
  - *No soft-prompt or the like*

- We did not include non-substantive options, such as "Don't know"

- No recording time restrictions

# Method: Collecting Voice Data



See https://github.com/JKHoehne/SVoice/tree/v1.0.0

- SurveyVoice (SVoice) tool (Höhne et al. 2021)

- Open-Source
  - *Apache 2.0 license*

- JavaScript, CSS, HTML, and PHP

- Implementable in browser-based smartphone surveys

# Method: Sample

- Smartphone survey conducted in the Forsa Omninet Panel in Germany in November 2021

| | |
|---|---|
| **Sample size:** | N = 501 |
| **Mean age:** | 49 years |
| **Gender:** | 48% females |
| **Education:** | 31% lower secondary school<br>43% intermediate secondary school<br>26% at least college preparatory secondary school |

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# Method: Analytical Strategy

- RQ1: We look at the share of questions that respondents answered
    - *Distinguishing responders and non-responders*

- RQ2: We compare responders and non-responders with the full sample
    - *Demographic characteristics: age, gender, and education*
    - *Technological skills: smartphone skills and internet use via smartphone*
    - *Survey-related aspects: interest, difficulty, length, and topic sensitivity*

- RQ3: We compare item-nonresponse among responders with respect to demographic characteristics, technological skills, and survey-related aspects
    - *See variables under RQ2*

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# Results: Research Question 1

| # quest. answ. | None | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| % | **29.5** | 1.2 | 0.4 | 0.8 | 1.4 | 2.6 | 6.4 | **21.0** | **36.8** |

"# quest. answ." stands for "Number of questions answered."

About 30% of respondents do not answer questions at all. We call these respondents **non-responders**.

The remaining respondents are called **responders**.

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# Results: Research Question 2

| Variables | Full sample | Non-responders | Responders |
|---|---|---|---|
| Age | **48.7** | **47.1** | **49.3** |
| Female | **48.3%** | **37.8%** | **52.7%** |
| Education: Medium | 42.5% | 41.6% | 42.8% |
| Education: High | 26.3% | 26.4% | 26.3% |
| Smartphone skills | 5.6 | 5.5 | 5.6 |
| Internet use | 6.0 | 6.0 | 6.0 |
| Survey: interest | **5.4** | **4.6** | **5.7** |
| Survey: difficulty | 3.1 | 3.3 | 3.0 |
| Survey: length | 2.6 | 2.8 | 2.6 |
| Survey: sensitivity | 4.6 | 4.6 | 4.6 |

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# Results: Research Question 3
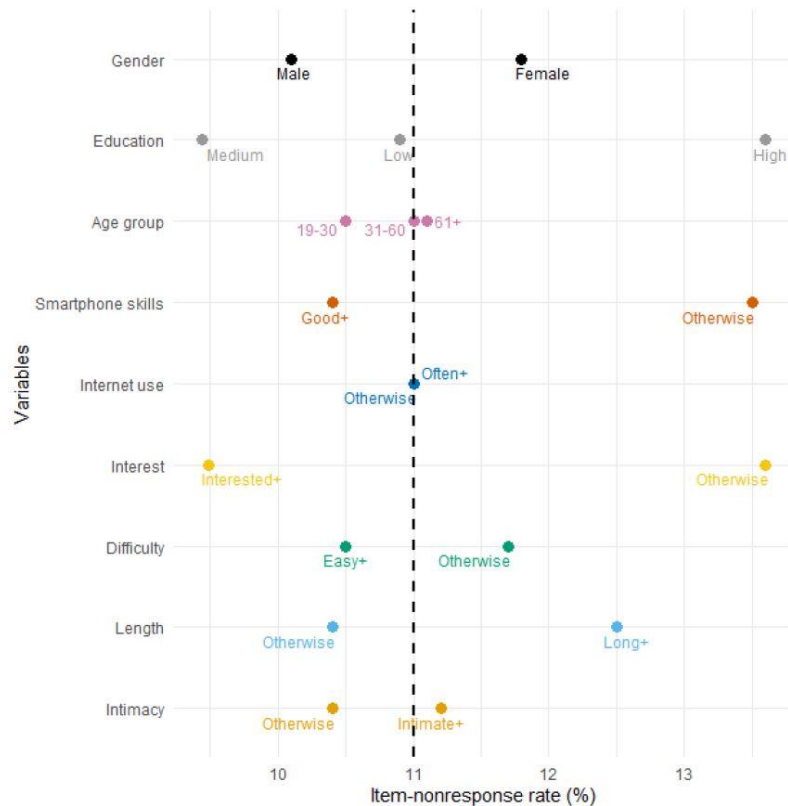


