Supplement

Trust keeps anger at bay: Germany's experience with the measles vaccine mandate – a longitudinal survey study

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This supplement contains:

Supplementary results on data quality

Dropout analysis

We found small but significant differences on key outcome variables at T1 between dropouts and non-dropouts at T2, using t-tests:

- Dropouts reported higher levels of reactance ($M = 1{\cdot}93$) than non-dropouts ($M = 1{\cdot}83$), $t(3427) = 3{\cdot}02$, $p = 0{\cdot}003$, Cohen's $d = 0{\cdot}11$.
- Dropouts had a more negative attitude toward the mandate ($M = 3{\cdot}74$) than non-dropouts ($M = 3{\cdot}84$), $t(3607) = -3{\cdot}55$, $p < 0{\cdot}001$, Cohen's $d = -0{\cdot}12$.
- Dropouts reported lower levels of vaccine confidence ($M = 3{\cdot}42$) than non-dropouts ($M = 3{\cdot}54$), $t(3696) = -4{\cdot}04$, $p < 0{\cdot}001$, Cohen's $d = -0{\cdot}13$.
- Dropouts reported lower levels of institutional trust ($M = 3{\cdot}03$) than non-dropouts ($M = 3{\cdot}10$), $t(3789) = -3{\cdot}10$, $p = 0{\cdot}002$, Cohen's $d = -0{\cdot}09$.

Robustness checks

We tested the robustness of the primary analysis in several ways. All confirmatory analyses were repeated using different data.

- For data frame 1, we excluded duplicates and individuals who reappeared in the refreshment sample after initially dropping out. We also excluded individuals who changed their parental status, allowing us to keep the group comparison between parents and adults without children coherent.
- For data frame 2, we applied the exclusions from data frame 1 and additionally excluded speeders and those who failed attention checks. Speeders were defined as individuals who completed the survey in more than 1 standard deviation below the mean duration time. A single item was included as an attention check to detect inattentive responders: for T1 this was ‘Which colour do you prefer? Please select red and green’; for T2–T6 this was ‘It is very important that you answer every question carefully. Please click “Yes, does apply” here.’ Individuals who failed any attention check were excluded.
- For data frame 3, in addition to the above, we excluded individuals who had made implausible or inconsistent entries for key survey items: those who changed their sex or number of children over time, and those for whom the youngest child’s age decreased across waves.
- For data frame 4, we conducted multiple imputation based on data frame 1, additionally excluding individuals with implausible or inconsistent entries. Multiple imputation was used to replace missing values across all measurement points, covering both wave and item non-response. Data from participants recruited later (refreshment sample) were not imputed for earlier waves (before recruitment); i.e., data missing by design were not imputed. We used n = 100 imputations and restricted possible values for all scales to their respective endpoints.

Supplementary Table S1. Robustness checks for results from final model 4: changes in psychological reactance over time as a function of changes in trust

	DF1			DF2			DF3			Imputation		
Predictors	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*
(Intercept)	2·80	2·73 – 2·88	**<0·001**	2·76	2·68 – 2·85	**<0·001**	2·74	2·65 – 2·84	**<0·001**	2·72	2·64 – 2·79	**<0·001**
Time (months)	-0·00	-0·00 – 0·00	0·503	-0·00	-0·00 – 0·00	0·054	-0·00	-0·00 – 0·00	0·390	0·01	0·01 – 0·01	**<0·001**
Group (adults without children, ref: parents)	-0·12	-0·18 – -0·06	**<0·001**	-0·13	-0·19 – -0·06	**<0·001**	-0·10	-0·16 – -0·04	**0·002**	−0·01	-0·07 – 0·04	0.625
Trust (person mean score = level 2 effect, between subjects)	-0·28	-0·30 – -0·26	**<0·001**	-0·29	-0·32 – -0·26	**<0·001**	-0·29	-0·32 – -0·26	**<0·001**	−0·28	-0·30 – -0·26	**<0·001**
Trust (deviation from person mean = level 1 effect, within subject)	-0·02	-0·04 – -0·00	**0·038**	-0·06	-0·08 – -0·04	**<0·001**	-0·07	-0·09 – -0·04	**<0·001**	−0·07	-0·10 – −0·05	**<0·001**
Interaction: time × group (adults without children, ref: parents)	-0·00	-0·01 – -0·00	**0·008**	-0·00	-0·01 – -0·00	**0·003**	-0·01	-0·01 – -0·00	**0·001**	−0·01	-0·01 – -0·01	**0.002**
Random Effects												
σ^2	0·36			0·27			0·24			-		
τ_{00}	0·94 $_{ID}$			0·92 $_{ID}$			0·92 $_{ID}$			-		
ICC	0·72			0·78			0·79			-		
N	10,771 $_{ID}$			8489 $_{ID}$			7884 $_{ID}$			8390 $_{ID}$		
Observations	29,896			21,730			19,279			5,084,643		
Marginal R^2 / Conditional R^2	0·047 / 0·737			0·058 / 0·788			0·054 / 0·804			-		
AIC	74,105·979			50,116·216			43,554·036			-		

