Identifying a Set of Key Paradata Indicators in Web Surveys Based on the Relationship with Response Quality, Respondent Characteristics and Substantive Variables

Online Appendix: Data, Paradata Indicators and Analyses

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1 Data, questionnaire and scripts

The data, questionnaire and scripts used in this study are available for access and reference:

- IBM SPSS and CSV datafile and codebook (see Vehovar et al., 2023b) are available at https://doi.org/10.23668/psycharchives.12981
- IBM SPSS syntax for regression analyses (see Vehovar et al., 2023a) is available at https://doi.org/10.23668/psycharchives.12982
- The archived questionnaire (see Centre for Social Informatics & The Samuel Neaman Institute for National Policy Research, 2021) is available at https://doi.org/10.23668/psycharchives.5106
- JavaScript for capturing and Python scripts for processing raw paradata (see Berzelak et al., 2022) are available at https://zenodo.org/record/6806131
- The five raw paradata datasets (see Berzelak et al., 2023) are available at https://zenodo.org/record/8154489

2 Detailed description of the procedures for capturing paradata

The data were stored in five comma-separated *raw paradata datasets*, including up to five ID variables (i.e. respondent, page, page session number [in cases where a respondent returns to a certain page in multiple sessions], question item and response ID) and the following:

a) *Page sessions* (292,499 lines, 18 variables). Each line contained the respondent sequence, load timestamp, post timestamp, user agent string, language, device pixel ratio, width, height, available width, available height, jQuery window width, jQuery window height, jQuery document width and jQuery document height. For further information, refer to https://api.jquery.com/. Additionally, ID variables were included.

b) *Events* (5,226,004 lines, 10 variables). Events were related to actions, such as typing, clicking (e.g. on response options and back and forward buttons), scrolling, focus-out and resizing or zooming into the survey content. Each line contained the event timestamp, event type, input value of the event, X coordinate, Y coordinate, ID of the survey element, class of the survey element and type of the survey element. Additionally, ID variables were included.

c) *Responses* (718,185 lines, 7 variables). Each line provided the timestamp, type of response action (e.g. radio button selection, check-box selection or text entry) and response value. Additionally, ID variables were included.

d) *Mouse actions* (1,356,606 lines, 9 variables). Each line contained the start timestamp, end timestamp, starting X coordinate, starting Y coordinate, end X coordinate, end Y coordinate and distance travelled. Additionally, ID variables were included. A new pointer move event was defined if the pointer stopped moving for at least 300 milliseconds, and distances were calculated based on pixels.

e) *Alert prompts* (7,304 lines, 10 variables). Each line provided the timestamp for the displaying of the alert, timestamp for the closing of the alert, type of alert, alert trigger ID, type of trigger, whether the alert was ignorable, text of the alert and action of the respondent to the alert. Additionally, ID variables were included.

3 Comments on the third stage of the selection process (Table 2)

Table 2 displays several groups of decisions made during the process of reducing paradata indicators from 29 to 14. Below are the detailed elaborations:

- First, two indicators—'Total number of pageviews' and 'Total number of page visits'—were replaced with the indicator 'Total number of pages visited' due to high correlation.
- Next, the indicator 'Duration adjusted for focus-out' was replaced by the indicators 'Duration' and 'Total focus-out duration' since it did not contribute to the explained variance and was highly correlated with the indicators that replaced it.
- The indicator 'Type of device' replaced five other specific device characteristics that were correlated with it, as the broader device types contributed the most to the proportion of explained variance.
- Likewise, the indicator 'Operating system version' was replaced with the indicator 'Operating system' since the original version did not provide added value to the regression models.
- The indicator 'Total number of items with answer changes' was replaced with the indicator 'Total number of answer changes', which contributed more to explaining the variance.
- The indicator 'Total number of validation prompts' was replaced by the indicator 'Total number of item nonresponse prompts' since the latter was the only type of prompt that contributed to the proportion of explained variance.
- The 'Pointer movement speed' indicator was replaced by the 'Total number of excess clicks' indicator since the latter was not limited to PCs and provided more value to the proportion of explained variance.
- The indicator 'Pointer movement duration' was replaced by the indicator 'Pointer movement distance' since the duration did not further explain the variance in the regression model.
- Finally, the 'Total number of focus-out events' indicator was replaced by the 'Total number of focus-out events (longer than five seconds)' since eliminating very short focus-out events reduced noise in the data, improving the contribution to the proportion of explained variance.

4 Analysis of additional paradata indicators

4.1 Pointer movement distance (PC respondents)

Table A.1: Associations between pointer movement distance and response quality indicators

	Breakoffs[a]	Outliers[a]	Item nonresponse[b]	Straightlining[b]	Extreme positive[b]	Extreme negative[b]	Midpoint[b]	Concurrent multitasking[b]	Sequential multitasking[b]	Duration[b]	Effort[b]	Burden[b]	IMC[b]
Pointer movement distance	1.000	1.000	-0.032	-0.073 **	0.031	-0.031	-0.042	0.025	-0.019	0.108 ***	0.026	0.004	-0.022
Total $R^{2,c}$	0.299	0.111	0.192	0.058	0.059	0.127	0.086	0.064	0.121	0.443	0.102	0.107	0.228

NOTE. * $p < .05$; ** $p < .01$; *** $p < .001$. Each model included controls for the sociodemographic characteristics and 10 key paradata indicators. Sampling weights applied.
[a] Values in cells show odds ratios (binary logistic regression).
[b] Values in cells show standardised beta coefficients (linear regression).
[c] Nagelkerke's pseudo R^2 coefficient is shown for binary logistic regression, and the adjusted R^2 coefficient is shown for linear regression.