Dashed vertical line is the average item-nonresponse rate across all 8 voice questions. "Intimacy" stands for "topic sensitivity."

- Item-nonresponse analysis among **responders**

- Demographic characteristics
  - *Item-nonresponse is lower among **males**, **younger** respondents, and respondents with **low to medium education** levels*

- Technological skills
  - *Respondents with **good smartphone skills** exhibit lower item-nonresponse rates*

- Survey-related aspects
  - *Respondents with **high interest** and evaluating survey as **easy**, **not long**, and **not sensitive** produce lower item-nonresponse*

# Discussion and Conclusion

- The majority (about 60%) answers all questions or misses just one
  - *About 40% of respondents engage in some kind of item-nonresponse*

- Responders and non-responders slightly differ from the full sample
  - *Demographic characteristics: age and gender (severe!)*
  - *Technological skills: No differences*
  - *Survey-related aspects: interest*

- Item-nonresponse analysis among "responders" shows that demographic characteristics, technological skills, and survey-related aspects matter
  - *These respondents may be convinced through tailored incentive strategies*

- Take home message
  - *Missing data in the form of item-nonresponse remain a concern*
  - *Substantiveness of answers must be still evaluated*

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*Höhne, Gavras, & Claassen (2024). Typing or speaking? Comparing text and voice answers to open questions on sensitive topics in smartphone surveys. Social Science Computer Review. DOI: 10.1177/08944393231160961*

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# Research Questions (RQs)

- Do voice and text answers differ in terms of …

  *… dropouts?* RQ1

  *… item-nonresponse?* RQ2

  *… number of words?* RQ3

  *… number of topics?* RQ4

  *… sentiments?* RQ5

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# Method: Study Design



forsa.omninet

Was halten Sie ganz grundsätzlich von der Impf-Kampagne der Bundesregierung zur Bekämpfung der Corona-Pandemie?

Antworten Sie bitte so ausführlich wie möglich.

Bitte schreiben Sie Ihre Antwort in das Feld.

< Zurück    Weiter >

Impressum    Datenschutz



forsa.omninet

Was halten Sie ganz grundsätzlich von der Impf-Kampagne der Bundesregierung zur Bekämpfung der Corona-Pandemie?

Antworten Sie bitte so ausführlich wie möglich.

Halten Sie das Mikrofon-Symbol gedrückt, während Sie Ihre Antwort aufnehmen.

< Zurück    Weiter >

Impressum    Datenschutz

- **Between-subject design**
  - *Group 1: text answers (n = 500)*
  - *Group 2: voice answers (n = 501)*

- **4 questions on sensitive topics**
  - *Refugees, working women, media reporting, and vaccination campaign*

- **Text version left**
  - *No character limitation*

- **Voice version right**
  - *No recording time limitation*

# Method: Collecting Voice Data



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# Method: Sample

- Smartphone survey conducted in the Forsa Omninet Panel in Germany in November 2021