Note: DF1 = all respondents, excluding duplicates and individuals who reappeared in the refreshment sample. DF2 = DF1 minus speeders and attention-check failures. DF3 = DF2 minus respondents with implausible or inconsistent entries in relevant survey items. Imputation = DF1 minus implausible or inconsistent entries in relevant survey items, with multiple imputation applied.

Supplementary Table S2. Robustness checks for results from final model 4: changes in attitude toward the mandate over time as a function of changes in trust

	DF1			DF2			DF3			Imputation		
Predictors	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*
(Intercept)	2·49	2·42 – 2·55	**<0·001**	2·50	2·42 – 2·59	**<0·001**	2·53	2·44 – 2·62	**<0·001**	2·59	2·52 – 2·66	**< 0·001**
Time (months)	-0·01	-0·02 – -0·01	**<0·001**	-0·01	-0·02 – -0·01	**<0·001**	-0·02	-0·02 – -0·01	**<0·001**	-0·02	-0·02 – -0·02	**< 0·001**
Group (adults without children, ref: parents)	-0·02	-0·07 – 0·03	0·402	-0·03	-0·09 – 0·03	0·331	-0·05	-0·12 – 0·02	0·150	-0·05	-0·10 – <0·01	0.054
Trust (person mean score = level 2 effect, between subjects)	0·43	0·41 – 0·45	**<0·001**	0·44	0·41 – 0·46	**<0·001**	0·43	0·41 – 0·46	**<0·001**	0·42	0·39 – 0·44	**<0.001**
Trust (deviation from person mean = level 1 effect, within subject)	0·14	0·12 – 0·15	**<0·001**	0·11	0·09 – 0·13	**<0·001**	0·10	0·08 – 0·13	**<0·001**	0·17	0·14 – 0·19	**< 0·001**
Interaction: time × group (adults without children, ref: parents)	0·01	0·00 – 0·01	**<0·001**	0·01	0·01 – 0·01	**<0·001**	0·01	0·01 – 0·01	**<0·001**	0·01	<0·01 – 0·01	**<0·001**
Random Effects												
σ^2	0·36			0·36			0·35			-		
τ_{00}	0·65 $_{ID}$			0·70 $_{ID}$			0·70 $_{ID}$			-		
ICC	0·64			0·66			0·66			-		
N	11,250 $_{ID}$			8787 $_{ID}$			8048 $_{ID}$			8390 $_{ID}$		
Observations	31,988			22,789			19,808			5,084,643		
Marginal R^2 / Conditional R^2	0·128 / 0·691			0·120 / 0·701			0·119 / 0·703			-		
AIC	71,716·558			53,080·022			46,275·079			-		

Note: DF1 = all respondents, excluding duplicates and individuals who reappeared in the refreshment sample. DF2 = DF1 minus speeders and attention-check failures. DF3 = DF2 minus respondents with implausible or inconsistent entries in relevant survey items. Imputation = DF1 minus implausible or inconsistent entries in relevant survey items, with multiple imputation applied.

Supplementary Table S3. Robustness checks for results from logistic regression: association between level of reactance at T1 and vaccination status against MenC at T5

	DF1			DF2			DF3		
Predictors	*Odds Ratios*	*CI*	*p*	*Odds Ratios*	*CI*	*p*	*Odds Ratios*	*CI*	*p*
(Intercept)	15·05	6·42 – 39·39	**<0·001**	12·63	4·75 – 38·30	**<0·001**	12·12	3·93 – 43·68	**<0·001**
mreactance_T1	0·49	0·34 – 0·68	**<0·001**	0·56	0·36 – 0·85	**0·007**	0·57	0·32 – 0·99	**0·045**
Observations	122			88			68		
R^2 Tjur	0·177			0·059			0·079		

Note: DF1 = all respondents, excluding duplicates and individuals who reappeared in the refreshment sample. DF2 = DF1 minus speeders and attention-check failures. DF3 = DF2 minus respondents with implausible or inconsistent entries in relevant survey items.

