Beyond binary: a machine-learning classification of childhood COVID-19 vaccination intentions using behavioural data

Supplementary Information

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S1 Vaccinated respondents in the sample and in the respective population

Table S1: Cumulative proportion of vaccinated respondents in the sample and in the population aged 18 or older (weighted by the sample's age distribution), shown by week (week 1 = first week of June), for Italy and the UK respectively.

Week	**Sample (Italy)**	**Population (Italy)**	**Sample (UK)**	**Population (UK)**
1	0.70	0.30	0.80	0.62
2	0.72	0.38	0.84	0.64
3	0.71	0.44	0.80	0.67
4	0.67	0.50	0.85	0.70
5	0.62	0.55	0.81	0.72
6	0.65	0.58	0.78	0.73
7	0.62	0.59	0.68	0.74
8	0.61	0.62	0.63	0.75

S2 Participants' characteristics by parental status and outcome class

The set of variables used in the analysis are reported. The statistics refer to the dataset in respondent-child age group format.

Table S2

Characteristic	Parent			Non parent		
	Unwilling, N = 827[1*]	**Undecided**, N = 897[1*]	**Willing**, N = 1,092[1*]	**Unwilling**, N = 5,673[1*]	**Undecided**, N = 5,005[1*]	**Willing**, N = 6,414[1*]
Age	39.22 (8.92)	38.78 (8.51)	42.09 (9.34)	42.59 (16.94)	40.37 (17.06)	42.36 (18.17)
Flu vaccines						
0	623 (75.33%)	363 (40.47%)	392 (35.90%)	3,912 (68.96%)	2,654 (53.03%)	2,999 (46.76%)
1	98 (11.85%)	103 (11.48%)	143 (13.10%)	512 (9.03%)	703 (14.05%)	896 (13.97%)
2	46 (5.56%)	171 (19.06%)	162 (14.84%)	343 (6.05%)	542 (10.83%)	562 (8.76%)
3	21 (2.54%)	144 (16.05%)	136 (12.45%)	213 (3.75%)	377 (7.53%)	445 (6.94%)
4	15 (1.81%)	79 (8.81%)	145 (13.28%)	152 (2.68%)	193 (3.86%)	267 (4.16%)
5	24 (2.90%)	37 (4.12%)	114 (10.44%)	541 (9.54%)	536 (10.71%)	1,245 (19.41%)
Right-wing leaning	4.08 (1.52)	3.76 (1.35)	3.94 (1.67)	4.04 (1.50)	3.76 (1.46)	3.63 (1.57)
Friends' attitude	48.91 (30.17)	66.56 (19.55)	82.48 (17.13)	59.44 (30.12)	73.15 (21.95)	85.21 (19.07)
Vaccine info from partner/family	2.57 (1.42)	2.35 (1.42)	2.71 (1.42)	2.82 (1.44)	2.90 (1.50)	3.28 (1.40)
Vaccine info from friends	3.94 (1.39)	3.64 (1.45)	3.85 (1.31)	3.88 (1.45)	4.01 (1.42)	4.36 (1.31)
Vaccine info from doctor/paediatrician	2.64 (1.42)	2.46 (1.34)	2.35 (1.31)	2.76 (1.51)	2.49 (1.39)	2.23 (1.24)
Vaccine info from internet/Social Media	4.26 (1.70)	4.28 (1.42)	4.49 (1.43)	4.28 (1.67)	4.52 (1.51)	4.78 (1.46)
Vaccine info from TV/Newspapers/Radio	4.49 (1.57)	4.56 (1.37)	4.19 (1.58)	4.25 (1.63)	4.24 (1.55)	4.12 (1.48)
Vaccine info from Ministry of Health	3.59 (1.92)	3.79 (1.93)	3.50 (2.06)	3.51 (2.04)	3.03 (1.94)	2.44 (1.75)
Vaccine info from other source	6.51 (1.53)	6.92 (0.53)	6.90 (0.62)	6.49 (1.55)	6.81 (0.85)	6.79 (0.92)
Treatment						
Placebo	305 (36.88%)	290 (32.33%)	371 (33.97%)	2,061 (36.33%)	1,609 (32.15%)	1,905 (29.70%)
Herd immunity	273 (33.01%)	278 (30.99%)	377 (34.52%)	1,726 (30.42%)	1,652 (33.01%)	2,296 (35.80%)
Risk	249 (30.11%)	329 (36.68%)	344 (31.50%)	1,886 (33.25%)	1,744 (34.85%)	2,213 (34.50%)
Gender						
Female	595 (71.95%)	517 (57.64%)	532 (48.72%)	3,382 (59.62%)	2,851 (56.96%)	3,584 (55.88%)
Male	232 (28.05%)	380 (42.36%)	560 (51.28%)	2,291 (40.38%)	2,154 (43.04%)	2,830 (44.12%)
Region						
North-West	140 (16.93%)	95 (10.59%)	107 (9.80%)	901 (15.88%)	785 (15.68%)	894 (13.94%)
North-East	85 (10.28%)	52 (5.80%)	155 (14.19%)	533 (9.40%)	387 (7.73%)	537 (8.37%)
Centre	71 (8.59%)	56 (6.24%)	80 (7.33%)	525 (9.25%)	514 (10.27%)	656 (10.23%)
South	100 (12.09%)	66 (7.36%)	102 (9.34%)	614 (10.82%)	555 (11.09%)	742 (11.57%)
Islands	57 (6.89%)	41 (4.57%)	50 (4.58%)	422 (7.44%)	224 (4.48%)	328 (5.11%)
England	315 (38.09%)	517 (57.64%)	514 (47.07%)	2,256 (39.77%)	2,175 (43.46%)	2,749 (42.86%)
Northern Ireland	13 (1.57%)	22 (2.45%)	13 (1.19%)	43 (0.76%)	41 (0.82%)	51 (0.80%)
Scotland	24 (2.90%)	25 (2.79%)	39 (3.57%)	242 (4.27%)	188 (3.76%)	250 (3.90%)
Wales	22 (2.66%)	23 (2.56%)	32 (2.93%)	137 (2.41%)	136 (2.72%)	207 (3.23%)
Residence						

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Table S2 – *Continued from previous page*

Characteristic	Parent			Non parent		
	Unwilling, N = 827[1*]	**Undecided**, N = 897[1*]	**Willing**, N = 1,092[1*]	**Unwilling**, N = 5,673[1*]	**Undecided**, N = 5,005[1*]	**Willing**, N = 6,414[1*]
City	284 (34.34%)	375 (41.81%)	515 (47.16%)	2,065 (36.40%)	1,864 (37.24%)	2,068 (32.24%)
Suburb	155 (18.74%)	237 (26.42%)	246 (22.53%)	1,296 (22.85%)	1,204 (24.06%)	1,610 (25.10%)
Town	262 (31.68%)	220 (24.53%)	228 (20.88%)	1,612 (28.42%)	1,294 (25.85%)	1,891 (29.48%)
Rural area	126 (15.24%)	65 (7.25%)	103 (9.43%)	700 (12.34%)	643 (12.85%)	845 (13.17%)
Education						
1	73 (8.83%)	52 (5.80%)	56 (5.13%)	528 (9.31%)	501 (10.01%)	522 (8.14%)
2	297 (35.91%)	273 (30.43%)	304 (27.84%)	2,041 (35.98%)	1,642 (32.81%)	2,090 (32.58%)
3	149 (18.02%)	183 (20.40%)	165 (15.11%)	999 (17.61%)	940 (18.78%)	1,305 (20.35%)
4	113 (13.66%)	169 (18.84%)	248 (22.71%)	761 (13.41%)	764 (15.26%)	871 (13.58%)
5	141 (17.05%)	143 (15.94%)	215 (19.69%)	946 (16.68%)	818 (16.34%)	1,202 (18.74%)
6	54 (6.53%)	77 (8.58%)	104 (9.52%)	398 (7.02%)	340 (6.79%)	424 (6.61%)
Marital status						
Married, living with spouse	535 (64.69%)	663 (73.91%)	870 (79.67%)	1,709 (30.13%)	1,521 (30.39%)	1,982 (30.90%)
Domestic partnership	152 (18.38%)	92 (10.26%)	99 (9.07%)	768 (13.54%)	540 (10.79%)	612 (9.54%)
Single, never married	92 (11.12%)	72 (8.03%)	54 (4.95%)	2,625 (46.27%)	2,418 (48.31%)	3,118 (48.61%)
Separated	27 (3.26%)	30 (3.34%)	37 (3.39%)	143 (2.52%)	107 (2.14%)	111 (1.73%)
Divorced	18 (2.18%)	29 (3.23%)	23 (2.11%)	264 (4.65%)	287 (5.73%)	433 (6.75%)
Widowed	3 (0.36%)	11 (1.23%)	9 (0.82%)	164 (2.89%)	132 (2.64%)	158 (2.46%)
Employment						
Working full time	362 (43.77%)	514 (57.30%)	725 (66.39%)	1,957 (34.50%)	1,781 (35.58%)	2,022 (31.52%)
Working part time	144 (17.41%)	183 (20.40%)	188 (17.22%)	994 (17.52%)	746 (14.91%)	909 (14.17%)
Taking care of home or family	189 (22.85%)	79 (8.81%)	78 (7.14%)	260 (4.58%)	238 (4.76%)	307 (4.79%)
Unemployed	80 (9.67%)	68 (7.58%)	58 (5.31%)	875 (15.42%)	720 (14.39%)	742 (11.57%)
Student	4 (0.48%)	5 (0.56%)	4 (0.37%)	626 (11.03%)	703 (14.05%)	1,093 (17.04%)
Retired	4 (0.48%)	1 (0.11%)	7 (0.64%)	727 (12.82%)	615 (12.29%)	1,050 (16.37%)
Other	16 (1.93%)	10 (1.11%)	12 (1.10%)	100 (1.76%)	102 (2.04%)	98 (1.53%)
Temporarily laid off	15 (1.81%)	28 (3.12%)	9 (0.82%)	60 (1.06%)	53 (1.06%)	57 (0.89%)
Permanently disabled	13 (1.57%)	9 (1.00%)	11 (1.01%)	74 (1.30%)	47 (0.94%)	136 (2.12%)
Religious attendance						
Never	368 (44.50%)	195 (21.74%)	251 (22.99%)	2,571 (45.32%)	2,041 (40.78%)	2,988 (46.59%)
A few times a year	141 (17.05%)	230 (25.64%)	234 (21.43%)	961 (16.94%)	925 (18.48%)	998 (15.56%)
Seldom	202 (24.43%)	176 (19.62%)	212 (19.41%)	1,506 (26.55%)	1,168 (23.34%)	1,578 (24.60%)
Regularly	116 (14.03%)	296 (33.00%)	395 (36.17%)	635 (11.19%)	871 (17.40%)	850 (13.25%)
Religion						
Agnostic	16 (1.93%)	33 (3.68%)	40 (3.66%)	293 (5.16%)	290 (5.79%)	486 (7.58%)
Atheist	85 (10.28%)	51 (5.69%)	94 (8.61%)	722 (12.73%)	626 (12.51%)	1,172 (18.27%)
Buddhist	3 (0.36%)	21 (2.34%)	14 (1.28%)	91 (1.60%)	76 (1.52%)	83 (1.29%)
Eastern or Greek Orthodox	11 (1.33%)	31 (3.46%)	28 (2.56%)	50 (0.88%)	68 (1.36%)	59 (0.92%)
Hindu	3 (0.36%)	27 (3.01%)	15 (1.37%)	35 (0.62%)	38 (0.76%)	17 (0.27%)