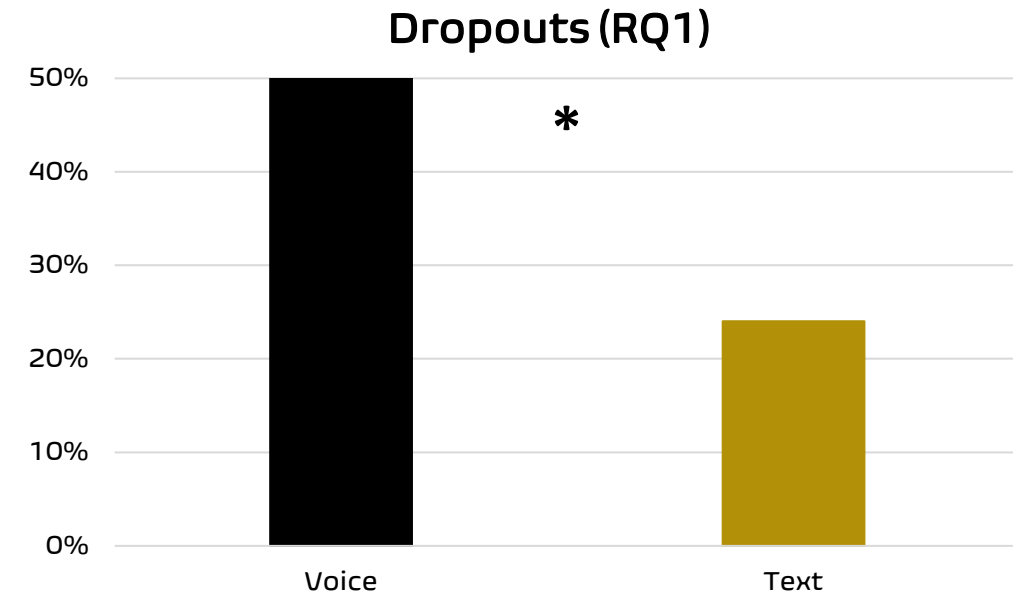| | |
|---|---|
| **Sample size:** | N = 1,001 |
| **Mean age:** | 48 years |
| **Gender:** | 49% females |
| **Education:** | 30% lower secondary school |
| | 42% intermediate secondary school |
| | 28% at least college preparatory secondary school |

Chi-square tests reveal no significant differences between the two experimental groups with respect to age, gender, and education

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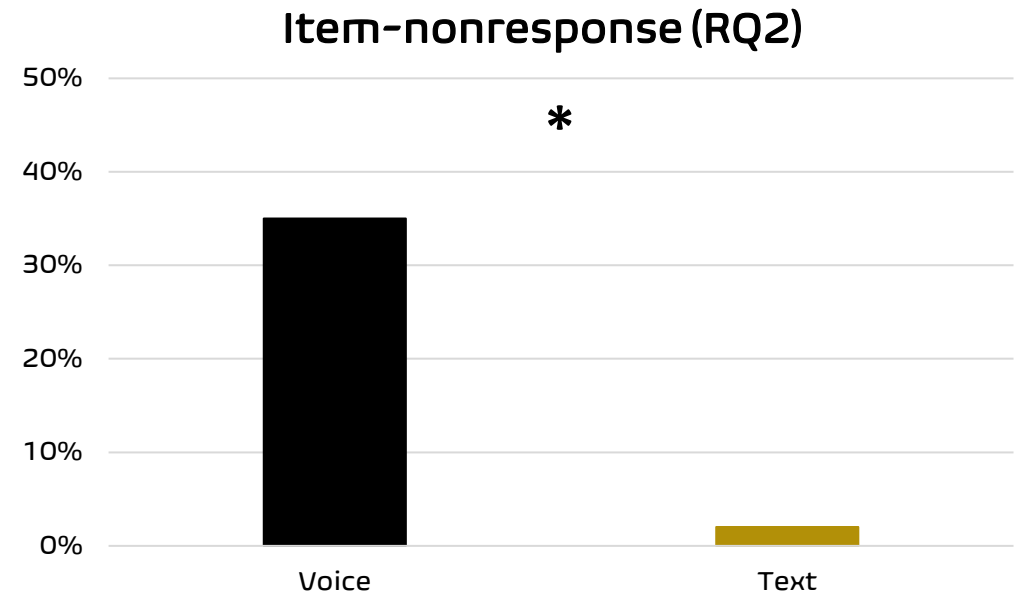*Computational Survey and Social Science*

# Method: Analytical Strategy

- Transcription of voice answers via OpenAI's Whisper
  - *OpenAI's Whisper using the model "Large" – Language code was set to German*

- RQ1: Determining the share of dropouts (comparing voice and text groups)

- RQ2: Determining the share of item-nonresponse (aggregated across all four voice and text questions)