Table A.2: Associations between pointer movement distance and respondent characteristics

	Gender[a]	Age[b]	Education[a]	Extraversion[b]	Agreeableness[b]	Conscientiousness[b]	Neuroticism[b]	Openness[b]
Pointer movement distance	1.000	0.163 ***	1.000	-0.029	0.022	0.001	-0.011	-0.039
Total $R^{2,c}$	0.115	0.291	0.150	0.158	0.186	0.101	0.135	0.134

NOTE. * $p < .05$; ** $p < .01$; *** $p < .001$. Each model included controls for the remaining sociodemographic characteristics and 10 key paradata indicators. Sampling weights applied.
[a] Values in cells show odds ratios (binary logistic regression).
[b] Values in cells show standardised beta coefficients (linear regression).
[c] Nagelkerke's pseudo R^2 coefficient is shown for binary logistic regression, and the adjusted R^2 coefficient is shown for linear regression.

Table A.3: Associations between pointer movement distance and estimates about Internet use

	How often, on average, did you use the Internet in the last 12 months[b]	Did you use any of the following devices to browse the web in the last 12 months?					Do you use a smartphone for personal purposes?[a]
		Desktop or laptop computer[a]	Tablet computer[a]	Mobile phone or smartphone[a]	Smart TV[a]	O2e: Other devices (e.g. media or games player)[a]	
Pointer movement distance	0.022	1.000	1.000	1.000	1.000	1.000	1.000
Total $R^{2,c}$	0.062	0.116	0.133	0.157	0.202	0.199	0.198

NOTE. * $p < .05$; ** $p < .01$; *** $p < .001$. Each model included controls for the remaining sociodemographic characteristics and 10 key paradata indicators. Sampling weights applied.
[a] Values in cells show odds ratios (binary logistic regression).
[b] Values in cells show standardised beta coefficients (linear regression).
[c] Nagelkerke's pseudo R^2 coefficient is shown for binary logistic regression, and the adjusted R^2 coefficient is shown for linear regression.

Table A.4: Associations between pointer movement distance and estimates about trust in computers

	Please specify to what extent you agree or disagree that the computers can be trusted to carry out the following.					
	Autocompletion of text	Spelling and grammar check	Selecting a playlist to match my musical preferences	Selecting the best and most efficient route in my GPS navigation app while driving	Autonomous driving of a motor vehicle	Diagnosis of my medical status by an AI system
Pointer movement distance	0.046	0.036	-0.006	0.015	0.022	0.001
Total R^2	0.026	0.053	0.046	0.066	0.030	0.036

NOTE. * $p < .05$; ** $p < .01$; *** $p < .001$. Values in cells show standardised beta coefficients (linear regression). Each model included controls for the sociodemographic characteristics and 10 key paradata indicators. Sampling weights applied.

4.2 Operating system (iOS versus other smartphones)

Table A.5: Associations between operating system and response quality indicators

	Breakoffs[a]	Outliers[a]	Item nonresponse[b]	Straightlining[b]	Extreme positive[b]	Extreme negative[b]	Midpoint[b]	Concurrent multitasking[b]	Sequential multitasking[b]	Duration[b]	Effort[b]	Burden[b]	IMC[b]
Operating system	0.196	0.549	-0.025	-0.029	-0.066 *	-0.049	-0.021	0.033	-0.037	-0.011	0.046	0.086 **	-0.042
Total $R^{2,c}$	0.205	0.062	0.383	0.020	0.050	0.090	0.038	0.038	0.048	0.185	0.085	0.117	0.305

NOTE. * $p < .05$; ** $p < .01$; *** $p < .001$. Each model included controls for the sociodemographic characteristics and 10 key paradata indicators. Sampling weights applied.
[a] Values in cells show odds ratios (binary logistic regression).
[b] Values in cells show standardised beta coefficients (linear regression).
[c] Nagelkerke's pseudo R^2 coefficient is shown for binary logistic regression, and the adjusted R^2 coefficient is shown for linear regression.

Table A.6: Associations between operating system and respondent characteristics

	Gender[a]	Age[b]	Education[a]	Extraversion[b]	Agreeableness[b]	Conscientiousness[b]	Neuroticism[b]	Openness[b]
Operating system	1.522 *	-0.177 ***	1.482	0.035	-0.064 *	0.003	-0.051	-0.051
Total $R^{2,c}$	0.176	0.266	0.156	0.165	0.214	0.116	0.158	0.158

NOTE. * $p < .05$; ** $p < .01$; *** $p < .001$. Each model included controls for the remaining sociodemographic characteristics and 10 key paradata indicators. Sampling weights applied.
[a] Values in cells show odds ratios (binary logistic regression).
[b] Values in cells show standardised beta coefficients (linear regression).
[c] Nagelkerke's pseudo R^2 coefficient is shown for binary logistic regression, and the adjusted R^2 coefficient is shown for linear regression.

Table A.7: Associations between operating system and estimates about Internet use

	How often, on average, did you use the Internet in the last 12 months[b]	Did you use any of the following devices to browse the web in the last 12 months?					Do you use a smartphone for personal purposes?[a]
		Desktop or laptop computer[a]	Tablet computer[a]	Mobile phone or smartphone[a]	Smart TV[a]	O2e: Other devices (e.g. media or games player)[a]	
Operating system	0.011	3.127 **	1.116	0.227	0.935	0.934	0.000
Total $R^{2,c}$	0.024	0.142	0.124	0.171	0.168	0.193	0.322

NOTE. * $p < .05$; ** $p < .01$; *** $p < .001$. Each model included controls for the sociodemographic characteristics and 10 key paradata indicators. Sampling weights applied.

