Appendix

The multilingual Twitter-discourse on Vaccination in Germany during the Covid-19 Pandemic

1. Twitter queries used for data collection

Language	Query
German	(covid19impfstoff OR covid19 impfstoff OR covid19impfung OR covid19 impfung OR covid19 biontech OR covid19 pfizer OR covid19 fosun OR covid19 moderna OR covid19 niaid OR covid19 astrazeneca OR covid19 "Universität Oxford" OR covid19 janssen OR covid19 johnsonjohnson OR covid19 curevac OR covid19 cepi OR covid19 novavax OR covid19 gamaleya OR covid19 "russisches gesundheitsministerium" OR covid19 "russisches verteidigungsministerium" OR covid19 vector OR comirnaty OR tozinameran OR bnt162b2 OR "mRNA-1273" OR "CX-024414" OR Vaxzevria OR Covishield OR ChAdOx1 OR AZD1222 OR "Ad26.COV2" OR Ad26COVS1 OR "JNJ-78436735" OR VAC31518 OR CVnCoV OR Zorecimeran OR CV07050101 OR covovax OR "NVX-CoV2373" OR "SARS-CoV-2 rS" OR "Sputnik V" OR SputnikV OR "Gam-COVID-Vac")
Polish	(Covid19szczepionka OR Covid19 szczepionka OR covid19szczepienie OR covid19 szczepienie OR covid19 biontech OR covid19 pfizer OR covid19 fosun OR covid19 moderna OR covid19 niaid OR covid19 astrazeneca OR covid19 "Uniwersytet Oksfordzki" OR covid19 janssen OR covid19 johnsonjohnson OR covid19 curevac OR covid19 cepi OR covid19 novavax OR covid19 gamaleya OR covid19 "Rosyjskie Ministerstwo Zdrowia" OR covid19 "Rosyjskie Ministerstwo Obrony" OR covid19 vector OR comirnaty

	OR tozinameran OR bnt162b2 OR "mRNA-1273" OR "CX-024414" OR Vaxzevria OR Covishield OR ChAdOx1 OR AZD1222 OR "Ad26.COV2" OR Ad26COVS1 OR "JNJ-78436735" OR VAC31518 OR CVnCoV OR Zorecimeran OR CV07050101 OR covovax OR "NVX-CoV2373" OR "SARS-CoV-2 rS" OR "Sputnik V" OR SputnikV OR "Gam-COVID-Vac")
Russian	(ковид19вакцина OR ковид19 вакцина OR ковид19вакцинация OR ковид19 вакцинация OR ковид19прививка OR ковид19 прививка OR ковид19 байонтек OR ковид19 пфайзер OR ковид19 фосун OR ковид19 модерна OR ковид19 ниаид OR ковид19 астразенека OR ковид19 "Оксфордский университет" OR ковид19 янссен OR ковид19 Джонсон и Джонсон OR ковид19 CureVac OR ковид19 CEPI OR ковид19 новавакс OR ковид19 гамалея OR ковид19 "Министерство здравоохранения Российской" Федерации OR ковид19 "Министерство обороны Российской Федерации" OR ковид19 вектор OR комирнати OR тозинамеран OR bnt162b2 OR "мРНК-1273" OR "CX-024414" OR Ваксзевриа OR Covishield OR ChAdOx1 OR AZD1222 OR "Ad26.COV2" OR Ad26COVS1 OR "JNJ-78436735" OR VAC31518 OR CVnCoV OR зорецимеран OR CV07050101 OR кововакс OR "NVX-CoV2373" OR "SARS-CoV-2 rS" OR "Спутник V" OR СпутникV OR "Гам-КОВИД-Вак)
Turkish	(kovid19aşısı OR covid19aşısı OR kovid19 aşısı OR covid19 aşısı OR covid19aşılama OR kovid19aşılama OR covid19 aşılama OR kovid19 aşılama OR kovid19 biontech OR covid19 biontech OR kovid19 pfizer OR covid19 pfizer OR kovid19 fosun OR covid19 fosun OR kovid19 moderna OR covid19 moderna OR kovid19 niaid OR covid19 niaid OR kovid19 astrazeneca OR covid19 astrazeneca OR kovid19 "Oxford Üniversitesi" OR covid19 "Oxford Üniversitesi" OR kovid19 janssen OR