- RQ3: Determining the number of words using quanteda (R) (Benoit et al. 2018)

- RQ4: Determining the number of topics using stm (R) (Roberts et al. 2014)

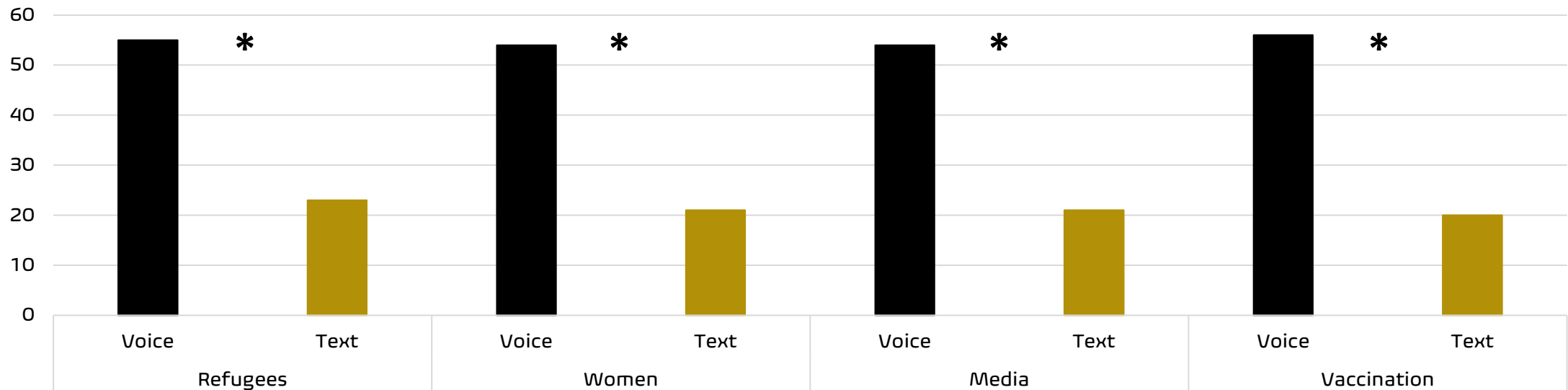- RQ5: Determining sentiments using SentiWS (R) (Remus et al. 2010)

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# Results: Research Questions 1 & 2

### Dropouts (RQ1)



*p < 0.05. Z-test.

### Item-nonresponse (RQ2)



*p < 0.05. Z-test.

# Results: Research Question 3

**Average Number of Words (RQ3)**



*p < 0.05. T-tests.