[a] Values in cells show odds ratios (binary logistic regression).

[b] Values in cells show standardised beta coefficients (linear regression).

[c] Nagelkerke's pseudo R^2 coefficient is shown for binary logistic regression, and the adjusted R^2 coefficient is shown for linear regression.

Table A.8: Associations between operating system and estimates about trust in computers

	Please specify to what extent you agree or disagree that computers can be trusted to carry out the following.					
	Autocompletion of text	Spelling and grammar check	Selecting a playlist to match my musical preferences	Selecting the best and most efficient route in my GPS navigation app while driving	Autonomous driving of a motor vehicle	Diagnosis of my medical status by an AI system
Operating system	-0.059	0.014	-0.070 *	-0.061	0.017	0.058
Total R^2	0.020	0.037	0.045	0.015	0.063	0.080

NOTE. * $p < .05$; ** $p < .01$; *** $p < .001$. Values in cells show standardised beta coefficients (linear regression). Each model included controls for the sociodemographic characteristics and 10 key paradata indicators. Sampling weights applied.

4.3 Summary of the results—Replication of Figure 1 without *branching items omitted*

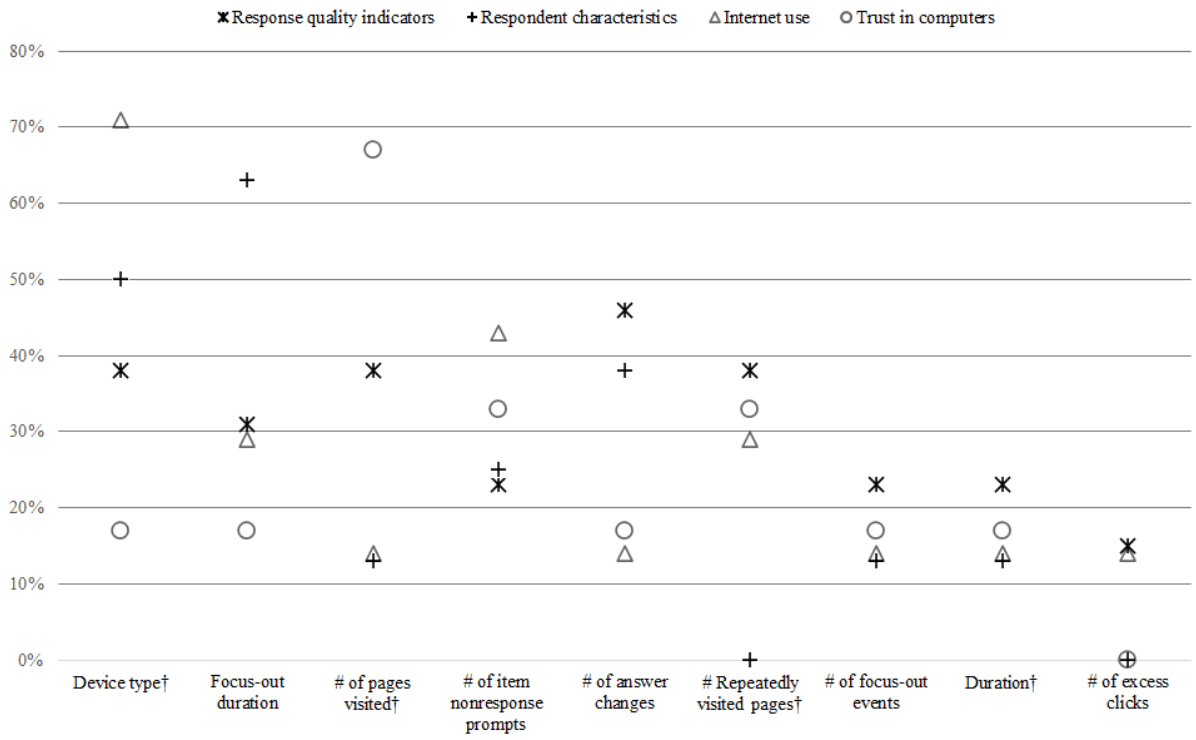

Figure A.1: The share (%) of the number of variables—among the total number of 13 RQI variables, 8 respondent characteristics, 7 estimates about Internet use and 6 estimates about trust in computers—that were statistically significantly ($p < .05$) associated with the corresponding paradata indicators (excluding *branching items omitted*, † denotes possibility of server-side paradata capturing)

5 List of 112 initial paradata indicators and the second step of the reduction of indicators

Table A.9: List of initial paradata indicators, their aggregation and reasons for their eventual exclusion

#	Initial indicator name	Category	Subcategory	Aggregation level	Set of 29 respondent-level indicators (Table 2)	Exclusion of the initial paradata indicator from subsequent sets	
						Reasons for exclusion	Category of the main reason for exclusion
1	# of displayed items in total	Questionnaire length	# of questionnaire elements	Respondent		Redundant to '# of branching items omitted'	Redundancy
2	# of branching items omitted	Questionnaire length	# of questionnaire elements	Respondent	Yes	---	---
3	# of displayed different items	Questionnaire length	# of questionnaire elements	Respondent		Response time used for length estimation as it takes into account between-subject differences in reading speed	More accurate/relevant measure available
4	# of displayed words in questions	Questionnaire length	# of questionnaire elements	Respondent		Response time used for length estimation as it takes into account between-subject differences in reading speed	More accurate/relevant measure available
5	# of displayed characters in questions	Questionnaire length	# of questionnaire elements	Respondent		Response time used for length estimation as it takes into account between-subject differences in reading speed	More accurate/relevant measure available
6	# of displayed words in all text elements	Questionnaire length	# of questionnaire elements	Respondent		Response time used for length estimation as it takes into account between-subject differences in reading speed	More accurate/relevant measure available
7	# of displayed characters in all text elements	Questionnaire length	# of questionnaire elements	Respondent		Response time used for length estimation as it takes into account between-subject differences in reading speed	More accurate/relevant measure available
8	Duration (total)	Questionnaire length	Survey duration	Respondent		Used to derive indicators that adjust for off-survey time	More accurate/relevant measure available
9	Duration (adjusted for outliers)	Questionnaire length	Survey duration	Respondent	Yes	---	---
10	Duration adjusted for focus-out	Questionnaire length	Survey duration	Respondent	Yes	---	---
11	Duration adjusted for inactivity	Questionnaire length	Survey duration	Respondent		High amount of noise in the Inactivity indicator	Data quality or availability issues
12	Type of device	Device	Hardware	Respondent	Yes	---	---
13	Device brand	Device	Hardware	Respondent	Yes	---	---
14	Device model	Device	Hardware	Respondent	Yes	---	---
15	Device touch capability	Device	Hardware	Respondent	Yes	---	---
16	Operating system	Device	Software	Respondent	Yes	---	---