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Characteristic	Parent			Non parent		
	Unwilling, N = 827[1*]	**Undecided**, N = 897[1*]	**Willing**, N = 1,092[1*]	**Unwilling**, N = 5,673[1*]	**Undecided**, N = 5,005[1*]	**Willing**, N = 6,414[1*]
Jewish	3 (0.36%)	42 (4.68%)	40 (3.66%)	27 (0.48%)	90 (1.80%)	98 (1.53%)
Mormon	3 (0.36%)	50 (5.57%)	51 (4.67%)	21 (0.37%)	93 (1.86%)	91 (1.42%)
Muslim	25 (3.02%)	69 (7.69%)	47 (4.30%)	129 (2.27%)	191 (3.82%)	172 (2.68%)
Nothing in particular	246 (29.75%)	155 (17.28%)	172 (15.75%)	1,352 (23.83%)	1,054 (21.06%)	1,178 (18.37%)
Protestant	54 (6.53%)	73 (8.14%)	90 (8.24%)	576 (10.15%)	499 (9.97%)	785 (12.24%)
Roman Catholic	338 (40.87%)	318 (35.45%)	471 (43.13%)	2,028 (35.75%)	1,762 (35.20%)	1,972 (30.75%)
Something else	40 (4.84%)	27 (3.01%)	30 (2.75%)	349 (6.15%)	218 (4.36%)	301 (4.69%)
Medical conditions	348 (42.08%)	347 (38.68%)	559 (51.19%)	2,342 (41.28%)	2,008 (40.12%)	2,810 (43.81%)
Follow political news						
Hardly at all	115 (13.91%)	68 (7.58%)	55 (5.04%)	660 (11.63%)	427 (8.53%)	333 (5.19%)
Only now and then	143 (17.29%)	198 (22.07%)	172 (15.75%)	910 (16.04%)	925 (18.48%)	929 (14.48%)
Some of the time	297 (35.91%)	410 (45.71%)	398 (36.45%)	2,063 (36.37%)	2,023 (40.42%)	2,526 (39.38%)
Most of the time	272 (32.89%)	221 (24.64%)	467 (42.77%)	2,040 (35.96%)	1,630 (32.57%)	2,626 (40.94%)
Trust in government						
Never	274 (33.13%)	98 (10.93%)	90 (8.24%)	1,447 (25.51%)	714 (14.27%)	890 (13.88%)
Some of the time	422 (51.03%)	339 (37.79%)	384 (35.16%)	2,945 (51.91%)	2,468 (49.31%)	2,964 (46.21%)
Most of the time	111 (13.42%)	325 (36.23%)	388 (35.53%)	1,145 (20.18%)	1,472 (29.41%)	1,990 (31.03%)
Just about always	20 (2.42%)	135 (15.05%)	230 (21.06%)	136 (2.40%)	351 (7.01%)	570 (8.89%)
Vaccine confidence	0.50 (0.22)	0.64 (0.16)	0.72 (0.17)	0.57 (0.24)	0.70 (0.18)	0.80 (0.16)
Trust in doctors	0.56 (0.23)	0.72 (0.20)	0.78 (0.19)	0.61 (0.24)	0.72 (0.21)	0.80 (0.20)
Vaccination decision						
Children's Parents	803 (97.10%)	665 (74.14%)	849 (77.75%)	4,817 (84.91%)	3,650 (72.93%)	4,185 (65.25%)
The Local Government	20 (2.42%)	201 (22.41%)	196 (17.95%)	709 (12.50%)	1,132 (22.62%)	1,898 (29.59%)
Councils and Schools	4 (0.48%)	31 (3.46%)	47 (4.30%)	147 (2.59%)	223 (4.46%)	331 (5.16%)
COVID-19 infection						
Yes	57 (6.89%)	49 (5.46%)	85 (7.78%)	327 (5.76%)	331 (6.61%)	416 (6.49%)
No	571 (69.04%)	666 (74.25%)	845 (77.38%)	4,238 (74.70%)	3,726 (74.45%)	5,017 (78.22%)
I'm not sure	199 (24.06%)	182 (20.29%)	162 (14.84%)	1,108 (19.53%)	948 (18.94%)	981 (15.29%)
COVID-19 worry						
Not worried at all	238 (28.78%)	81 (9.03%)	76 (6.96%)	1,515 (26.71%)	621 (12.41%)	706 (11.01%)
Slightly worried	301 (36.40%)	259 (28.87%)	258 (23.63%)	2,017 (35.55%)	1,881 (37.58%)	2,095 (32.66%)
Somewhat worried	186 (22.49%)	392 (43.70%)	518 (47.44%)	1,482 (26.12%)	1,726 (34.49%)	2,367 (36.90%)
Very worried	102 (12.33%)	165 (18.39%)	240 (21.98%)	659 (11.62%)	777 (15.52%)	1,246 (19.43%)
COVID-19 spread worry						
Not worried at all	183 (22.13%)	64 (7.13%)	44 (4.03%)	1,252 (22.07%)	477 (9.53%)	574 (8.95%)
Slightly worried	259 (31.32%)	228 (25.42%)	239 (21.89%)	1,815 (31.99%)	1,496 (29.89%)	1,484 (23.14%)
Somewhat worried	209 (25.27%)	302 (33.67%)	416 (38.10%)	1,464 (25.81%)	1,665 (33.27%)	2,046 (31.90%)
Very worried	176 (21.28%)	303 (33.78%)	393 (35.99%)	1,142 (20.13%)	1,367 (27.31%)	2,310 (36.01%)
Mask use						

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Table S2 – *Continued from previous page*