# Results: Research Question 4
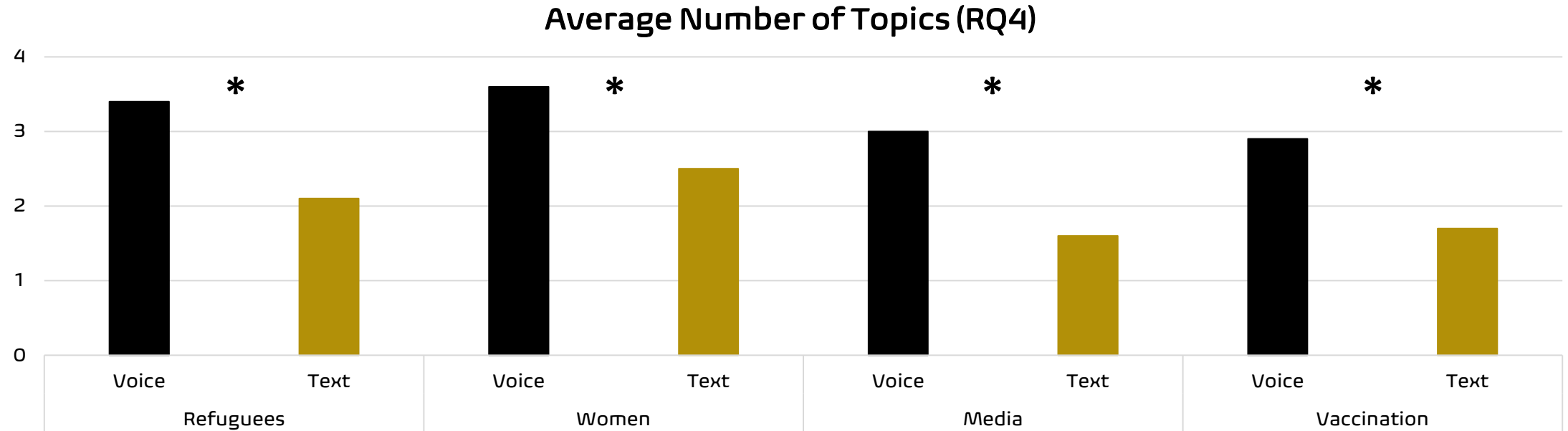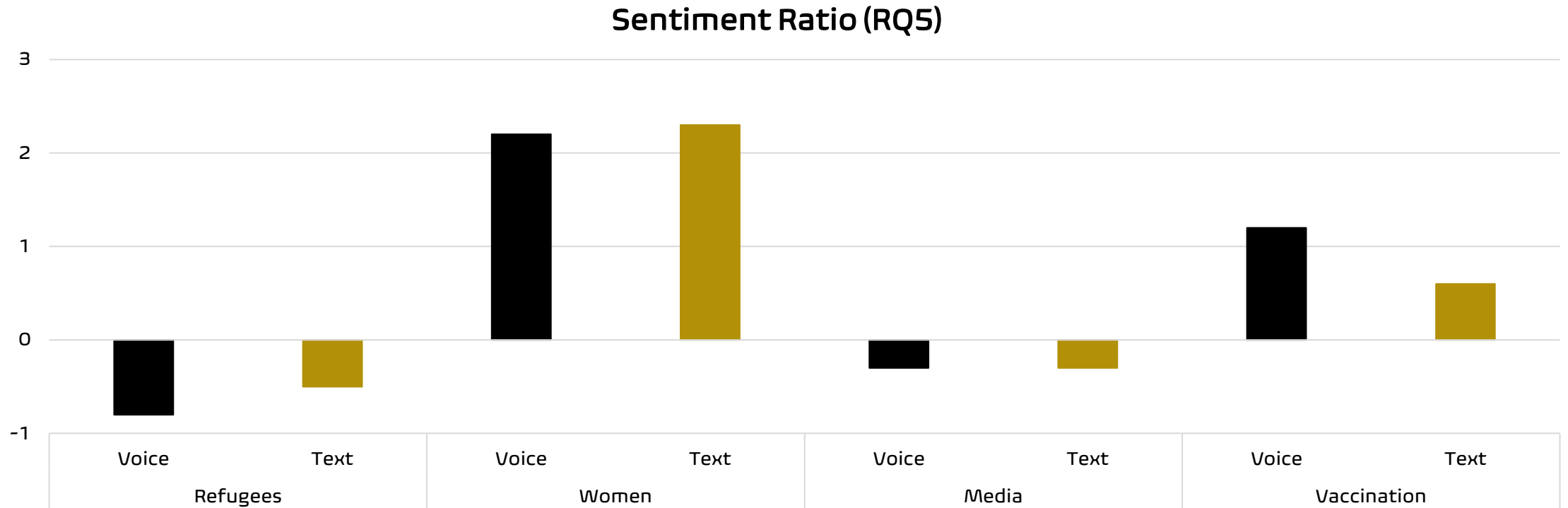
**Average Number of Topics (RQ4)**



*p < 0.05. T-tests.

# Results: Research Question 5



Sentiment Ratio (RQ5)

*p < 0.05. T-tests.

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# Discussion and Conclusion

- Higher share of missing data in voice answers
  - *Respondents may not be able and/or willing to provide voice answers*
  - *Reduction through tailored incentives and/or choice of answer format*

- Higher number of words and topics in voice answers
  - *Pointing to narrations, more information, and less respondent burden*

- No differences regarding sentiments
  - *Voice answers are similarly robust against social desirability bias as their text counterparts*

- Voice answers have great potential for social science research
  - *Connectable to all research fields with survey data*
  - *Build a bridge between qualitative and quantitative research*
  - *BUT: Share of missing data must be reduced!*

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*Lenzner, Höhne, & Gavras (2024). Innovating web probing: Comparing written and oral answers to open-ended probing questions in a smartphone survey. Journal of Survey Statistics and Methodology. DOI: 10.1093/jssam/smae031*

# Research Questions (RQs)

- Do voice and text answers differ in terms of ...