	covid19 janssen OR kovid19 curevac OR covid19 curevac OR kovid19 cepi OR covid19 cepi OR kovid19 "rusya sağlık bakanlığı" OR covid19 "rusya sağlık bakanlığı" OR kovid19 "rusya savunma bakanlığı" OR covid19 "rusya savunma bakanlığı" OR kovid19 vektör OR covid19 vector OR comirnaty OR tozinameran OR bnt162b2 OR "mRNA-1273" OR "CX-024414" OR Vaxzevria OR Covishield OR ChAdOx1 OR AZD1222 OR "Ad26.COV2" OR Ad26COVS1 OR "JNJ-78436735" OR VAC31518 OR CVnCoV OR Zorecimeran OR CV07050101 OR covovax OR "NVX-CoV2373" OR "SARS-CoV-2 rS" OR "Sputnik V" OR SputnikV OR "Gam-COVID-Vac)
English	(covid19vaccine OR covid19 vaccine OR covid19vaccination OR covid19 vaccination OR covid19 biontech OR covid19 pfizer OR covid19 fosun OR covid19 moderna OR covid19 niaid OR covid19 astrazeneca OR covid19 "University of Oxford" OR covid19 janssen OR covid19 johnsonjohnson OR covid19 curevac OR covid19 cepi OR covid19 novavax OR covid19 gamaleya OR covid19 russian health ministry OR covid19 russian defence ministry OR covid19 vector OR comirnaty OR tozinameran OR bnt162b2 OR "mRNA-1273" OR "CX-024414" OR Vaxzevria OR Covishield OR ChAdOx1 OR AZD1222 OR "Ad26.COV2" OR Ad26COVS1 OR "JNJ-78436735" OR VAC31518 OR CVnCoV OR Zorecimeran OR CV07050101 OR covovax OR "NVX-CoV2373" OR "SARS-CoV-2 rS" OR "Sputnik V" OR SputnikV OR "Gam-COVID-Vac")

2. Geocoding results for Tweets from March 2021 by language of Tweet. Geocoding was based on the user profile information in the field 'location'

Geocoding Result	Tweet Language	No. Tweets	No. distinct users
Germany	de	20522	9005
Germany	ru	480	124
Germany	pl	57	35
Germany	tr	136	78
Outside Germany	de	7980	3711
Outside Germany	ru	29626	7731
Outside Germany	pl	3423	1655
Outside Germany	tr	3467	2146
No results	de	23150	11116
No results	ru	29061	7624
No results	pl	3190	1735
No results	tr	4359	3102

3. Sampling

A multistep procedure was used to sample tweets for manual coding. First, all 3,216 active users with two or more vaccination-related tweets were included in the sample. Second, we sampled tweets in different languages differently due to limited resources: All Russian (n=420), Turkish (n=88), and Polish (n=39) tweets by active users were included in the sample. Regarding German tweets, we drew a proportionate stratified sample composed of 18% of all German tweets (n=2,658): Starting from the retweet-mention-network, we identified subgraphs, or communities, of heavily connected users. For community detection we used an implementation of the fast-greedy-algorithm by Csardi and Nepusz (2006). The decision to use fast greedy follows Bello-Orgaz et al. (2017). Here, it performs best in a comparison of several community detection algorithms on network data similar to ours. To apply the algorithm, we had to use an undirected version of our network, in which edges e_{ij} and e_{ji} are collapsed (= 4,150 undirected edges). In this way, we identify 66 communities, ranging from 277 to 2 members

(modularity = .6). We then randomly sampled 25% of German tweets from each of the 11 largest communities as well as from an additional community of 15 users. The 11 largest communities were chosen because they contain 1,987 or 89.1% of all connected users and the following smaller communities would not add a substantial number of users to the sample. While the communities under study contain between 12.4% and 4.7% of all connected users, the 12th largest community contains only 2.2%. The additional community of 15 users was chosen because of our research interest in the debates among people with a migration background. In this community a majority of users tweeted mainly in Russian (86.7%) and German tweets only played a minor role.