Characteristic	Parent			Non parent		
	Unwilling, N = 827[1*]	**Undecided**, N = 897[1*]	**Willing**, N = 1,092[1*]	**Unwilling**, N = 5,673[1*]	**Undecided**, N = 5,005[1*]	**Willing**, N = 6,414[1*]
Never	41 (4.96%)	11 (1.23%)	6 (0.55%)	149 (2.63%)	26 (0.52%)	37 (0.58%)
Just when required	276 (33.37%)	153 (17.06%)	151 (13.83%)	1,659 (29.24%)	1,035 (20.68%)	1,218 (18.99%)
Occasionally	37 (4.47%)	95 (10.59%)	78 (7.14%)	485 (8.55%)	496 (9.91%)	451 (7.03%)
Usually	136 (16.44%)	270 (30.10%)	375 (34.34%)	1,030 (18.16%)	1,189 (23.76%)	1,502 (23.42%)
Always	337 (40.75%)	368 (41.03%)	482 (44.14%)	2,350 (41.42%)	2,259 (45.13%)	3,206 (49.98%)
Others' mask use						
0-20%	173 (20.92%)	70 (7.80%)	66 (6.04%)	969 (17.08%)	575 (11.49%)	829 (12.92%)
21-40%	131 (15.84%)	183 (20.40%)	137 (12.55%)	910 (16.04%)	860 (17.18%)	929 (14.48%)
41-60%	200 (24.18%)	258 (28.76%)	300 (27.47%)	1,341 (23.64%)	1,360 (27.17%)	1,516 (23.64%)
61-80%	223 (26.96%)	249 (27.76%)	402 (36.81%)	1,532 (27.01%)	1,502 (30.01%)	1,992 (31.06%)
81-100%	100 (12.09%)	137 (15.27%)	187 (17.12%)	921 (16.23%)	708 (14.15%)	1,148 (17.90%)
COVID-19 vaccine						
No	599 (72.43%)	395 (44.04%)	271 (24.82%)	3,098 (54.61%)	1,556 (31.09%)	1,094 (17.06%)
No, but I have made an appointment to get it	85 (10.28%)	202 (22.52%)	304 (27.84%)	713 (12.57%)	1,088 (21.74%)	1,520 (23.70%)
Yes	143 (17.29%)	300 (33.44%)	517 (47.34%)	1,862 (32.82%)	2,361 (47.17%)	3,800 (59.25%)
Trust state officials for vaccine information	62 (7.50%)	152 (16.95%)	241 (22.07%)	568 (10.01%)	860 (17.18%)	1,325 (20.66%)
Trust local government for vaccine information	88 (10.64%)	226 (25.20%)	256 (23.44%)	650 (11.46%)	839 (16.76%)	1,097 (17.10%)
Trust health experts for vaccine information	435 (52.60%)	530 (59.09%)	715 (65.48%)	3,286 (57.92%)	3,443 (68.79%)	5,153 (80.34%)
Trust employer for vaccine information	22 (2.66%)	138 (15.38%)	184 (16.85%)	266 (4.69%)	418 (8.35%)	403 (6.28%)
Trust coworkers for vaccine information	29 (3.51%)	105 (11.71%)	150 (13.74%)	232 (4.09%)	350 (6.99%)	331 (5.16%)
Trust GP for vaccine information	478 (57.80%)	469 (52.29%)	637 (58.33%)	3,334 (58.77%)	3,403 (67.99%)	4,771 (74.38%)
Trust pharmacy for vaccine information	118 (14.27%)	182 (20.29%)	290 (26.56%)	1,032 (18.19%)	1,175 (23.48%)	1,616 (25.19%)
Trust family/friends for vaccine information	198 (23.94%)	187 (20.85%)	216 (19.78%)	1,194 (21.05%)	891 (17.80%)	784 (12.22%)
Trust local health centre for vaccine information	203 (24.55%)	236 (26.31%)	347 (31.78%)	1,493 (26.32%)	1,706 (34.09%)	2,629 (40.99%)
Trust vip for vaccine information	11 (1.33%)	46 (5.13%)	42 (3.85%)	136 (2.40%)	142 (2.84%)	113 (1.76%)
Trust leader for vaccine information	39 (4.72%)	28 (3.12%)	29 (2.66%)	196 (3.45%)	150 (3.00%)	153 (2.39%)
Trust other for vaccine information	125 (15.11%)	16 (1.78%)	6 (0.55%)	631 (11.12%)	105 (2.10%)	108 (1.68%)
Child age						
0-2	160 (19.35%)	110 (12.26%)	91 (8.33%)	1,645 (29.00%)	1,029 (20.56%)	740 (11.54%)
3-5	168 (20.31%)	204 (22.74%)	172 (15.75%)	1,403 (24.73%)	1,126 (22.50%)	851 (13.27%)
6-11	261 (31.56%)	295 (32.89%)	363 (33.24%)	1,155 (20.36%)	1,139 (22.76%)	1,092 (17.03%)
12-16	176 (21.28%)	219 (24.41%)	331 (30.31%)	834 (14.70%)	1,019 (20.36%)	1,595 (24.87%)
17-18	62 (7.50%)	69 (7.69%)	135 (12.36%)	636 (11.21%)	692 (13.83%)	2,136 (33.30%)
Country						
ITA	453 (54.78%)	310 (34.56%)	494 (45.24%)	2,995 (52.79%)	2,465 (49.25%)	3,157 (49.22%)
UK	374 (45.22%)	587 (65.44%)	598 (54.76%)	2,678 (47.21%)	2,540 (50.75%)	3,257 (50.78%)

[1]Mean (SD); n (%)
Percentages may not total 100 due to rounding

S3 Extended information on survey items and variables encoding

In this section, we present details about the survey items and their coding in English. Differences between the survey items in Italy and the UK are reported when relevant.

S3.1 Outcome measure

Intention to support COVID-19 childhood vaccination was assessed with two different survey items, one for parents and one for non-parents. Parents were asked: "Suppose you could obtain a MHRA-approved (in Italy: Ministry of Health) COVID-19 vaccine for your children of age Z. How likely are you to get a COVID-19 vaccine for your children of age Z? (Response Scale: 0 = definitely not, 100 = definitely yes)", where Z could be 0-2, 3-5, 6-11, 12-16, 17-18, depending on the age of the respondent's children. Non-parents were asked: "Suppose some friends of yours could obtain a MHRA-approved (in Italy: Ministry of Health) COVID-19 vaccine for their children, and that they asked you for advice. How likely are you to recommend them to vaccinate their children? (Response Scale: 0 = definitely not, 100 = definitely yes)" asked for each child age bracket (0-2, 3-5, 6-11, 12-16, 17-18) to every non-parent respondent.

S3.2 Parental status

Two items were used in the survey to screen between parents and non-parents for the purpose of assigning the outcome question. One question asked "Do you have any children?", with options "Yes" or "No". Conditional on answering "Yes", a question asking to select all applicable children's age brackets (options: "0-2", "3-5", "6-11", "12-16", "17-18", "19 or older") was proposed. Parents are respondents with children under 18 years. Respondents with older children only or no-children were considered as non-parents for the outcome question assignment.

S3.3 Predictors

In the Table below, the variables used in the analysis (column 1), the related original survey items (column 2), and the encoding for the analysis (column 3) are reported. Percentages shown in the notes below the table refer to the sequentially filtered datasets.

Table S3

Variable	**Survey item**	**Encoding**
Age	1 item: "How old are you?", open numeric answer	As numeric[1]
Gender	1 item: "What is your gender?", options: "Female", "Male, "Not listed"	2 categories[2], Dummy
Country	Built	Dummy
Region	1 item: "In which UK country do you currently reside?"/ "In which region do you currently reside?", options: 4 States/ 19 regions plus "Provincia Autonoma di Bolzano" and "Provincia Autonoma di Trento"	4 categories/5 categories[3], One-hot
Residence	1 item: "How would you describe the place where you live?", options: "City", "Suburb", "Town", "Rural area", "Other"	4 categories[4], One-hot
Education	1 item: "What is the highest level of education you have completed?", 6 options (form "Did not graduate from high school" to "Postgraduate degree"/8 options (from "Primary School Diploma" to "Postgraduate degree"	6 categories[5], as numeric
Marital status	1 item: "What is your marital status?", options: see Table S1	One-hot
Employment	1 item: "Which statement best describes your current employment status?", options: see Table S1	One-hot
Religion	1 item: "What is your present religion, if any?", options: see Table S1	One-hot
Religious attendance	1 item: "Aside from weddings and funerals, how often do you attend religious services?", 6 options (from "Never" to "More than once a week")	4 categories[6], One-hot

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Table S3 – *Continued from previous page*

Variable	**Survey item**	**Encoding**
Medical conditions	1 item: "Public health officials have determined that people with the following conditions are at greater risk of severe illness if they contract COVID-19. Do you have any of the following conditions? Please select all that apply, 10 options (9 medical conditions, "None of the above")	2 categories[7], Dummy
Child age	5 age brackets, from answers to outcome questions (see *Outcome measure*)	As numeric
Follow political news	1 item: "Would you say you follow what's going on in politics and public affairs...", options: see Table S1	As numeric
Trust in government	1 item: "How much of the time do you think you can trust the government in London to do what is right?"/"Do you trust the actions of the Italian government?", options: see Table S1	As numeric
Vaccination decision	1 item: "Who should be entitled to take decision regarding children's vaccination?", options: see Table S1	One-hot
Flu vaccines	1 item: "How many times have you gotten the flu vaccine (flu shot) in the last five years?", 6 options (from 0 to 5)	As numeric
Right-wing leaning	1 item: "Where would you place yourself on this scale?"/"Thinking about your political views, where would you place yourself on a scale of 0 to 10 where 0 means the left, 10 the right, and 5 the center?", 7 options (from "Extremely liberal" to "Extremely conservative") /slider 0-10	As numeric on 1-7 range
Friends' attitude	1 item: "How would you describe your friends' attitudes toward vaccination?", slider 0-100	As numeric
Vaccine info from [*source*]	1 item: "Please rank the sources of information you use to make decisions regarding vaccinations from the most to the least important", rank 1-7	7 variables as numeric
COVID-19 infection	1 item: "Do you believe that you have contracted COVID-19 since the beginning of the pandemic?", 4 options	3 categories[8], One-hot
COVID-19 worry	1 item: "Taking into consideration both your risk of contracting it and the seriousness of the illness, how worried are you about experiencing COVID-19?", options: see Table S1	As numeric
COVID-19 spread worry	1 item: "How worried are you about contracting COVID-19 and then spreading it to your family, friends, and other people in your community?", options: see Table S1	As numeric
Mask use	1 item: "How often do you wear a mask?", options: see Table S1	As numeric
Others' mask use	1 item: "When you go out in your neighborhood and community, how many people that you see out in public are wearing a mask properly (covering the mouth and the nose)?", options: see Table S1	As numeric
COVID-19 vaccine	1 item: "Have you received the first shot of a COVID-19 vaccine?", 5 options	3 categories[9], One-hot
Trust [*source*] for vaccine information	1 item: "Who would you trust the most to receive information on the COVID-19 vaccine in the near future? [Indicate the 3 main choices]", options: see Table 1	One dummy for each option
Vaccine confidence	6 items[10], 5 options (from "Strongly disagree" to "Strongly agree")	Numeric index - first component PCA[11]
Trust in doctors	2 items[12], 5 options (from "Strongly disagree" to "Strongly agree")	Numeric index - first component PCA
Treatment	3 randomized messages[13]	One-hot