#	Initial indicator name	Category	Subcategory	Aggregation level	Set of 29 respondent-level indicators (Table 2)	Exclusion of the initial paradata indicator from subsequent sets	
						Reasons for exclusion	Category of the main reason for exclusion
17	Operating system version	Device	Software	Respondent	Yes	---	---
18	Browser	Device	Software	Respondent	Yes	---	---
19	Browser version	Device	Software	Respondent	Yes	---	---
20	Total # of pageviews	Page navigation	Pageviews	Respondent	Yes	---	---
21	# of page # pageviews	Page navigation	Pageviews	Page		Used to aggregate to 'Total # of pageviews' at the respondent level and derive '# of visits of page #' that counts only page visits without potential refreshes of the same page	Aggregation to another level
22	# of page visits in total	Page navigation	Page visits	Respondent	Yes	---	---
23	# of pages visited in total	Page navigation	Page visits	Respondent	Yes	---	---
24	# of visits of page #	Page navigation	Page visits	Page		Used to aggregate to '# of pages visited in total' at the respondent level	Aggregation to another level
25	# of repeatedly visited pages	Page navigation	Page visits	Respondent	Yes	---	---
26	Page # visited more than once (TRUE/FALSE)	Page navigation	Page visits	Page		# of repeatedly visited pages regarded as more relevant	More accurate/relevant measure available
27	Total time on page #	Page navigation	Time on page	Page		Used to aggregate to 'Duration' at the respondent level and derive indicators 'Total time on page # adjusted for outliers', 'Total time on page # adjusted for focus-out' and 'Total time on page # adjusted for inactivity' that account for off-survey time	More accurate/relevant measure available
28	Total time on page # adjusted for outliers	Page navigation	Time on page	Page		Used to aggregate to 'Duration' at the respondent level	Aggregation to another level
29	Total time on page # adjusted for focus-out	Page navigation	Time on page	Page		Used to aggregate to 'Duration adjusted for focus-out' at the respondent level	Aggregation to another level
30	Total time on page # adjusted for inactivity	Page navigation	Time on page	Page		Used to aggregate to 'Duration adjusted for inactivity' at the respondent level; high amount of noise in the inactivity time measure	Data quality or availability issues
31	Time on page # at first visit	Page navigation	Time on page	Page		Total page times more relevant for survey duration estimation	More accurate/relevant measure available
32	Time on page # at first visit adjusted for outliers	Page navigation	Time on page	Page		Total page times more relevant for survey duration estimation	More accurate/relevant measure available

#	Initial indicator name	Category	Subcategory	Aggregation level	Set of 29 respondent-level indicators (Table 2)	Exclusion of the initial paradata indicator from subsequent sets	
						Reasons for exclusion	Category of the main reason for exclusion
33	Time on page # at first visit adjusted for focus-out	Page navigation	Time on page	Page		Total page times more relevant for survey duration estimation	More accurate/relevant measure available
34	Time on page # at first visit adjusted for inactivity	Page navigation	Time on page	Page		Total page times more relevant for survey duration estimation	More accurate/relevant measure available
35	Total # of responses provided in the questionnaire	Responses	# of responses	Respondent	Yes	---	---
36	# of answer changes	Responses	# of responses	Respondent	Yes	---	---
37	# of responses to item #	Responses	# of responses	Item		Used to derive '# of responses to question #' and aggregate to 'Total # of responses provided in the questionnaire' at the respondent level	Aggregation to another level
38	# of responses to question #	Responses	# of responses	Question		Redundant to '# of responses to item #' for aggregation and to 'Total # of responses provided in the questionnaire' at the respondent level	Redundancy
39	# of items with answer change	Responses	# of responses	Respondent	Yes	---	---
40	# of questions with answer changes	Responses	# of responses	Respondent		# of items with answer changes regarded as more relevant	More accurate/relevant measure available
41	Proportion of items with answer changes	Responses	# of responses	Respondent		# of items with answer changes regarded as more relevant	More accurate/relevant measure available
42	Proportion of questions with answer changes	Responses	# of responses	Respondent		# of items with answer changes regarded as more relevant	More accurate/relevant measure available
43	First response time for item #	Responses	Response time	Item		Total page times more relevant for survey duration estimation	More accurate/relevant measure available
44	Total response time for item #	Responses	Response time	Item		Total page times more relevant for survey duration estimation	More accurate/relevant measure available
45	First response time for item # adjusted for focus-out	Responses	Response time	Item		Total page times more relevant for survey duration estimation	More accurate/relevant measure available
46	First response time for item # adjusted for inactivity	Responses	Response time	Item		Total page times more relevant for survey duration estimation	More accurate/relevant measure available
47	Total response time for item # adjusted for focus-out	Responses	Response time	Item		Total page times more relevant for survey duration estimation	More accurate/relevant measure available
48	Total response time for item # adjusted for inactivity	Responses	Response time	Item		Total page times more relevant for survey duration estimation	More accurate/relevant measure available