4. Coding and Reliability

All in all, five trained coders were involved in the coding process: Three German native speakers, one Turkish native speaker, and one Russian native speaker with a sound knowledge of Polish. The latter two also speak German.

Mirroring the structure of our codebook[1], the coding as well as the accompanying reliability tests were conducted in two stages. During the first stage we were concerned with all account-related variables and during the second stage we were concerned with all tweet-related variables. At the time of the first stage only three of the five coders were available for training, namely two of the German native speakers as well as the Russian- and Polish-speaking coder. We trained these three coders with regard to all account-related variables and tested for inter-coder reliability using a subsample of 30 Twitter accounts that tweet in German (the results can be found in the table below). Since the Turkish-speaking coder had not received any training during this first stage, she translated the Turkish users' names and bios into German and the actual coding was then done by the trained German coders.

In the second stage, which encompassed the tweet-related variables, we trained all five coders and tested for inter-coder reliability using a subsample of 34 German tweets (the results can again be found in the table below). In some cases, Krippendorff's Alpha was not applicable as a measurement for reliability (e.g., for binary variables). Here, we used Gwet's AC instead (cf. Feng, 2015; Gwet, 2008).

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[1] The complete Codebook is available from the authors by request.

5. Results of the reliability tests

variable	n	percent agreement	Krippendorff's Alpha	Gwet's AC 1/2
user ID	30	1	1	-
username	30	1	1	-
the user's main language	30	1	1	-
the user's actor type	30	0.91	0.85	-
user ID	34	1	1	-
username	34	1	1	-
main language of the tweet	34	1	NaN	1
ID of the tweet	34	1	1	-
main topic of the tweet	33	0.90	0.83	-
the user's sentiment regarding the topic of the tweet	26	0.92	0.85	-
the mention of the BioNTech vaccine	32	1	1	-
the user's sentiment regarding the BioNTech vaccine	32	1	1	-
the mention of the Moderna vaccine	32	1	NaN	1
the user's sentiment regarding the Moderna vaccine	32	1	NaN	1
the mention of the AstraZeneca vaccine	32	0.99	0.97	-
the user's sentiment regarding the AstraZeneca vaccine	31	0.92	0.84	-

the mention of the Janssen vaccine	32	1	1	-
the user's sentiment regarding the Janssen vaccine	32	0.99	0.80	-
the mention of the CureVac vaccine	32	1	NaN	1
the user's sentiment regarding the CureVac vaccine	32	1	NaN	1
the mention of the Novavax vaccine	32	0.99	0	0.99
the user's sentiment regarding the Novavax vaccine	31	1	1	-
the mention of the Sputnik vaccine	32	0.98	0.95	-
the user's sentiment regarding the Sputnik vaccine	30	0.93	0.88	-
the user's sentiment regarding vaccination in general	32	0.85	0.75	-

Note. bases vary since cases with missing values were excluded from the reliability tests.