[1]Respondents indicating age = 99 (0.39% [N = 14] in Italy and 0.24% [N = 8] in the UK) were excluded from the sample.
[2]The option "Not listed" was selected by the 0.36% in the UK (12) and by 0.28% in Italy (10). In Italy, one observation was reclassified as "Male" based on the open text answers. Given the low cell counts, the other observations were labelled as "missing" in both countries.
[3]Italian regions grouped in macro-areas, i.e. "North-West", "North-East", "Centre", "South", "Islands".
[4]The option 5 ("Other") was selected by the 0.27% of respondents (9) in the UK and 0.25% (9) in Italy. Based on the open text answers, in the UK 2 of the 9 respondents were reclassified in "Rural area", while the other 7 were labelled as "missing". In Italy, 8 respondents were labelled as "City" based on the open text, while 1 was labelled as "missing".
[5]As the educational level options were more numerous in the Italian survey, lower levels were merged in "Did not graduate from high school". Education levels were labelled with successive numbers for comparability.
[6]As the options expressing regular attendance were not entirely homogeneous between the two countries, they were grouped in the category "Regularly".
[7]All 9 medical conditions listed were included in the "Yes" category.
[8]The options "I think I have, but I did not get tested" and "I'm not sure" were merged in the "I'm not sure" category.
[9]The 3 options "Yes, I received the first shot of [*AstraZeneca/Pfizer-BioNTech/Moderna*]" were merged in the "Yes" category.
[10]Original items in English were: "Vaccines are necessary to protect the health of people close to my age", "Vaccines do a good job in preventing the diseases that they are produced for", "Vaccines are safe", "If I do not vaccinate myself, "I may get a disease and cause other people close to my age to get the disease", "People receive too many vaccines", "If I vaccinate myself, I may have serious side effects". The first principal competent captures 58% of the cumulative variance.
[11]The two last items asking to evaluate negative statements about vaccination were reversed before computing the index.
[12]Original items in English were: "In general, medical professionals in charge of vaccinations have my best interests at heart", "I have a good relationship with my healthcare provider". The first principal competent captures 74% of the cumulative variance.
[13]See Chiavenna et al. (2023).

S4 Materials XGBoost main models

S4.1 Training set performance

We performed a grid search over the hyperparameter space and optimized the macro-F1. We evaluated the models' performance with different numbers of boosting iterations (*nrounds* 200, 300, 400 for parents, 400, 500, 600 for non-parents), maximum tree depth (*max_depth* 5, 7, 9 for parents, 6, 8, 9 for non-parents), minimum sum of instance weight (*min_child_weight* 1, 2 for both parents and non-parents), subsample ratio of columns (*colsample_bytree* 0.6, 0.7 for both parents and non-parents), subsample percentage (*subsample* 0.7, 0.8 for both parents and non-parents) and minimum loss reduction (*gamma* 0.05, 0.1, 0.15 for both parents and non-parents). Shrinkage was fixed (*eta* 0.05 for parents, 0.1 for non-parents). Performance results of the hyperparameters tuning are reported in the Table below for parents and non-parents. The reported performance metrics are the average of the metrics across 5 rounds of stratified cross-validation for the selected best tune, with associated standard deviation (SD). The performance metrics are produced by the caret R package's *train* function.

Table S4: Macro performance scores of the models on the training set using the optimal hyperparameters.

Group	**Accuracy**	**Mean_Precision**	**Mean_Recall**	**Mean_F1**	**AUC**
Parents	0.653	0.648	0.648	0.646	0.819
SD	0.010	0.010	0.010	0.011	0.003
Non-parents	0.585	0.570	0.573	0.571	0.767
SD	0.005	0.006	0.005	0.005	0.003

S4.2 Full SHAP values ranking

Full ranking of variables in the models for parents and non-parents based on mean absolute SHAP value by outcome class.

Table S5

	Parent			**Non parent**		
Feature	**Unwilling**	**Undecided**	**Willing**	**Unwilling**	**Undecided**	**Willing**
Friends' attitude	1	1	1	3	2	2
Vaccine confidence	2	2	2	2	3	3
COVID vaccine: No	3	8	4	5	8	5
Flu vaccines	4	6	5	10	7	6
Child age	5	4	3	1	1	1
Trust in government	6	10	9	9	10	15
Vax decision: Parents	7	7	17	7	17	7
Trust in doctors	8	12	8	4	4	4
Right-wing leaning	9	3	6	8	6	9
Religious attendance	10	18	16	16	9	22
COVID worry	11	26	12	13	18	16
Age	12	5	7	6	5	8

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Table S5 – *Continued from previous page*

	Parent			Non parent		
Feature	**Unwilling**	**Undecided**	**Willing**	**Unwilling**	**Undecided**	**Willing**
Mask use	13	16	28	23	22	23
Vax info from partner/family	14	11	14	24	15	26
Follow political news	15	9	23	14	19	17
Vax info from internet/Social Media	16	19	26	22	16	18
Vax info from Ministry of Health	17	21	18	17	14	10
Trust other	18	29	45	66	60	72
Employment: Working full time	19	34	19	37	37	33
Others' mask use	20	17	20	18	11	21
COVID vaccine: Yes	21	39	30	29	46	32
Trust employer	22	38	32	35	62	39
Employment: Taking care of home	23	42	50	67	72	66
Treatment: Placebo	24	27	38	11	24	14
Gender: Male	25	40	25	32	29	29
Vax info from friends	26	13	13	30	23	28
Vax info from doctor/paediatrician	27	31	33	20	21	25
Vax decision: Local government	28	22	34	26	28	12
COVID spread worry	29	15	10	12	20	13
Education	30	23	21	19	12	20
Vax info from TV/Newspapers/Radio	31	14	11	21	13	11
Treatment: Risk	32	32	44	36	48	41
Religion: Nothing	33	47	55	43	42	44
Region: England	34	35	47	57	34	45
Trust local government	35	20	27	51	54	37
Medical conditions: Yes	36	28	24	41	25	24
Trust pharmacy	37	43	29	28	41	27
COVID infection: No	38	45	37	56	56	62
Religion: Atheist	39	37	61	62	45	52
Trust health experts	40	50	41	31	40	36
Region: North west	41	33	22	63	57	57
Trust GP	42	49	36	44	43	50
Trust state officials	43	24	15	27	30	47
Trust local health centre	44	41	39	15	26	19
Marital status: Married	45	30	35	48	44	43
COVID vaccine: Appointment	46	56	40	33	47	51
Residence: City	47	57	51	53	32	35
Country: UK	48	25	31	61	38	40
Marital status: Cohabiting	49	62	59	45	51	49
Residence: Suburb	50	36	49	50	50	54
Vax info from other source	51	51	65	34	36	68
Residence: Town	52	58	54	39	31	34
COVID infection: Not sure	53	54	42	59	64	61
Religion: Catholic	54	48	46	47	27	30
Trust family/friends	55	52	52	65	66	65
Employment: Working part time	56	46	43	40	35	55
Residence: Rural area	57	61	69	58	59	64
Marital status: Single	58	55	62	52	55	53
Treatment: Herd immunity	59	59	53	25	33	31
Region: North east	60	60	64	68	52	46
Region: Islands	61	65	56	46	39	63
Region: South	62	44	48	64	63	58
COVID infection: Yes	63	53	58	60	67	67
Religion: Protestant	64	70	71	70	69	69
Employment: Unemployed	65	71	73	54	49	42
Region: Centre	66	69	70	55	61	59
Trust coworkers	67	64	67	74	73	70

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Table S5 – *Continued from previous page*

	Parent			Non parent		
Feature	**Unwilling**	**Undecided**	**Willing**	**Unwilling**	**Undecided**	**Willing**
Region: Northern Ireland	68	68	66	83	87	88
Employment: Temporarily laid off	69	67	60	82	83	80
Region: Scotland	70	82	79	73	74	71
Marital status: Divorced	71	74	76	49	68	48
Religion: Agnostic	72	78	75	72	58	56
Region: Wales	73	79	80	76	79	76
Religion: Something else	74	80	81	69	71	73
Marital status: Separated	75	81	78	79	76	77
Trust leader	76	77	82	78	75	81
Religion: Muslim	77	73	72	80	77	75
Religion: Mormon	78	63	57	81	86	83
Trust vip	79	76	74	85	85	86
Vax decision: Councils/Schools	80	72	68	75	78	79
Employment: Other	81	86	86	71	70	74
Religion: Orthodox	82	75	77	77	81	87
Employment: Disabled	83	83	84	88	80	78
Religion: Jewish	84	66	63	86	88	84
Employment: Student	85	88	88	42	53	60
Religion: Hindu	86	84	83	89	89	89
Marital status: Widowed	87	87	87	84	82	82
Religion: Buddhist	88	85	85	87	84	85
Employment: Retired	89	89	89	38	65	38

S5 Materials sub-models

S5.1 Training set performance

The same hyparparameter spaces as for the main models were grid-searched for tuning the XGBoost models including either only health register-type of data or only behavioural variables. Initially, 25 predictors were identified as health register-like, while 33 were identified as behavioural. To allow a fair comparison between the two models' performances, a first round of tuning and testing was made for the behavioural model, and the top 25 variables based on mean absolute SHAP value across the three outcome classes were identified. Then, the hyperparameters' optimization was conducted again only including the top predictors. Performance results of the hyperparameters tuning are reported in the Table below for parents and non-parents. The reported performance metrics are the average of the metrics across 5 rounds of stratified cross-validation for the selected best tune, with associated standard deviation (SD). The performance metrics are produced by the caret R package's *train* function.