#	Initial indicator name	Category	Subcategory	Aggregation level	Set of 29 respondent-level indicators (Table 2)	Exclusion of the initial paradata indicator from subsequent sets	
						Reasons for exclusion	Category of the main reason for exclusion
49	First response time for question #	Responses	Response time	Question		Total page times more relevant for survey duration estimation	More accurate/relevant measure available
50	Total response time for question #	Responses	Response time	Question		Total page times more relevant for survey duration estimation	More accurate/relevant measure available
51	First response time for question # adjusted for focus-out	Responses	Response time	Question		Total page times more relevant for survey duration estimation	More accurate/relevant measure available
52	First response time for question # adjusted for inactivity	Responses	Response time	Question		Total page times more relevant for survey duration estimation	More accurate/relevant measure available
53	Total response time for question # adjusted for focus-out	Responses	Response time	Question		Total page times more relevant for survey duration estimation	More accurate/relevant measure available
54	Total response time for question # adjusted for inactivity	Responses	Response time	Question		Total page times more relevant for survey duration estimation	More accurate/relevant measure available
55	Total # of items with speeding	Responses	Speeding	Respondent		Total page times more relevant for survey duration estimation	More accurate/relevant measure available
56	Uniformity of speeding	Responses	Speeding	Respondent		Total page times more relevant for survey duration estimation	More accurate/relevant measure available
57	# of focus-out events	Focus	# of focus-out events	Respondent	Yes	---	---
58	# of focus-out events on page #	Focus	# of focus-out events	Page		Used to aggregate to '# of focus-out events' at the respondent level; very short focus-out events may present noise in data	More accurate/relevant measure available
59	# of focus-out events longer than 5 s	Focus	# of focus-out events	Respondent	Yes	---	---
60	# of focus-out events longer than 5 s on page #	Focus	# of focus-out events	Page		Used to aggregate to '# of focus-out events longer than 5 s' at the respondent level	
61	Total focus-out duration	Focus	Focus-out duration	Respondent	Yes	---	---
62	Focus-out duration on page #	Focus	Focus-out duration	Page		Used to aggregate to 'Total focus-out duration' at the respondent level	Data quality or availability issues
63	# of short inactivity events	Inactivity	# of inactivity events	Respondent		High amount of noise in inactivity events identification	Data quality or availability issues
64	# of short inactivity events on page #	Inactivity	# of inactivity events	Page		High amount of noise in inactivity events identification; used to aggregate to '# of short inactivity events' at the respondent level.	Data quality or availability issues
65	# of long inactivity events	Inactivity	# of inactivity events	Respondent		High amount of noise in inactivity events identification	Data quality or availability issues

#	Initial indicator name	Category	Subcategory	Aggregation level	Set of 29 respondent-level indicators (Table 2)	Exclusion of the initial paradata indicator from subsequent sets	
						Reasons for exclusion	Category of the main reason for exclusion
66	# of long inactivity events on page #	Inactivity	# of inactivity events	Page		High amount of noise in inactivity events identification; used to aggregate to '# of long inactivity events' at the respondent level	Data quality or availability issues
67	Total inactivity time	Inactivity	Inactivity time	Respondent		High amount of noise in inactivity time estimation	Data quality or availability issues
68	Inactivity time on page #	Inactivity	Inactivity time	Page		High amount of noise in inactivity time estimation; used to aggregate to 'Total inactivity time' at the respondent level	Data quality or availability issues
69	Total # of clicks	Clicks and pointer actions	# of clicks	Respondent	Yes	---	---
70	# of excess clicks	Clicks and pointer actions	# of clicks	Respondent	Yes	---	---
71	# of clicks on page #	Clicks and pointer actions	# of clicks	Page		Used to aggregate to '# of excess clicks' at the respondent level	Aggregation to another level
72	Total # of non-input clicks	Clicks and pointer actions	# of clicks	Respondent		High amount of noise in identifying clicked elements	Data quality or availability issues
73	# of non-input clicks on page #	Clicks and pointer actions	# of clicks	Page		Used to aggregate to '# of excess clicks' at the respondent level; high amount of noise in identifying clicked elements	Data quality or availability issues
74	Pointer movement distance	Clicks and pointer actions	Pointer movement	Respondent	Yes	---	---
75	Pointer movement duration	Clicks and pointer actions	Pointer movement	Respondent	Yes	---	---
76	Pointer movement speed	Clicks and pointer actions	Pointer movement	Respondent	Yes	---	---
77	Pointer movement distance on page #	Clicks and pointer actions	Pointer movement	Page		Aggregated to 'Pointer movement distance' at the respondent level; only available if mouse or another pointing device is used	Data quality or availability issues
78	Pointer movement distance to answer item #	Clicks and pointer actions	Pointer movement	Item		Low reliability of data	Data quality or availability issues
79	# of pages with zoom-level changes	Page display	Zoom level	Respondent		High amount of noise in identifying zoom changes and meaningful thresholds; used to derive 'Proportion of pages with zoom level change' that provides a relative measure	Data quality or availability issues
80	Proportion of pages with zoom-level changes	Page display	Zoom level	Respondent		High amount of noise in identifying zoom changes and difficulties setting meaningful thresholds	Data quality or availability issues