  *... answer quality?* RQ1

  *... number of themes?* RQ2

  *... survey evaluations?* RQ3

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# Method: Study Design



- **Between-subject design**
  - *Group 1: text answers (n = 500)*
  - *Group 2: voice answers (n = 501)*

- **2 closed questions + probes**
  - *Relationship between citizens and state* (ISSP 2013, 2014)
  - *Advanced replication* (Lenzner & Neuert 2017)

- **Closed question on the left**

- **Text probe in the middle**
  - *No character limitation*

- **Voice probe on the right**
  - *No recording time limitation*

# Method: Collecting Voice Data



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# Method: Sample

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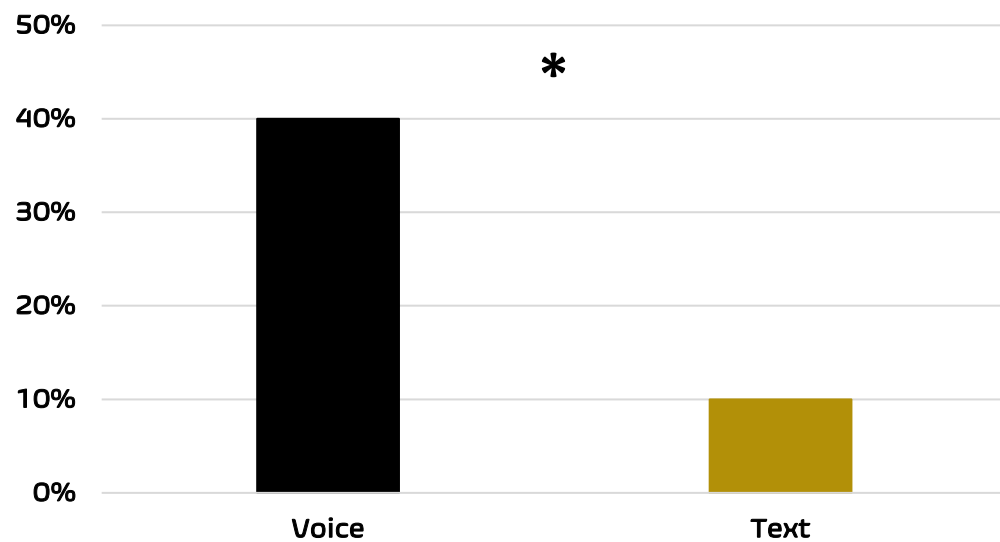| | |
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# Method: Analytical Strategy

- Transcription of voice answers by student assistant (verbatim)
  - *Subsample of 10% was double-checked by the first author*

- RQ1: Determining probe nonresponse, uninterpretable answers, and number of words (comparing voice and text groups)

- RQ2: Determining the number of topics through manual coding (comparing voice and text groups)
  - *Interrater agreement was deemed substantial (> 83%) with Cohen's kappa values > 0.79*

- RQ3: Determining the respondents' survey evaluations (comparing voice and text groups)
  - *Evaluative dimensions: interest, difficulty, and length*

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# Results: Research Questions 1

## Probe Nonresponse (RQ1)



\*

| | Voice | Text |

50% — 40% (Voice), 10% (Text)

\*p < 0.05. Z-test.

## Uninterpretable Answers (RQ1)



\*

25% — 10% (Voice), 14% (Text)

\*p < 0.05. Z-test.