Table S6: Macro performance scores of the models on the training set using the optimal hyperparameters.

Model	**Group**	**Accuracy**	**Mean_Precision**	**Mean_Recall**	**Mean_F1**	**AUC**
Administrative	**Parents**	0.525	0.523	0.521	0.521	0.701
Administrative	SD	0.012	0.013	0.011	0.012	0.008
Administrative	**Non-parents**	0.477	0.465	0.467	0.466	0.653
Administrative	SD	0.002	0.003	0.002	0.003	0.004
Behavioural	**Parents**	0.637	0.634	0.632	0.631	0.805
Behavioural	SD	0.007	0.011	0.006	0.008	0.005
Behavioural	**Non-parents**	0.541	0.530	0.525	0.521	0.709
Behavioural	SD	0.006	0.007	0.006	0.007	0.005

S5.2 Variables included in sub-models

Table S7: Variables included in the Administrative (left column) and Behavioural (right columns) sub-models. The first 25 features of the Behavioural models are ordered based on mean absolute SHAP value for parents and non-parents.

N	Administrative	Behavioural (Parents)	Behavioural (Non-parents)
1	Age	Friends' attitude	Vaccine confidence
2	Flu vaccines	Vaccine confidence	Friends' attitude
3	Child age	Right-wing leaning	Trust in doctors
4	Region: North west	Trust in government	Right-wing leaning
5	Region: North east	Trust in doctors	Vax decision: Parents
6	Region: Centre	COVID worry	Trust in government
7	Region: South	Religious attendance	Others' mask use
8	Region: Islands	Vax decision: Parents	Follow political news
9	Region: England	Follow political news	Vax info from internet/Social Media
10	Region: Northern Ireland	Others' mask use	Vax info from Ministry of Health
11	Region: Scotland	Vax info from TV/Newspapers/Radio	Vax info from partner/family
12	Region: Wales	Vax info from friends	Religious attendance
13	Residence: City	Vax info from partner/family	Vax info from TV/Newspapers/Radio
14	Residence: Suburb	Vax info from internet/Social Media	COVID spread worry
15	Residence: Town	Mask use	COVID worry
16	Residence: Rural area	Vax info from Ministry of Health	Vax decision: Local government
17	COVID infection: Yes	COVID spread worry	Vax info from doctor/paediatrician
18	COVID infection: No	Trust state officials	Trust local health centre
19	COVID infection: Not sure	Vax info from doctor/paediatrician	Mask use
20	Gender: Male	Trust employer	Vax info from friends
21	Medical conditions: Yes	Vax decision: Local government	Trust pharmacy
22	Country: UK	Trust local government	Trust state officials
23	COVID vaccine: No	Trust other	Trust health experts
24	COVID vaccine: Appointment	Trust pharmacy	Trust GP
25	COVID vaccine: Yes	Trust GP	Trust local government
26		Vax info from other source	Vax info from other source
27		Trust health experts	Trust employer
28		Trust coworkers	Trust coworkers
29		Trust family/friends	Trust family/friends
30		Trust local health centre	Trust vip
31		Trust vip	Trust leader
32		Trust leader	Trust other
33		Vax decision: Councils/Schools	Vax decision: Councils/Schools

S6 Up- and down-sampling

S6.1 Training set performance

The same hyparparameter spaces as for the main models were grid-searched for tuning the XGBoost models on the up- and down-sampled training set. Performance results of the hyperparameters tuning are reported in the Table below for parents and non-parents, and for up- (**Up**) and down- (**Down**) sampling. The reported performance metrics are the average of the metrics across 5 rounds of stratified cross-validation for the selected best tune, with associated standard deviation (SD). The performance metrics are produced by the caret R package's *train* function.

Table S8: Macro performance scores of the models on the training set using the optimal hyperparameters.

Resampling	Group	Accuracy	Mean_Precision	Mean_Recall	Mean_F1	AUC
Up	**Parents**	0.637	0.639	0.637	0.634	0.814
Up	SD	0.014	0.015	0.014	0.015	0.011
Up	**Non-parents**	0.573	0.566	0.573	0.568	0.763
Up	SD	0.003	0.003	0.002	0.003	0.002
Down	**Parents**	0.642	0.642	0.642	0.641	0.818
Down	SD	0.013	0.010	0.013	0.012	0.008
Down	**Non-parents**	0.580	0.577	0.580	0.578	0.767
Down	SD	0.004	0.004	0.004	0.004	0.003

S6.2 Test set performance

Table S9: Macro performance scores on the test set of XGBoost models trained using up- (**Up**) and down- (**Down**) sampled training sets. Results are shown for both parent and non-parent models. All metrics except *Accuracy* are macro-averages of per-class metrics calculated using a one-vs-rest approach.

Resampling	Group	Accuracy	Precision	Recall	F1	MCC	AUC
Up	**Parents**	0.655	0.651	0.651	0.651	0.478	0.844
Down	**Parents**	0.638	0.636	0.640	0.637	0.457	0.830
Up	**Non-parents**	0.574	0.562	0.564	0.562	0.351	0.764
Down	**Non-parents**	0.578	0.574	0.571	0.572	0.362	0.763

S7 Alternative cut-offs specifications

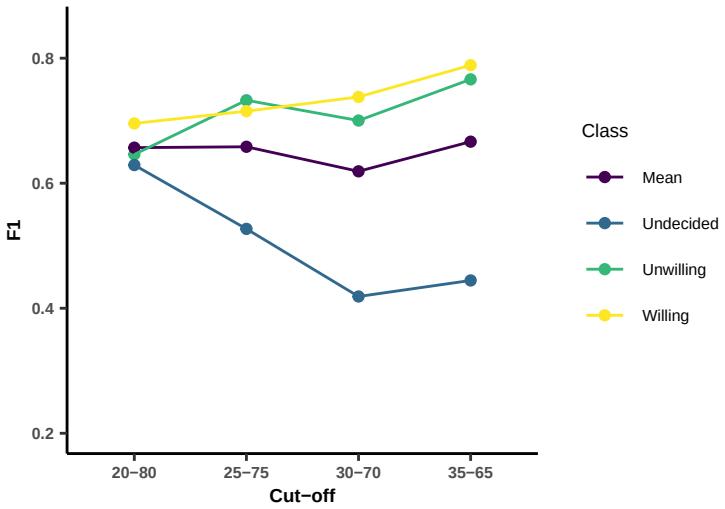

Figure S1: Plot of mean F1 for different outcome cut-offs for parents. F1 are calculated on the left-out test set.

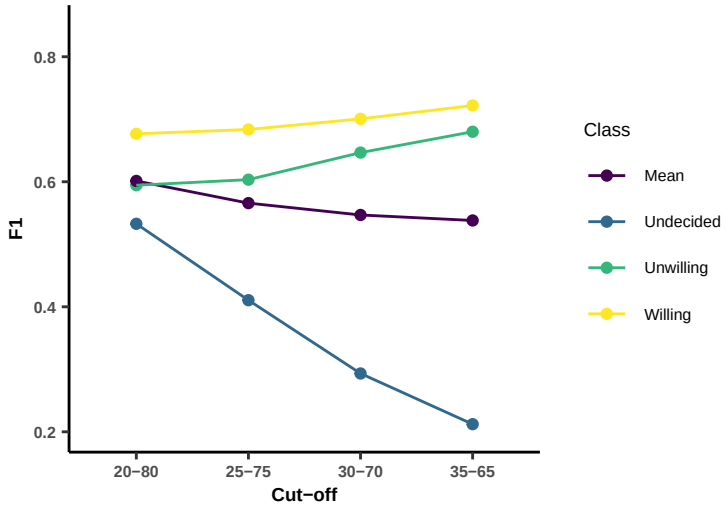

Figure S2: Plot of mean F1 with for different outcome cut-offs for non-parents. F1 are calculated on the left-out test set.

S8 Full SHAP values ranking Untreated

Full ranking of variables in the models for parents and non-parents based on mean absolute SHAP value by outcome class.