6. Example Tweets

example no.	tweet in original language	translation
01	"RT @NvqCIrQcYlHT9Zt: Еврокомиссар Тьерри Бретон отказался выдать разрешение на применение российской вакцины «Спутник V» и заявил, что ЕС совершенно не в чем себя упрекнуть. \nДа, народ расплачивается своими жизнями за корыстные и политические интересы власть имущих. https://t.co/S9bYZOvTez"	"RT @NvqCIrQcYlHT9Zt: European Commissioner Thierry Breton refused to authorize the Russian Sputnik V vaccine and stated that the EU has absolutely nothing to blame itself for. \Yes, the people are paying with their lives for the greedy and political interests of those in power. https://t.co/S9bYZOvTez"
02	"RT @RadioStydoba: Пока запад обвиняет Россию в намеренном очернении их вакцин, глава Европейского лекарственного агентства называет Спутник-V «русской рулеткой».\nПравда потом поясняет, что её «неправильно поняли»"	"RT @RadioStydoba: While the West accuses Russia of deliberately denigrating their vaccines, the head of the European Medicines Agency calls Sputnik-V a 'Russian roulette.' \But later she explained that she was 'misunderstood'."
03	"#Almanya Cumhurbaşkanı Frank-Walter Steinmeier #Kovid19 aşısını geliştiren #BioNTech'in kurucu ortakları Prof. Dr. Uğur Şahin ve Dr. Özlem Türeci'ye liyakat nişanı verdi. https://t.co/tOHSd5eIep"	"#German President Frank-Walter Steinmeier awarded the Order of Merit to Prof. Dr. Uğur Şahin and Dr. Özlem Türeci, co-founders of #BioNTech, who developed the #Covid19 vaccine. https://t.co/tOHSd5eIep"
04	"RT @watch_union: Neues vom #AstraZeneca-#Coronavirus-Impfstoff: in den #USA 🇺🇸 wurde bei einer klinischen Studie mit n=32.000 ein Schutz vor #Covid19-Ausbruch mit 79% festgestellt. Viel wichtiger: auch AZ schützt zu 100% vor schweren und tödlichen Krankheitsverläufen. /MS\nhttps://t.co/6bRIyfUIYt"	"RT @watch_union: update on #AstraZeneca #coronavirus vaccine: in the #USA 🇺🇸 , a clinical trial of n=32,000 found it to be 79% effective against a #Covid19 disease onset. More importantly, AZ also is 100% effective against severe and fatal courses of disease /MS\nhttps://t.co/6bRIyfUIYt"
05	"RT @PBeatap: ▪ USA : VAERS / CDC : 35 przypadków ze śmiercią płodu po szczepieniu Covid-19 szczepionką firmy MODERNA i PFIZER/BIONTECH. CDC mówi kobietom w ciąży, że nie ma problemów z zaszczepieniem się szczepionką Covid19 w czasie ciąży,	"RT @PBeatap: ▪ USA : VAERS / CDC : 35 cases of fetal deaths after Covid-19 vaccination with MODERNA and PFIZER/BIONTECH vaccines. The CDC is telling pregnant women that there are no problems with getting vaccinated with the Covid19 vaccine during pregnancy, here's what

	oto co może się zdarzyć…\nhttps://t.co/aptsq0fHC2 https://t.co/ifjI0ADFkg"	can happen...\nhttps://t.co/aptsq0fHC2 https://t.co/ifjI0ADFkg "
06	"RT @VorsitzenderNAV: Ab Montag in #hamburg arbeiten Fachärzte, Impfzentrum und ab Ostern auch Hausärzte Hand in Hand zusammen. Und das unter dem Dach der KV. So geht es effektiv gegen #COVID19 #CoronaVirusDE mit #Impfstoff weiter. Schutz der Gefährdeten zuerst! https://t.co/VSPrUgoLfe"	"RT @VorsitzenderNAV: Starting on Monday in #hamburg, medical specialists, vaccination center and, starting on Easter, also general practitioners will work hand in hand. And all of this is being done within the framework of the health insurance system. This is how it is done effectively against #COVID19 #CoronaVirusDE with the #vaccine. Protect those at risk first! https://t.co/VSPrUgoLfe"
07	"RT @qujunil: Sabahtan beri harıl harıl 1. doz Covid19 aşısı yapıyoruz. Çünkü biz bu işi iyi yaparız. ASM'lerde çalışan tüm ekipleri kutluyorum. ❤️❤️❤️ "	"RT @qujunil: We've been working hard since this morning, administering the 1st dose of Covid19 vaccine. Because we do this job well. I congratulate all the teams working in ASMs [*Family Health Centers*]. ❤️❤️❤️ "
08	"@RegSprecher Astra ist der schlechteste Impfstoff von allen bisher. Aber günstig und aus Europa bzw. GB. Über 50 Länder nehmen Sputnik V, hier hört man nichts von Problemen. Warum keine Zulassung, nur weil er aus Russland kommt? Scheinbar liebt die Regierung Lockdown als einzige Lösung?"	"@RegSprecher [*the German Federal Government's spokesman*] Astra is the worst vaccine of them all so far. But cheap and made in Europe or GB. Over 50 countries use Sputnik V, yet we hear nothing about problems. Why is it not approved just because it is from Russia? Seems like the government loves lockdowns as the only solution?"
09	"\'Man kann eine Schraube lange anziehen, aber nach fest kommt ab\'. @c_lindner Recht hat der Mann. Mittelalterliche Methoden, kein #SputnikV, keine Perspektiven, keine Ideen außer #Ruhetage. #Osterlockdown #Lindner #aufnachMalle Humanistische Grüße <3 PS. Stärkt euer Immunsystem!"	"\'You can tighten a screw for a long time, but after getting tighter it will become loose' [*German proverb, roughly equivalent to 'Don't push too hard'*]. @c_lindner [*German opposition politician at the time*] The man is right. Medieval methods, no #SputnikV, no perspectives, no ideas except #restingdays. #Easterlockdown #Lindner #letsgotoMallorca Humanistic greetings <3 PS. Boost your immune system!"