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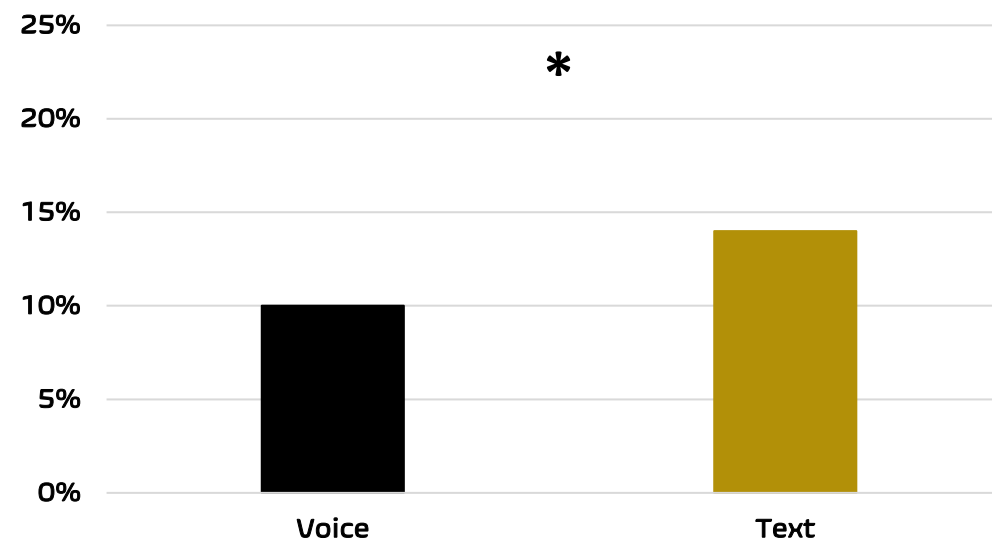
# Results: Research Questions 1 & 2

**Average Number of Words (RQ1)**
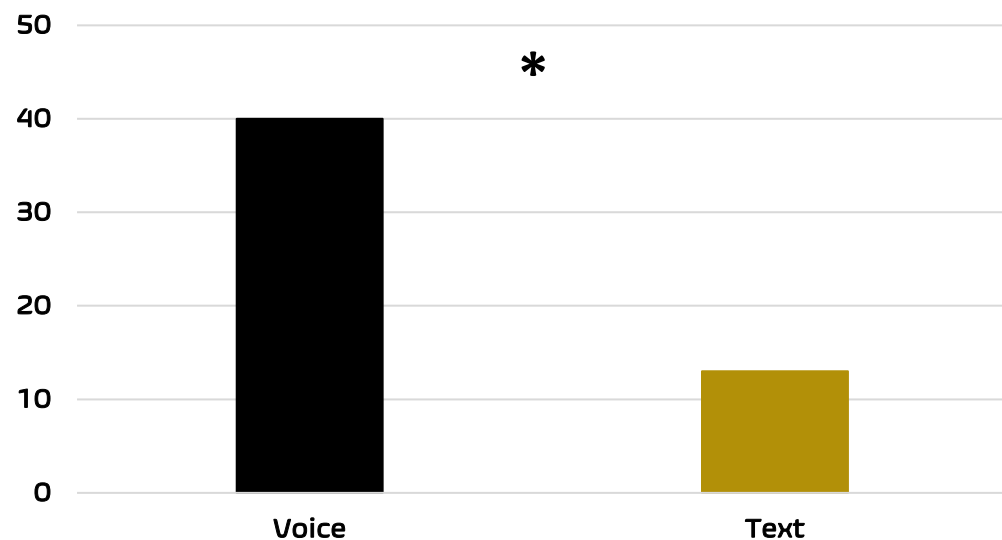


*p < 0.05. T-test.