Table S10

	Parent			Non parent		
Feature	**Unwilling**	**Undecided**	**Willing**	**Unwilling**	**Undecided**	**Willing**
Friends' attitude	1	1	1	3	2	2
Vaccine confidence	2	2	2	2	3	3
COVID vaccine: No	3	8	4	5	9	6
Child age	4	3	3	1	1	1
Flu vaccines	5	5	5	9	7	5
Trust in government	6	10	9	11	10	13
Vax decision: Parents	7	7	16	7	18	7
Trust in doctors	8	11	6	4	5	4
Religious attendance	9	20	13	15	8	20
Right-wing leaning	10	4	7	10	6	10
Age	11	6	8	6	4	8
Vax info from partner/family	12	12	14	24	15	26
COVID worry	13	27	12	14	20	17
Mask use	14	16	28	23	23	22
Vax info from internet/Social Media	15	19	23	21	16	19
Vax info from Ministry of Health	16	23	18	18	14	11
Follow political news	17	9	21	12	19	16
Employment: Working full time	18	33	19	37	36	32
Treatment: Placebo	19	22	32	8	13	9
Others' mask use	20	18	20	19	12	21
Trust other	21	28	43	67	62	71
COVID vaccine: Yes	22	39	30	32	46	31
Trust employer	23	36	34	34	59	34
Employment: Taking care of home	24	38	44	65	72	65
Vax info from friends	25	13	15	27	24	27
Gender: Male	26	37	26	28	27	30
Vax decision: Local government	27	21	31	26	30	14
COVID spread worry	28	14	11	13	22	15
Vax info from doctor/paediatrician	29	31	36	20	21	25
Vax info from TV/Newspapers/Radio	30	15	10	22	17	12

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Table S10 – *Continued from previous page*

	Parent			Non parent		
Feature	**Unwilling**	**Undecided**	**Willing**	**Unwilling**	**Undecided**	**Willing**
Region: England	31	34	46	56	34	42
Education	32	24	22	17	11	23
Religion: Nothing	33	42	53	39	44	46
Trust local government	34	17	24	53	53	39
Medical conditions: Yes	35	29	25	38	25	24
Trust GP	36	47	35	45	42	50
Trust pharmacy	37	43	29	31	40	29
Religion: Atheist	38	44	65	63	49	53
Region: North west	39	35	27	62	56	56
COVID infection: No	40	49	38	55	58	62
Trust health experts	41	50	40	29	33	37
Treatment: Risk	42	41	51	42	55	51
Trust state officials	43	25	17	25	32	45
Trust local health centre	44	40	42	16	29	18
COVID vaccine: Appointment	45	55	39	33	47	43
Residence: City	46	56	50	52	28	35
Marital status: Married	47	30	37	43	43	41
Country: UK	48	26	33	61	37	44
Marital status: Cohabiting	49	60	57	47	50	48
Residence: Suburb	50	32	48	49	48	54
Residence: Town	51	58	54	41	31	36
Vax info from other source	52	51	61	35	39	69
Religion: Catholic	53	48	45	46	26	28
Employment: Working part time	54	45	41	40	35	55
COVID infection: Not sure	55	52	47	64	64	64
Region: Islands	56	61	55	48	38	66
Region: North east	57	59	63	69	54	47
Trust family/friends	58	53	52	66	65	63
Residence: Rural area	59	62	69	60	61	61
Marital status: Single	60	57	62	54	52	52
Region: South	61	46	49	59	63	59
Treatment: Herd immunity	62	65	60	30	41	33
COVID infection: Yes	63	54	59	58	67	67
Region: Centre	64	68	70	57	60	60
Employment: Unemployed	65	71	73	51	45	38
Religion: Protestant	66	69	71	70	69	68
Trust coworkers	67	66	67	74	73	70
Region: Scotland	68	79	75	73	74	72
Region: Northern Ireland	69	70	66	80	86	87
Employment: Temporarily laid off	70	67	56	78	80	77
Religion: Something else	71	78	80	68	70	73
Trust leader	72	75	81	79	75	78
Marital status: Divorced	73	76	78	50	68	49
Marital status: Separated	74	82	79	82	79	79
Religion: Muslim	75	73	72	81	78	75
Region: Wales	76	81	82	75	77	74
Religion: Agnostic	77	80	77	71	57	58
Religion: Mormon	78	63	58	77	83	82
Vax decision: Councils/Schools	79	72	68	76	76	80
Trust vip	80	77	74	86	85	86
Employment: Other	81	85	85	72	71	76
Religion: Orthodox	82	74	76	83	87	88
Religion: Jewish	83	64	64	85	88	83
Employment: Disabled	84	83	84	88	82	81
Employment: Student	85	88	88	36	51	57

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Table S10 – *Continued from previous page*

	Parent			Non parent		
Feature	**Unwilling**	**Undecided**	**Willing**	**Unwilling**	**Undecided**	**Willing**
Religion: Hindu	86	84	83	89	89	89
Religion: Buddhist	87	86	86	87	84	84
Marital status: Widowed	88	87	87	84	81	85
Employment: Retired	89	89	89	44	66	40

S9 Alternative variable importance measures

Table S11: Top six features based on the Gain metric for parents and non-parents. Values are computed using the caret package's *varImp* function.

Parents	**Gain**	**Non-parents**	**Gain**
Friends' attitude	0.17045	Vaccine confidence	0.13609
Vaccine confidence	0.09601	Friends' attitude	0.08898
Age	0.05331	Child age	0.08016
Child age	0.04236	Age	0.05722
Flu vaccines	0.03841	Trust in doctors	0.03970
Trust in doctors	0.03657	Right-wing leaning	0.03729

Table S12: Top six features based on permutation importance for parents and non-parents. Values are computed using the vip package (version 0.4.1). The metric is computed on the training set data evaluating the reduction in the macro-F1 score. The mean and standard deviation (in parenthesis) result from 30 simulation rounds for parents and 10 for non-parents.

Parents	**Importance**	**Non-parents**	**Importance**
Friends' attitude	0.150 (0.0064)	Child age	0.266 (0.0040)
Child age	0.072 (0.0042)	Friends' attitude	0.070 (0.0028)
Vaccine confidence	0.031 (0.0029)	Vaccine confidence	0.056 (0.0018)
Age	0.010 (0.0015)	Age	0.009 (0.0007)
Flu vaccines	0.009 (0.0016)	Trust in doctors	0.004 (0.0004)
COVID vaccine: No	0.008 (0.0018)	Right-wing leaning	0.002 (0.0002)

S10 Materials XGBoost imputed dataset

S10.1 Training set performance

The same hyparparameter spaces as for the main models were grid-searched for tuning the XGBoost models on the imputed dataset. Performance results of the hyperparameters tuning are reported in the Table below for parents and non-parents. The reported performance metrics are the average of the metrics across 5 rounds of stratified cross-validation for the selected best tune, with associated standard deviation (SD). The performance metrics are produced by the caret R package's *train* function.

Table S13: Macro performance scores of the models on the training set using the optimal hyperparameters.

Group	**Accuracy**	**Mean_Precision**	**Mean_Recall**	**Mean_F1**	**AUC**
Parents	0.644	0.637	0.637	0.636	0.817
SD	0.006	0.007	0.007	0.007	0.003
Non-parents	0.583	0.570	0.572	0.570	0.765
SD	0.006	0.006	0.006	0.005	0.004

S10.2 Test set performance

Table S14: Macro performance scores on the test set of XGBoost models trained using the dataset with imputed missing values for the predictors. Results are shown for both parent and non-parent models. All metrics except *Accuracy* are macro-averages of per-class metrics calculated using a one-vs-rest approach.

Group	Accuracy	Precision	Recall	F1	MCC	AUC
Parents	0.679	0.674	0.677	0.674	0.515	0.858
Non-parents	0.581	0.568	0.570	0.568	0.360	0.772

S10.3 Full SHAP values ranking

Full ranking of variables in the models for parents and non-parents based on mean absolute SHAP value by outcome class.

Table S15

	Parent			Non parent		
Feature	**Unwilling**	**Undecided**	**Willing**	**Unwilling**	**Undecided**	**Willing**
Friends' attitude	1	1	1	3	2	2
Vaccine confidence	2	2	2	2	3	3
Flu vaccines	3	5	6	7	8	6
Child age	4	3	3	1	1	1
COVID vaccine: No	5	12	4	5	7	7
Trust in government	6	13	5	8	14	11
Vax decision: Parents	7	7	29	11	24	9
Mask use	8	14	14	27	21	22
Trust in doctors	9	17	10	4	5	4
Age	10	8	7	6	4	5
Vax info from Ministry of Health	11	9	21	19	18	17
Right-wing leaning	12	4	8	9	6	8
Gender: Male	13	29	9	20	26	30
Follow political news	14	6	20	21	16	12
Trust other	15	26	45	59	63	75
Trust employer	16	41	28	51	70	60
Others' mask use	17	20	25	23	15	18
Vax info from partner/family	18	10	11	24	9	16
Trust pharmacy	19	43	23	42	35	28
Employment: Working full time	20	46	27	37	32	33
COVID vaccine: Yes	21	39	19	26	31	40
Vax info from internet/Social Media	22	18	13	18	11	23
Religious attendance	23	22	24	17	12	27
Education	24	11	18	13	10	20
COVID vaccine: Appointment	25	45	38	34	47	35
Vax decision: Local government	26	23	46	28	19	10
Medical conditions: Yes	27	40	32	47	49	45
Treatment: Risk	28	19	31	54	54	55
Trust local government	29	33	39	50	55	51
Marital status: Cohabiting	30	30	59	53	53	57
COVID spread worry	31	38	26	12	17	14
Employment: Taking care of home	32	44	58	71	74	71
COVID worry	33	25	22	16	23	19
Vax info from doctor/paediatrician	34	27	35	14	20	15
Vax info from friends	35	16	12	29	22	26
Trust GP	36	48	34	30	34	38
Vax info from TV/Newspapers/Radio	37	21	15	25	13	21
Religion: Atheist	38	28	51	64	61	47
Country: UK	39	15	17	67	41	39