#	Initial indicator name	Category	Subcategory	Aggregation level	Set of 29 respondent-level indicators (Table 2)	Exclusion of the initial paradata indicator from subsequent sets	
						Reasons for exclusion	Category of the main reason for exclusion
81	# of zoom-level changes	Page display	Zoom level	Respondent		High amount of noise in identifying zoom changes and difficulties setting meaningful thresholds	Data quality or availability issues
82	# of zoom-in actions	Page display	Zoom level	Respondent		High amount of noise in identifying zoom changes and difficulties setting meaningful thresholds	Data quality or availability issues
83	# of zoom-out actions	Page display	Zoom level	Respondent		High amount of noise in identifying zoom changes and difficulties setting meaningful thresholds	Data quality or availability issues
84	# of zoom-level changes on page #	Page display	Zoom level	Page		High amount of noise in identifying zoom changes and meaningful thresholds; aggregated to '# of zoom level changes' at the respondent level	Data quality or availability issues
85	# of zoom-in actions on page #	Page display	Zoom level	Page		High amount of noise in identifying zoom changes and meaningful thresholds; aggregated to '# of zoom-in actions' at the respondent level	Data quality or availability issues
86	# of zoom-out actions on page #	Page display	Zoom level	Page		High amount of noise in identifying zoom changes and meaningful thresholds; aggregated to '# of zoom-out actions' at the respondent level	Data quality or availability issues
87	# of pages with window resize	Page display	Window resize	Respondent		High amount of noise in identifying window resize data and difficulties setting meaningful thresholds; used to derive 'Proportion of pages with window resize' that provides a relative measure	Data quality or availability issues
88	Proportion of pages with window resize	Page display	Window resize	Respondent		High amount of noise in identifying window resize data and difficulties setting meaningful thresholds	Data quality or availability issues
89	# of pages with scroll action	Page display	Window resize	Respondent		High amount of noise in identifying scroll actions and difficulties setting meaningful thresholds; used to derive 'Proportion of pages with scroll action' that provides a relative measure	Data quality or availability issues
90	Proportion of pages with scroll action	Page display	Window resize	Respondent		High amount of noise in identifying scroll actions and difficulties setting meaningful thresholds	Data quality or availability issues
91	# of pages with orientation change	Page display	Device orientation	Respondent	Yes	---	---
92	Proportion of pages with orientation change	Page display	Device orientation	Respondent		Not relevant for data quality estimation; 'Type of device' is a more relevant measure	Not relevant

#	Initial indicator name	Category	Subcategory	Aggregation level	Set of 29 respondent-level indicators (Table 2)	Exclusion of the initial paradata indicator from subsequent sets	
						Reasons for exclusion	Category of the main reason for exclusion
93	Orientation change to portrait on page #	Page display	Device orientation	Page		Used to derive and aggregate to '# of pages with orientation change' at the respondent level	Aggregation to another level
94	Orientation change to landscape on page #	Page display	Device orientation	Page		Used to derive and aggregate to indicator '# of pages with orientation change' at the respondent level	Aggregation to another level
95	Total time in portrait orientation	Page display	Device orientation	Respondent		Not relevant for data quality estimation; used to derive 'Proportion of time in portrait orientation' that provides a relative measure	Not relevant
96	Proportion of time in portrait orientation	Page display	Device orientation	Respondent		Not relevant for data quality estimation	Not relevant
97	Time on page # in portrait orientation	Page display	Device orientation	Page		Used to derive and aggregate to 'Total time in portrait orientation' at the respondent level and to derive 'Proportion of time on page # in portrait orientation' that provides a relative measure	Aggregation to another level
98	Proportion of time on page # in portrait orientation	Page display	Device orientation	Page		Not relevant for response quality estimation	Not relevant
99	Time on page # in landscape orientation	Page display	Device orientation	Page		Redundant to 'Time on page # in portrait orientation' and 'Total time on page #'	Redundancy
100	Proportion of time on page # in landscape orientation	Page display	Device orientation	Page		Redundant to 'Proportion of time on page # in portrait orientation'	Redundancy
101	Total # of validation prompts	Validation prompts	# of prompts	Respondent	Yes	---	---
102	Total # of item nonresponse prompts	Validation prompts	# of prompts	Respondent	Yes	---	---
103	# of items triggering validation prompts	Validation prompts	# of prompts	Respondent		Redundant to '# of items triggering item nonresponse prompts' due to small number of non-item nonresponse validations	Redundancy
104	# of items triggering item nonresponse prompts	Validation prompts	# of prompts	Respondent		Not considered to provide substantial added value to 'Total # of item nonresponse prompts' for response quality estimation; used to derive an indicator that provides a relative measure	Redundancy
105	Proportion of items triggering item nonresponse prompts	Validation prompts	# of prompts	Respondent		Not considered to provide substantial added value to 'Total # of item nonresponse prompts' for response quality estimation	Redundancy

#	Initial indicator name	Category	Subcategory	Aggregation level	Set of 29 respondent-level indicators (Table 2)	Exclusion of the initial paradata indicator from subsequent sets	
						Reasons for exclusion	Category of the main reason for exclusion
106	# of attempts to leave item # unanswered	Validation prompts	# of prompts	Respondent		Not considered to provide substantial added value to 'Total # of item nonresponse prompts' for response quality estimation	Redundancy
107	Total # of positive responses to validation prompts	Validation prompts	Message response	Respondent		Not considered to provide substantial added value to 'Total # of item nonresponse prompts' for response quality estimation	Redundancy
108	Total # of negative responses to validation prompts	Validation prompts	Message response	Respondent		Not considered to provide substantial added value to 'Total # of item nonresponse prompts' for response quality estimation	Redundancy
109	Total # of positive responses to item nonresponse prompts	Validation prompts	Message response	Respondent		Not considered to provide substantial added value to ''Total # of item nonresponse prompts' for response quality estimation	Redundancy
110	Total # of negative responses to item nonresponse prompts	Validation prompts	Message response	Respondent		Not considered to provide substantial added value to 'Total # of item nonresponse prompts' for response quality estimation	Redundancy
111	Average time to respond to validation message	Validation prompts	Message response	Respondent		Not relevant for data quality estimation	Redundancy
112	Average time to respond to item nonresponse message	Validation prompts	Message response	Respondent		Not relevant for data quality estimation	Redundancy