Supplementary results

Descriptive data

Supplementary Table S4. Mean, standard deviation, and percentage of data completeness for each variable of interest

Group: Parents						
	T1 (n = 4836) Mean (SD); % complete data	T2 (n = 3394) Mean (SD); % complete data	T3 (n = 2754) Mean (SD); % complete data	T4 (n = 5041) Mean (SD); % complete data	T5 (n = 3136) Mean (SD); % complete data	T6 (n = 2331) Mean (SD); % complete data
Time (months)	5·87 (0·26); 100%	7·63 (0·07); 100%	8·92 (0·10); 100%	15·6 (0·13); 100%	20·6 (0·10); 100%	24·6 (0·10); 100%
Attitude toward mandate	3·80 (1·05); 100%	3·78 (1·01); 100%	3·70 (1·03); 100%	3·44 (1·09); 100%	3·59 (1·10); 100%	3·56 (1·11); 100%
Trust	3·08 (0·87); 99·2%	3·11 (0·90); 99·5%	3·13 (0·92); 99·3%	3·02 (0·95); 99·3%	2·99 (0·93); 99·3%	2·97 (0·95); 99·2%
Reactance	1·89 (1·19); 97·2%	1·88 (1·18); 97·9%	1·89 (1·19); 97·7%	2·00 (1·22); 96·8%	1·86 (1·18); 97·0%	1·82 (1·15); 96·9%

Group: Adults without children						
	T1 (n = 2065) Mean (SD); % complete data	T2 (n = 1586) Mean (SD); % complete data	T3 (n = 1386) Mean (SD); % complete data	T4 (n = 2403) Mean (SD); % complete data	T5 (n = 1831) Mean (SD); % complete data	T6 (n = 1497) Mean (SD); % complete data
Time	5·89 (0·27); 100%	7·62 (0·05); 100%	8·88 (0·08); 100%	15·6 (0·10); 100%	20·6 (0·10); 100%	24·6 (0·08); 100%
Attitude toward mandate	3·84 (1·02); 100%	3·82 (1·00); 100%	3·75 (1·04); 100%	3·51 (1·10); 100%	3·74 (1·07); 100%	3·72 (1·08); 100%
Trust	3·05 (0·90); 99·0%	3·07 (0·93); 99·1%	3·09 (0·95); 98·7%	2·93 (0·91); 99·0%	2·95 (0·94); 98·6%	2·96 (0·96); 99·1%
Reactance	1·78 (1·11); 95·5%	1·77 (1·08); 95·7%	1·74 (1·07); 95·0%	1·77 (1·06); 94·2%	1·62 (1·01); 93·6%	1·65 (1·04); 93·1%

Note: Attitude toward the mandate, trust, and reactance were measured on a 5-point Likert scale (1 = lowest, 5 = highest), indicating, for example, low to high levels of reactance. Data shown are from data frame 1.

Linear mixed-effects models 1–4

Supplementary Table S5. Changes in psychological reactance over time as a function of changes in trust. Models 1–4.

	M1: null model			**M2: +time**			**M3: +group+AR1**			**M4: +trust**		
Predictors	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*
(Intercept)	1·89	1·87 – 1·91	**<0·001**	1·91	1·88 – 1·93	**<0·001**	1·94	1·91 – 1·97	**<0·001**	2·80	2·73 – 2·88	**<0·001**
Time (months)				-0·00	-0·00 – -0·00	**0·034**	-0·00	-0·00 – 0·00	0·816	-0·00	-0·00 – 0·00	0·503
Group (adults without children, ref: parents)							-0·11	-0·17 – -0·05	**<0·001**	-0·12	-0·18 – -0·06	**<0·001**
Interaction: time × group (adults without children, ref: parents)							-0·00	-0·01 – -0·00	**0·012**	-0·00	-0·01 – -0·00	**0·008**
Trust (person mean score = level 2 effect, between subjects)										-0·28	-0·30 – -0·26	**<0·001**
Trust (deviation from person mean = level 1 effect, within subject)										-0·02	-0·04 – -0·00	**0·038**
Random Effects												
σ^2	0·34			0·34			0·36			0·36		
τ_{00}	1·02 $_{ID}$			1·02 $_{ID}$			1·00 $_{ID}$			0·94 $_{ID}$		
ICC	0·75			0·75			0·74			0·72		
N	10,796 $_{ID}$			10,796 $_{ID}$			10,796 $_{ID}$			10,771 $_{ID}$		
Observations	30,051			30,050			30,050			29,896		
Marginal R^2 / Conditional R^2	0·000 / 0·748			0·000 / 0·748			0·004 / 0·737			0·047 / 0·737		
AIC	75,338·068			75,331·648			75,141·825			74,105·979		

Supplementary Table S6. Changes in attitude toward the mandate over time as a function of changes in trust. Models 1–4.