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Table S15 – *Continued from previous page*

	Parent			Non parent		
Feature	**Unwilling**	**Undecided**	**Willing**	**Unwilling**	**Undecided**	**Willing**
COVID infection: No	40	51	40	55	56	63
Region: England	41	31	44	63	50	48
COVID infection: Yes	42	34	57	70	71	72
Treatment: Placebo	43	37	47	10	25	13
Marital status: Married	44	32	36	32	30	32
Region: North west	45	42	30	45	48	49
Trust local health centre	46	50	42	22	28	31
Residence: City	47	57	43	49	37	42
Trust state officials	48	24	16	15	27	36
Trust family/friends	49	47	53	66	60	64
Religion: Nothing	50	60	60	40	46	34
Vax info from other source	51	53	64	39	36	67
Residence: Suburb	52	35	41	61	51	46
Residence: Town	53	56	61	46	39	41
Trust health experts	54	52	49	33	42	25
Treatment: Herd immunity	55	58	52	31	38	24
Marital status: Single	56	63	62	38	43	58
COVID infection: Not sure	57	49	37	57	64	66
Region: North east	58	54	55	62	58	43
Religion: Catholic	59	55	50	36	44	29
Region: South	60	36	33	58	52	54
Employment: Working part time	61	59	56	43	40	62
Employment: Unemployed	62	65	69	41	29	37
Residence: Rural area	63	70	65	44	45	59
Religion: Agnostic	64	66	72	69	67	61
Region: Centre	65	64	63	52	57	53
Trust vip	66	71	71	86	83	85
Employment: Temporarily laid off	67	61	48	79	62	69
Region: Islands	68	74	77	35	33	56
Religion: Protestant	69	67	67	56	65	52
Religion: Mormon	70	62	54	83	87	80
Region: Wales	71	81	85	82	82	79
Marital status: Divorced	72	69	66	48	68	50
Region: Northern Ireland	73	68	68	81	85	84
Trust coworkers	74	72	70	72	75	68
Marital status: Separated	75	84	81	84	81	83
Trust leader	76	73	76	80	79	76
Religion: Muslim	77	79	79	76	77	74
Region: Scotland	78	77	78	60	72	65
Marital status: Widowed	79	80	82	87	86	86
Religion: Something else	80	85	84	65	69	73
Religion: Orthodox	81	75	75	77	80	82
Religion: Jewish	82	78	74	75	78	81
Religion: Hindu	83	83	83	89	89	89
Religion: Buddhist	84	76	73	85	84	88
Vax decision: Councils/Schools	85	82	80	74	76	77
Employment: Disabled	86	86	86	88	88	87
Employment: Other	87	87	87	78	73	78
Employment: Student	88	88	88	68	66	70
Employment: Retired	89	89	89	73	59	44

S11 Mean absolute SHAP values XGBoost main models

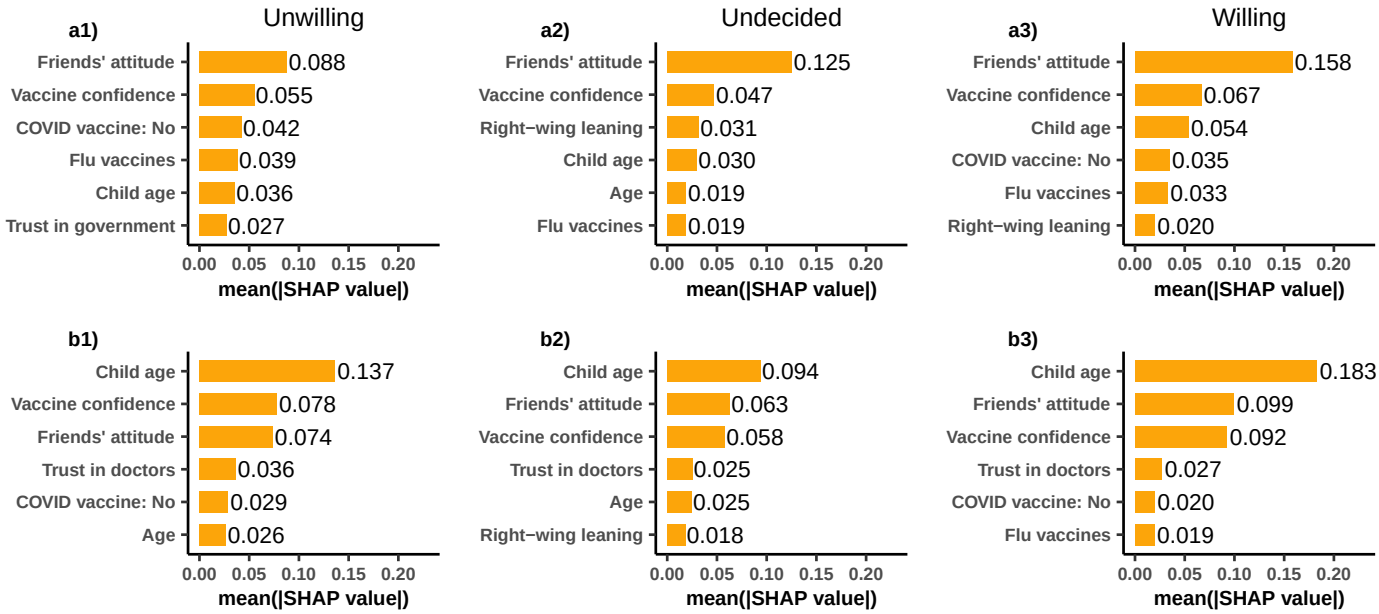

Figure S3: Mean absolute SHAP values of the six most important predictors identified by the XGBoost models. Panels a1–a3 correspond to parents, and panels b1–b3 to non-parents.

S12 Materials Random Forest

S12.1 Training set performance

We performed a grid search over the hyperparameter space and optimized the macro-F1. For each model (parents and non-parents) we evaluated different numbers of variables included at each round (*mtry*) (as a function of the number of columns in the dataset: $\sqrt{ncols}$, (0.2, 1/3)*$ncols$), of decision trees (*ntree* 125, 250), of maximum number of terminal nodes (as a function of the number of rows (observations) in the dataset (*maxnodes*: 0.08, 0.1, 0.12, 0.14, 0.16, 0.18)*$nrows$, rounded to multiples of 5) and maximum node size (*nodesize* 3, 5, 10, 15). Performance results of the hyperparameters tuning are reported in the Table below for parents and non-parents. The reported performance metrics are the average of the metrics across 5 rounds of stratified cross-validation for the selected best tune, with associated standard deviation (SD). The performance metrics are produced by the caret R package's *train* function.

Table S16: Macro performance scores of the models on the training set using the optimal hyperparameters.

Group	Accuracy	Mean_Precision	Mean_Recall	Mean_F1	AUC
Parents	0.653	0.650	0.647	0.645	0.818
SD	0.007	0.008	0.007	0.007	0.005
Non-parents	0.588	0.567	0.571	0.564	0.767
SD	0.004	0.007	0.005	0.008	0.004

S12.2 Full SHAP values ranking

Full ranking of variables in the models for parents and non-parents based on mean absolute SHAP value by outcome class.

Table S17

	Parent			Non parent		
Feature	**Unwilling**	**Undecided**	**Willing**	**Unwilling**	**Undecided**	**Willing**
Friends' attitude	1	1	1	3	3	3

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Table S17 – *Continued from previous page*