**Average Number of Topics (RQ2)**
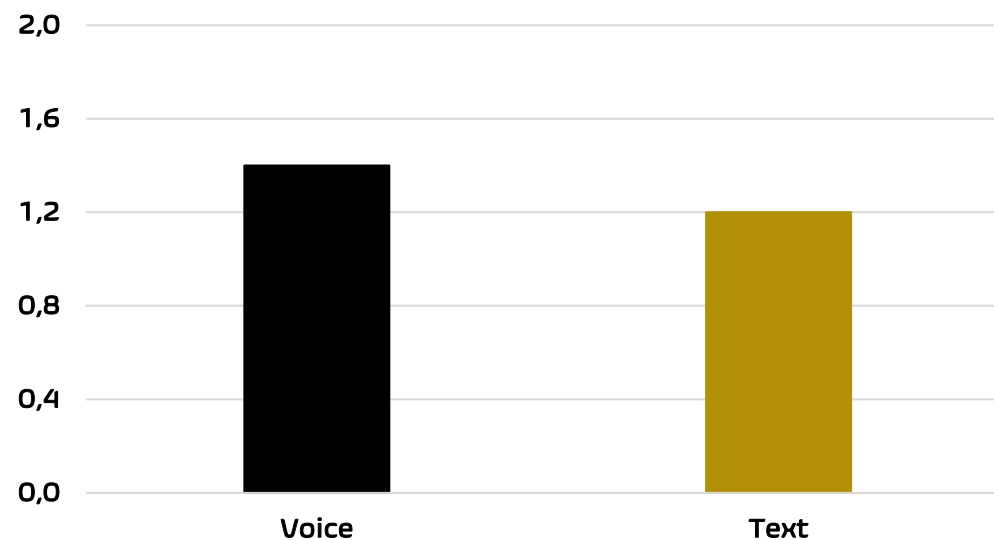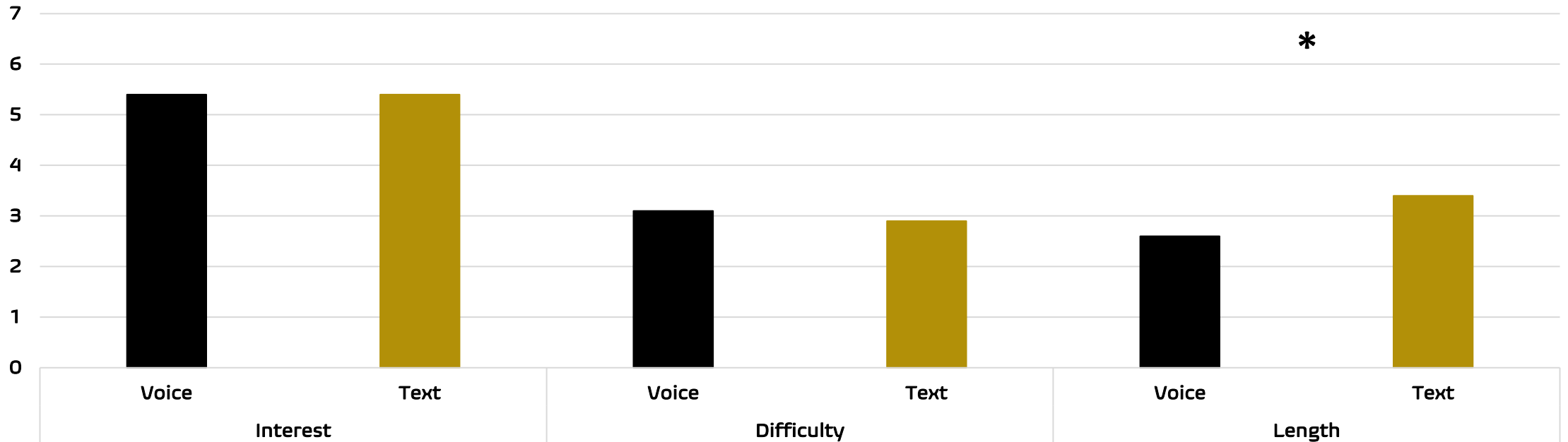


*p < 0.05. T-test.

# Results: Research Questions 3

**Survey evaluations (RQ3)**



*p < 0.05. T-Tests.

# Discussion and Conclusion

- Higher share of missing data in voice answers

  - *Respondents may not be able and/or willing to provide voice answers*
  - *Reduction through tailored incentives and/or choice of answer format*

- More interpretable voice answers and higher number of words

  - *Pointing to narrations, more information, and different cognitive answer processes*

- Voice and text answers do not differ in number of topics

  - *Both answer formats result in similar outcomes (or topics)*

- Some differences regarding survey evaluations

  - *The voice group evaluates the survey as lengthy*

- Take home message:

  - *Share of missing data in voice answers must be reduced*
  - *Voice answers potentially help to tailor web probing to some respondents*

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# Many thanks for your attention!

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# Literature I

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