	M1: null model			M2: +time			M3: +group+AR1			M4: +trust		
Predictors	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*	*Estimates*	*CI*	*p*
(Intercept)	3·64	3·62 – 3·66	**<0·001**	3·80	3·79 – 3·83	**<0·001**	3·81	3·78 – 3·84	**<0·001**	2·49	2·42 – 2·56	**<0·001**
Time (months)				-0·01	-0·01 – -0·01	**<0·001**	-0·02	-0·02 – -0·01	**<0·001**	-0·01	-0·02 – -0·01	**<0·001**
Group (adults without children, ref: parents)							-0·04	-0·10 – 0·01	0·132	-0·02	-0·07 – 0·03	0·486
Interaction: time × group (adults without children, ref: parents)							0·01	0·00 – 0·01	**<0·001**	0·01	0·01 – 0·01	**<0·001**
Trust (person mean score = level 2 effect, between subjects)										0·43	0·41 – 0·45	**<0·001**
Trust (deviation from person mean = level 1 effect, within subject)										0·13	0·11 – 0·15	**<0·001**
Random Effects												
σ^2	0·33			0·33			0·37			0·36		
τ_{00}	0·83 $_{ID}$			0·83 $_{ID}$			0·79 $_{ID}$			0·65 $_{ID}$		
ICC	0·71			0·72			0·68			0·64		
N	11,285 $_{ID}$			11,285 $_{ID}$			11,285 $_{ID}$			11,250 $_{ID}$		
Observations	32,259			32,258			32,258			31,988		
Marginal R^2 / Conditional R^2	0·000 / 0·714			0·007 / 0·719			0·007 / 0·688			0·128 / 0·691		
AIC	77,921·35			77,451·17			76,701·74			71,716·558		