	Parent			Non parent		
Feature	**Unwilling**	**Undecided**	**Willing**	**Unwilling**	**Undecided**	**Willing**
Vaccine confidence	2	2	2	2	2	2
COVID vaccine: No	3	3	3	4	4	4
Flu vaccines	4	4	4	8	8	8
Trust in government	5	5	5	13	13	13
Trust in doctors	6	6	6	5	5	5
Age	7	7	7	7	7	7
Child age	8	8	8	1	1	1
COVID worry	9	9	9	11	11	11
Vax decision: Parents	10	10	10	6	6	6
Right-wing leaning	11	11	11	14	14	14
COVID vaccine: Yes	12	12	12	18	18	19
Religious attendance	13	13	13	21	21	21
Vax decision: Local government	14	14	14	9	9	9
Follow political news	15	15	15	22	22	22
Country: UK	16	16	16	43	44	44
Vax info from TV/Newspapers/Radio	17	17	17	16	16	16
Others' mask use	18	18	19	20	20	20
Mask use	19	20	18	26	26	26
Vax info from Ministry of Health	20	19	20	12	12	12
COVID spread worry	21	21	21	10	10	10
Vax info from friends	22	22	22	17	17	17
Vax info from partner/family	23	23	23	15	15	15
Vax info from internet/Social Media	24	24	25	25	25	25
Region: England	25	25	24	38	37	35
Medical conditions: Yes	26	26	26	29	29	29
Trust other	27	27	27	62	63	63
Employment: Working full time	28	28	28	47	46	47
Gender: Male	29	29	29	30	30	30
Trust employer	30	30	30	53	53	53
Trust local government	31	32	31	58	58	58
Employment: Taking care of home	32	31	32	73	73	73
Vax info from doctor/paediatrician	33	33	34	24	24	24
COVID vaccine: Appointment	34	34	33	45	45	45
Education	35	35	35	23	23	23
Trust GP	36	36	36	44	43	43
Marital status: Married	37	37	37	36	38	38
Trust state officials	38	38	38	32	33	32
Region: North west	39	39	39	51	50	50
Religion: Nothing	40	40	40	40	40	40
COVID infection: No	41	42	41	54	54	54
Treatment: Placebo	42	41	42	19	19	18
Residence: Suburb	43	43	43	52	51	51
Region: North east	44	44	44	69	69	69
Trust pharmacy	45	45	45	33	32	33
Marital status: Single	46	47	46	41	41	42
COVID infection: Not sure	47	49	47	59	59	59
Treatment: Risk	48	48	49	49	49	49
Marital status: Cohabiting	49	50	50	46	47	46
Trust local health centre	50	46	48	27	27	27
Trust health experts	51	51	51	28	28	28
Residence: City	52	52	52	37	36	36
Religion: Catholic	53	53	53	35	35	37
Residence: Town	54	54	55	39	39	39
Trust family/friends	55	55	54	48	48	48
Residence: Rural area	56	56	56	55	56	55

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Table S17 – *Continued from previous page*

	Parent			Non parent		
Feature	**Unwilling**	**Undecided**	**Willing**	**Unwilling**	**Undecided**	**Willing**
Vax info from other source	57	57	57	56	55	56
Treatment: Herd immunity	58	60	58	31	31	31
Employment: Working part time	59	58	59	57	57	57
Region: South	60	59	60	63	62	61
Religion: Atheist	61	61	61	50	52	52
Region: Islands	62	62	62	66	65	66
Region: Northern Ireland	63	63	63	81	81	81
Religion: Protestant	64	64	64	60	60	60
COVID infection: Yes	65	65	65	68	68	68
Marital status: Separated	66	66	67	77	77	77
Trust coworkers	67	68	68	74	74	74
Employment: Unemployed	68	67	66	34	34	34
Region: Centre	69	70	70	64	64	64
Employment: Temporarily laid off	70	72	69	84	84	84
Religion: Jewish	71	69	72	88	88	88
Religion: Muslim	72	71	71	76	76	76
Religion: Something else	73	73	73	72	72	72
Marital status: Divorced	74	74	74	67	67	67
Religion: Agnostic	75	75	75	71	71	71
Trust vip	76	78	76	86	86	86
Region: Wales	77	76	78	79	79	79
Religion: Mormon	78	77	79	87	87	87
Vax decision: Councils/Schools	79	79	77	75	75	75
Region: Scotland	80	80	80	65	66	65
Religion: Hindu	81	81	83	89	89	89
Trust leader	82	82	81	80	80	80
Religion: Orthodox	83	84	82	82	82	82
Employment: Disabled	84	83	84	85	85	85
Employment: Other	85	85	85	70	70	70
Religion: Buddhist	86	86	86	83	83	83
Marital status: Widowed	87	87	87	78	78	78
Employment: Student	88	88	88	61	61	62
Employment: Retired	89	89	89	42	42	41

S13 Materials Multinomial Logistic Regression

S13.1 Training set performance

The Multinomial Logistic Regression model is estimated using the R *nnet* algorithm included in the *caret* library. We set the parameter for weight decay to 0 (the default) and estimate the model without the intercept. Performance results of the hyperparameters tuning are reported in the Table below for parents and non-parents. The reported performance metrics are the average of the metrics across 5 rounds of stratified cross-validation for the predefined value of weight decay, with associated standard deviation (SD). The performance metrics are produced by the caret R package's *train* function.

Table S18: Macro performance scores of the models on the training set using the optimal hyperparameters.

Group	**Accuracy**	**Mean_Precision**	**Mean_Recall**	**Mean_F1**	**AUC**
Parents	0.559	0.557	0.559	0.557	0.737
SD	0.018	0.017	0.018	0.017	0.015
Non-parents	0.562	0.541	0.546	0.541	0.738
SD	0.005	0.006	0.006	0.006	0.007

S13.2 Full SHAP values ranking

Full ranking of variables in the models for parents and non-parents based on mean absolute SHAP value by outcome class.

Table S19

	Parent			Non parent		
Feature	**Unwilling**	**Undecided**	**Willing**	**Unwilling**	**Undecided**	**Willing**
Friends' attitude	1	1	1	2	2	2
Employment: Working full time	2	2	2	56	56	56
Vaccine confidence	3	3	3	3	3	3
Employment: Working part time	4	4	4	45	45	45
Child age	5	5	5	1	1	1
Vax info from TV/Newspapers/Radio	6	6	6	6	6	6
Country: UK	7	7	7	16	16	16
COVID vaccine: No	8	8	8	10	10	10
Flu vaccines	9	9	9	14	14	14
Vax info from partner/family	10	10	10	8	8	8
Vax info from doctor/paediatrician	11	11	11	5	5	5
Employment: Taking care of home	12	12	12	62	62	62
Employment: Unemployed	13	13	13	48	48	48
Trust in government	14	14	14	15	15	15
Vax info from Ministry of Health	15	15	15	4	4	4
Vax decision: Parents	16	16	16	12	12	12
Age	17	17	17	11	11	11
Vax info from friends	18	18	18	9	9	9
Vax info from internet/Social Media	19	19	19	7	7	7
Trust local government	20	20	20	39	39	39
Trust state officials	21	24	21	30	30	30
Religion: Catholic	22	21	22	20	20	20
Region: England	23	23	23	40	40	40
Medical conditions: Yes	24	22	24	31	31	31
Trust employer	25	25	25	42	42	42
Trust GP	26	28	26	70	70	70
Religion: Nothing	27	27	29	19	19	19
Gender: Male	28	26	27	23	23	23
Follow political news	29	29	28	27	27	27
Vax decision: Local government	30	31	30	25	25	25
Religious attendance	31	30	31	32	32	32
Region: North west	32	33	34	55	55	55
COVID spread worry	33	32	32	34	34	34
Vax info from other source	34	34	33	24	24	24
Trust family/friends	35	35	35	72	72	72
Residence: Suburb	36	36	36	71	71	71
Religion: Atheist	37	37	37	38	38	38
Marital status: Married	38	38	38	60	60	59
COVID vaccine: Yes	39	39	39	26	26	26
Trust other	40	40	40	46	46	47
Treatment: Placebo	41	41	41	17	17	17
COVID worry	42	42	42	22	22	22
COVID vaccine: Appointment	43	43	43	35	35	36
Marital status: Cohabiting	44	44	44	53	53	53
Education	45	45	45	37	37	37
Residence: Rural area	46	46	46	84	84	84
Treatment: Risk	47	49	47	57	57	57
Trust in doctors	48	48	48	13	13	13
Employment: Temporarily laid off	49	47	49	78	78	78
Trust pharmacy	50	50	50	21	21	21
Mask use	51	53	52	73	73	73
COVID infection: No	52	51	51	63	61	63
Others' mask use	53	52	53	44	44	44
Region: South	54	54	54	82	82	82

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Table S19 – *Continued from previous page*

	Parent			Non parent		
Feature	**Unwilling**	**Undecided**	**Willing**	**Unwilling**	**Undecided**	**Willing**
Religion: Mormon	55	55	55	69	69	69
Religion: Muslim	56	57	57	85	85	85
Residence: City	57	56	56	52	52	52
Right-wing leaning	58	58	58	64	64	64
Region: Islands	59	59	59	50	50	49
Treatment: Herd immunity	60	60	60	36	36	35
Region: North east	61	61	62	67	68	67
Region: Centre	62	62	61	66	66	66
Region: Northern Ireland	63	64	64	87	87	87
Religion: Protestant	64	63	63	54	54	54
COVID infection: Not sure	65	65	65	51	51	51
Trust leader	66	68	68	88	88	88
Employment: Disabled	67	66	66	76	76	76
Vax decision: Councils/Schools	68	67	67	79	79	79
COVID infection: Yes	69	69	70	74	74	74
Religion: Jewish	70	70	69	77	77	77
Trust local health centre	71	71	71	18	18	18
Religion: Something else	72	72	72	49	49	50
Region: Wales	73	74	75	61	63	61
Trust vip	74	73	73	83	83	83
Employment: Other	75	75	74	58	58	58
Religion: Agnostic	76	77	78	68	67	68
Residence: Town	77	76	76	41	41	41
Religion: Hindu	78	79	77	89	89	89
Marital status: Separated	79	78	79	80	80	80
Marital status: Divorced	80	80	80	43	43	43
Religion: Orthodox	81	81	81	86	86	86
Region: Scotland	82	82	82	59	59	60
Marital status: Single	83	83	84	65	65	65
Employment: Student	84	84	83	33	33	33
Marital status: Widowed	85	85	85	75	75	75
Religion: Buddhist	86	86	87	81	81	81
Trust coworkers	87	87	86	47	47	46
Trust health experts	88	89	89	28	28	28
Employment: Retired	89	88	88	29	29	29