10	"@Karl_Lauterbach Wäre ein schnelleres Impfen, gerade in den Arztpraxen, mit #SputnikV nicht möglich? Wenn ich Sie richtig verstand dann trauen Sie diesem Impfstoff auch eine zuverlässige und sichere Immunisierung zu?! Dann sollte die EMA sich ranhalten und die BRD notfalls ohne EU ordern!"	"@Karl_Lauterbach [*German health politician at the time*] Wouldn't a faster immunization campaign, especially in doctors' offices, be possible with #SputnikV? If I understood you correctly then you trust this vaccine to be reliable and safe as well?! In that case, the EMA should get a move on and the FRG should order without the EU if necessary!"
11	"RT @RusPerspective: Vor diesem Hintergrund erstaunt es nicht, dass Russland vor kurzem gewarnt hat, man habe Hinweise darauf, dass im Westen bald eine großangelegte Diskreditierungskampagne gegen #SputnikV beginnen soll, inklusive einer Inszenierung mit Verstorbenen."	"RT @RusPerspective: Against this backdrop, it is not surprising that Russia has recently been warning that they have evidence that a large-scale campaign discrediting #SputnikV is about to start in the West, including a staging with deceased people."
12	"Um im Zweifel #SputnikV zu nehmen, muss man kein ‚Kind der DDR' sein. Es genügt der normale Menschenverstand.... 😂👏😂. #Russland impft übrigens in beeindruckender Geschwindigkeit. Arme kalte Krieger von der #EU und #Welt . Armer @jensspahn . Die können's halt. https://t.co/fTbhxnRLVe"	"To give #SputnikV the benefit of the doubt, you don't have to be a 'child of the GDR.' Common sense is enough.... 😂👏😂. #Russia is vaccinating at an impressive rate, by the way. Poor cold warriors of the #EU and #Welt [*German conservative newspaper*]. Poor @jensspahn [*German Federal Minister of Health at the time*]. They certainly have what it takes. https://t.co/fTbhxnRLVe"
13	"'Unterdessen werben mehrere ostdeutsche Länderchefs für Sputnik V.' Kommts denkbar dumm, werden gelernte Ossis, die ohnehin keine Impfmuffel wie Bayern sind, sich vom Russen retten lassen, während im Westen an Ideologie gestorben wird. Exakt wie bei der Kinderlähmung 1961/62 >>> https://t.co/KsjOupnoFm"	"'Meanwhile, several East German heads of state are promoting Sputnik V.' If the worst comes to the worst, learned Ossis [*term for people from the former GDR; often used pejoratively, but used here to construct an East German ingroup*], who aren't poopers when it comes to vaccination unlike the Bavarians, will be saved by the Russians, while in the West people will die of ideology. Exactly the same as for polio in 1961/62 >>> https://t.co/KsjOupnoFm"

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