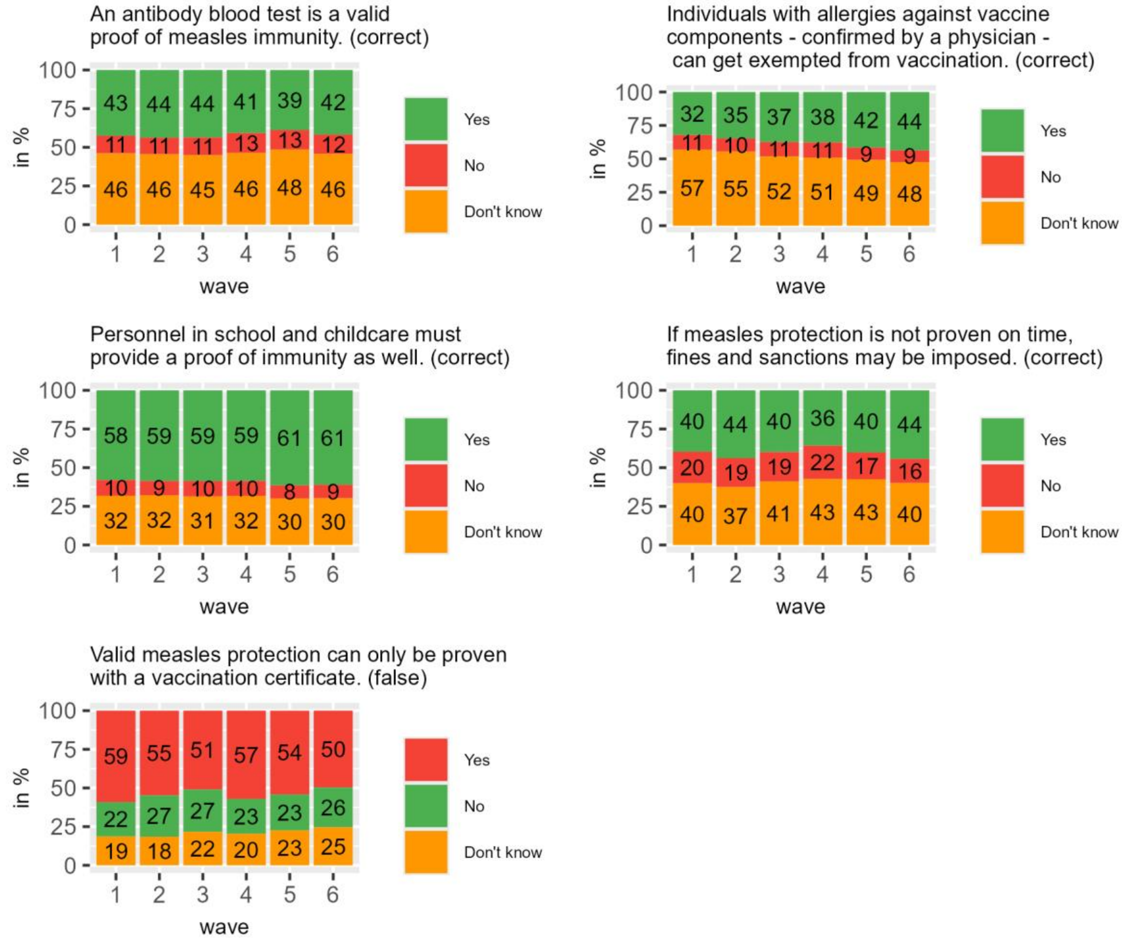
Logistic regression

Supplementary Table S7. Association between level of reactance at T1 and vaccination status against MenC at T5. Results from logistic regression analysis.

	Model 1 (all)			Model 2 (moderate–high confidence)		
Predictors	*Odds Ratios*	*CI*	*p*	*Odds Ratios*	*CI*	*p*
(Intercept)	15·05	6·42 – 39·39	**<0·001**	17·07	6·24 – 53·95	**<0·001**
Reactance (mean) at T1	0·49	0·34 – 0·68	**<0·001**	0·51	0·32 – 0·80	**0·004**
Observations	122			101		
R^2 Tjur	0·177			0·107		

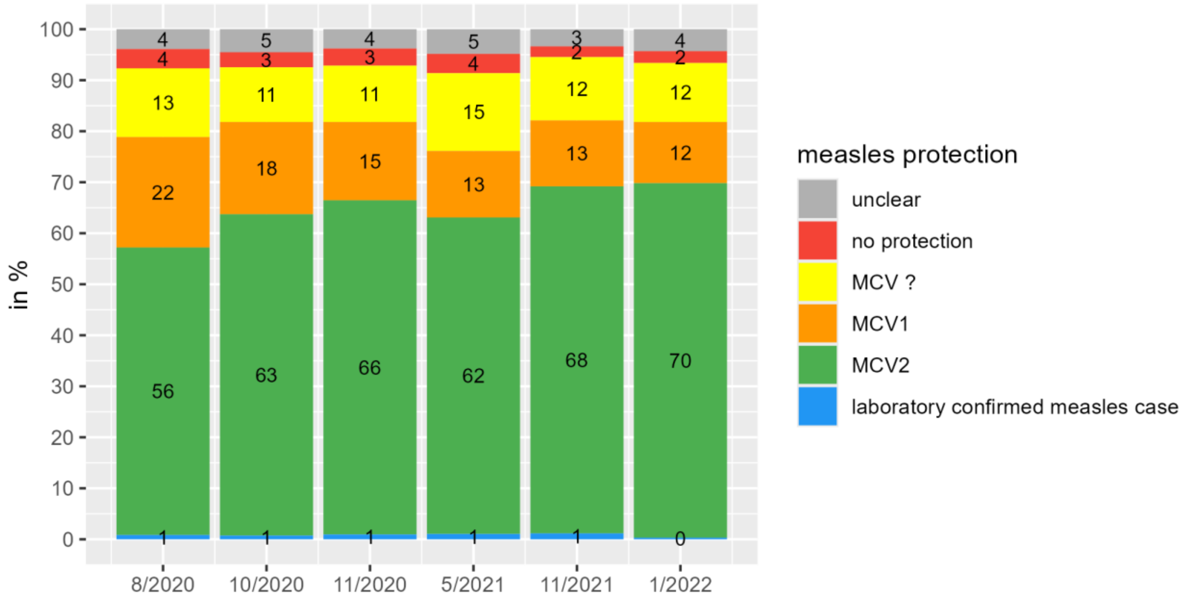
Exploratory analysis

Supplementary Figure S1. Knowledge about the measles vaccine mandate and the regulations it entails



Note: Adults without children and respondents who changed their parental status over time were excluded.

Supplementary Figure S2. Measles protection status of children aged 1–18 years



Note: n = 951. Self-reported data from parents who participated in all six waves. MCV1 = measles-containing vaccine, first dose; MCV2 = measles-containing vaccine, second dose; MCV? = number of measles-containing vaccine doses unknown; unclear = vaccination status unclear or self-reported measles case without laboratory confirmation.