6 Correlations between the key paradata indicators

Table A.10: Correlations between the key paradata indicators included in the main analysis

	Device type	# of focus-out events	Focus-out duration	Duration	# of item nonresponse prompts	# of excess clicks	# of branching items omitted	# of pages visited	# of repeatedly visited pages	# of answer changes
Device type	1.000	-0.044*	0.017	0.051**	0.152**	0.294**	-0.169**	-0.044**	0.068**	0.135**
# of focus-out events	-0.044*	1.000	0.687**	0.320**	0.005	-0.017	-0.118**	0.132**	0.065**	0.120**
Focus-out duration	0.017	0.687**	1.000	0.388**	0.012	-0.001	-0.133**	0.076**	0.073**	0.115**
Duration	0.051**	0.320**	0.388**	1.000	0.030	0.043*	0.013	0.233**	0.238**	0.134**
# of item nonresponse prompts	0.152**	0.005	0.012	0.030	1.000	0.302**	-0.069**	-0.089**	0.127**	0.325**
# of excess clicks	0.294**	-0.017	-0.001	0.043*	0.302**	1.000	-0.059**	-0.106**	0.098**	0.124**
# of branching items omitted	-0.169**	-0.118**	-0.133**	0.013	-0.069**	-0.059**	1.000	-0.036*	-0.001	-0.138**
# of pages visited	-0.044**	0.132**	0.076**	0.233**	-0.089**	-0.106**	-0.036*	1.000	0.185**	0.111**
# of repeatedly visited pages	0.068**	0.065**	0.073**	0.238**	0.127**	0.098**	-0.001	0.185**	1.000	0.199**
# of answer changes	0.135**	0.120**	0.115**	0.134**	0.325**	0.124**	-0.138**	0.111**	0.199**	1.000

NOTE—*, $p < .05$; **, $p < .01$. Sampling weights applied.

Table A.11: Correlations between the key paradata indicators included in the main analysis plus the pointer movement distance indicator (available only for PCs)

	Device type	# of focus-out events	Focus-out duration	Duration	# of item nonresponse prompts	# of excess clicks	# of branching items omitted	# of pages visited	# of repeatedly visited pages	# of answer changes	Pointer movement distance
Device type	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
# of focus-out events	(a)	1	0.688**	0.458**	0.018	0.011	-0.167**	0.135**	0.079**	0.156**	0.046*
Focus-out duration	(a)	0.688**	1	0.550**	0.013	0.030	-0.175**	0.087**	0.092**	0.160**	0.000
Duration	(a)	0.458**	0.550**	1	0.021	0.003	-0.035	0.279**	0.118**	0.204**	0.222**
# of item nonresponse prompts	(a)	0.018	0.013	0.021	1	0.157**	-0.001	-0.047*	0.089**	0.312**	-0.014
# of excess clicks	(a)	0.011	0.030	0.003	0.157**	1	-0.029	-0.113**	0.044	0.040	0.057*
# of branching items omitted	(a)	-0.167**	-0.175**	-0.035	-0.001	-0.029	1	-0.093**	-0.015	-0.099**	0.024
# of pages visited	(a)	0.135**	0.087**	0.279**	-0.047*	-0.113**	-0.093**	1	0.205**	0.113**	0.323**
# of repeatedly visited pages	(a)	0.079**	0.092**	0.118**	0.089**	0.044	-0.015	0.205**	1	0.213**	0.078**
# of answer changes	(a)	0.156**	0.160**	0.204**	0.312**	0.040	-0.099**	0.113**	0.213**	1	0.042
Pointer movement distance	(a)	0.046*	0.000	0.222**	-0.014	0.057*	0.024	0.323**	0.078**	0.042	1

NOTE—*, $p < .05$; **, $p < .01$. (a) denotes that the correlation cannot be computed because at least one of the variables is constant. Specifically, the device type included only PCs. Sampling weights applied.

Table A.12: Correlations between the key paradata indicators included in the main analysis plus the operating system indicator (available only for SPs)

	Device type	# of focus-out events	Focus-out duration	Duration	# of item nonresponse prompts	# of excess clicks	# of branching items omitted	# of pages visited	# of repeatedly visited pages	# of answer changes	Operating system
Device type	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
# of focus-out events	(a)	1.000	0.714**	0.221**	0.006	-0.035	-0.067**	0.126**	0.062*	0.077**	0.073**
Focus-out duration	(a)	0.714**	1.000	0.273**	0.007	-0.060*	-0.081**	0.064*	0.056*	0.054*	0.117**
Duration	(a)	0.221**	0.273**	1.000	0.024	0.057*	0.067**	0.212**	0.308**	0.070**	0.008
# of item nonresponse prompts	(a)	0.006	0.007	0.024	1.000	0.418**	-0.084**	-0.119**	0.138**	0.324**	-0.147**
# of excess clicks	(a)	-0.035	-0.060*	0.057*	0.418**	1.000	0.018	-0.075**	0.129**	0.171**	-0.533**
# of branching items omitted	(a)	-0.067**	-0.081**	0.067**	-0.084**	0.018	1.000	0.015	0.034	-0.143**	-0.116**
# of pages visited	(a)	0.126**	0.064*	0.212**	-0.119**	-0.075**	0.015	1.000	0.177**	0.126**	0.064*
# of repeatedly visited pages	(a)	0.062*	0.056*	0.308**	0.138**	0.129**	0.034	0.177**	1.000	0.177**	-0.016
# of answer changes	(a)	0.077**	0.054*	0.070**	0.324**	0.171**	-0.143**	0.126**	0.177**	1.000	0.065*
Operating system	(a)	0.073**	0.117**	0.008	-0.147**	-0.533**	-0.116**	0.064*	-0.016	0.065*	1.000

NOTE—*, $p < .05$; **, $p < .01$. (a) denotes that the correlation cannot be computed because at least one of the variables is constant. Specifically, the device type included only SPs. Sampling weights applied.

7 Descriptive statistics for Response Quality Indicators

Table A.13: Descriptive statistics for RQIs

Response quality indicator	Descriptive statistics					
	N	Mean	Std. Deviation	Median	Minimum	Maximum
Breakoffs	3542	0.070	0.000	0.248	0.000	1.000
Outliers	3196	0.050	0.000	0.225	0.000	1.000
Item nonresponse	3542	0.004	0.000	0.014	0.000	0.220
Straightlining	3420	0.412	0.000	0.645	0.000	4.000
Extreme positive responses	3422	0.049	0.025	0.078	0.000	1.000
Extreme negative responses	3422	0.124	0.090	0.117	0.000	1.000
Midpoint responses	3422	0.340	0.326	0.174	0.000	1.000
Concurrent multitasking	3311	0.220	0.000	0.496	0.000	4.000
Sequential multitasking	3311	0.210	0.000	0.573	0.000	5.000
Duration	3542	7.451	7.224	0.994	5.310	14.140
Effort	3317	3.470	3.000	0.889	1.000	5.000
Burden	3316	1.870	2.000	0.930	1.000	5.000
Instructional Manipulation Check	3515	0.110	0.000	0.393	0.000	2.000

NOTE— Sampling weights not applied. See Section 5.4 in the paper for a detailed description of RQIs.

8 Paradata comparison with the CRONOS panel

Table A.14: Comparisons between the paradata indicators from the CRONOS panel and the set of key paradata indicators

CRONOS paradata indicators	Key paradata indicators[a]
A1. *Screen resolution and dimensions*	(Not available)[b]
A2. *Final disposition status* (e.g. noncontact, breakoff)	(Not included, as it belongs to RQIs)
A3. *Last page displayed*	(Not included, as it belongs to RQIs)
A4. *Date and time of first access*	(See 1. *Duration*)
A5. *Date and time of last access*	(See 1. *Duration*)
A6. *Total time (s)*	1. *Duration*
A7. *Number of pages with back click*	2. *Total number of repeatedly visited pages*
A8. *Number of pages with attempted skip*	(See 7. *Total number of item nonresponse prompts*)
A9. *Device type used*	3. *Device type*
A10. *User agent used*	4. *Operating system*
A11. *Number of pages submitted*	5. *Total number of pages visited*
A12. *Time on a questionnaire page (seconds)* [c]	(See 1. *Duration*)
A13. *Back click on a questionnaire page*[c]	(See 2. *Total number of repeatedly visited pages)*
A14. *Attempted skip of a questionnaire page*[c]	6. *Total number of item nonresponse prompts*
(Not available)	7. *Total number of branching items omitted*
(Not available)	8. *Total number of answer changes*
(Not available)	9. *Total number of excess clicks*
(Not available)	10. *Total mouse pointer movement distance*
(Not available)	11. *Total number of focus-out events*
(Not available)	12. *Total focus-out duration*

[a]The study did not allow device switching, and the survey had to be completed in a single session (thus, all paradata were captured in relation to a single device, user agent string and session for each respondent).

[b]The paradata related to screen resolution were omitted in the present study by the first step, as they had a technically ambiguous interpretation.

[c]The paradata were aggregated at page level, and for the purpose of comparisons, they would need to be further aggregated to the respondent level.

9 Survey questions for survey estimates

Table A.15: Survey items which were the basis for survey estimates about Internet use

Question label: O1; Question type: Single answer
Question text: How often on average did you use the Internet in the last 12 months?
Substantive answer options: 1. Several times a day 2. Every day or almost every day 3. 3–4 times a week 4. 1–2 times a week 5. At least once a month 6. Less than once a month
Question label: O2; Question type: Multiple answers
Question text: Did you use any of the following devices to browse the web in the last 12 months? (Multiple answers are possible)
Substantive answer options: 1. Desktop or laptop computer 2. Tablet computer 3. Mobile phone or smartphone 4. Smart TV (web browsing through a browser app on TV) 5. Other devices (e.g. media or games player, e-book reader or smart watch)
Question label: O3, question type: Single answer
Question text: Do you use a smartphone for personal purposes?
Substantive answer options: 1. Yes 2. No

Table A.16: Survey items which were the basis for survey estimates about trust in computers

Question label: O21; Question type: Grid
Question text: Please specify to what extent you agree or disagree that computers can be trusted to carry out the following tasks.
Grid items: 1. Autocompletion of text 2. Spelling and grammar check 3. Selecting a playlist to match my musical preferences 4. Selecting the best and most efficient route in my GPS navigation app while driving 5. Autonomous driving of a motor vehicle 6. Diagnosis of my medical status by an AI system
Substantive answer options: 1. Strongly disagree 2. Disagree 3. Neither agree nor disagree 4. Agree 5. Strongly agree

10 References

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