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Covid and the common good: In-group out-group dynamics and Covid-19 vaccination in Wales and the United States

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ABSTRACT

Vaccination is a social act, where benefits spill-over to third parties. How we approach such social decisions is influenced by whether likely beneficiaries share salient social identities with us. This study explores these dynamics using representative survey data from two contexts: national identity groups in Wales (N = 4187) and political partisans in America (N = 4864).

In both cases, those in the minority in their local area were less likely to be vaccinated. In Wales, respondents who did not identify as Welsh were less likely to be vaccinated the greater the proportion of residents of their local area identified as Welsh. In America, the vaccination rate of Biden voters fell off more steeply than that of Trump voters as the proportion of Trump voters in their county increased. Results are robust to controlling for likely confounds and sensitivity analyses. In-group out-group dynamics help to shape important health decisions.

1. Introduction

The Covid-19 pandemic demonstrated the social nature of health. Individual behaviour had clear implications for others' health, raising difficult trade-offs for governments and citizens. From adherence to social distancing measures, to financial support for closed businesses, to vaccination, the pandemic raised the question of what we owe each other.

One insight from behavioural science borne out by the pandemic (Bavel et al., 2020; Ruggeri et al., 2024) was the importance of social norms in underpinning prosocial health behaviours. This influence is likely partly informational – in situations of uncertainty, copying others is often an effective strategy (Rendell et al., 2010). The role of social norms can also be conceptualised in terms of social identity theory (Hogg and Reid, 2006; Tajfel and Turner, 1979). If a health behaviour is seen being performed by group members, this can be integrated into wider prototypical ideas of the group at large, and spread further, as group members conform with this new group norm. This is one likely mechanism by which health behaviours spread across social networks (Christakis and Fowler, 2013), and fits with empirical findings in the context of Covid-19 (Ryoo and Kim, 2023; Zhuang, 2023). Vriens et al. (2023) showed that vaccine hesitant people underestimate the uptake of vaccination among others while Tunçgenç et al. (2021) found that perceived adherence to restrictions by one's social circle predicted participants' own reported adherence.

However, as well as informational mechanisms, might another social influence on uptake of prosocial health behaviours be motivational? The extent to which people are prepared to make sacrifices on behalf of their fellow citizens is influenced by how they see themselves in relation to their communities (Cikara et al., 2011). Humans are exquisitely attuned to group identities (Tajfel and Turner, 1979) and where group boundaries are drawn shapes our perceived obligations (Whitt and Wilson, 2007; Yamagishi and Mifune, 2008). Indeed, it has been suggested that the salience of infectious disease can heighten antipathy towards social out-groups, as part of the so-called *behavioural immune system* (Murray and Schaller, 2016). People may be more inclined to comply with pandemic restrictions where the likely beneficiaries are in-group members and less likely where they belong to social out-groups.

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To our knowledge, this possibility has not been tested directly in the context of Covid-19. However, there is evidence of some of these dynamics at play. Skinner-Dorkenoo et al. (2022) found that highlighting racial disparities in Covid outcomes reduced White Americans' support for pandemic restrictions; Bartoš et al. (2021) showed that hostility towards foreigners in a resource allocation game could be elicited by making Covid-19 more salient; while Saville and Thomas (2022) found that neighbourhoods of Wales with greater sense of belonging had lower Covid-19 rates specifically during lockdown periods, suggesting that residents of these areas were making greater behavioural changes.

Given the importance of in-group/out-group dynamics in shaping our sense of social obligation and altruism, it is plausible that these dynamics may be important in informing Covid-19 vaccination decisions. Indeed, European countries with higher rates of organ donation, as a proxy for altruism, had faster vaccine uptake, after adjusting for vaccine supply (Hierro et al., 2023). Vaccination, like many health decisions during a pandemic, is a social behaviour: many of the benefits accrue to third parties (Korn et al., 2020; Tan et al., 2023; Ward and Raude, 2014), while costs – risk of side effects, queues, injection discomfort – are borne individually. Our willingness to be vaccinated may, at the margins, be influenced by whether the likely recipients of positive externalities are fellow members of a socially salient in-group.

The present study explores these dynamics across two contexts, where different identities are socially salient: national identity groups in Wales and political partisans in the United States of America. Using area of residence as a proxy for people's social environment, we look at whether the association between identity on the individual level and Covid-19 vaccination varies as a function of whether such identities place one in the majority or the minority locally.

2. National identity in Wales

National identity, the sense of belonging to a nation, is perhaps the social identity *par excellence*. Greenfeld and Chirot (1994) put it especially strongly: "… in the modern world, national identity constitutes what may be called the 'fundamental identity', the identity that is believed to be the very essence of the individual… other identities are considered secondary". Thus it should be no surprise that national responses to Covid-19 activated this key identity: strength of national identity has been shown to be associated with lockdown behaviour and attitudes internationally (Van Bavel et al., 2022).

National identities can be complex. Their boundaries are constantly negotiated and contested on the basis of civic and ethnic frames (Zimmer, 2003). This is especially the case in multi-national states, such as the United Kingdom (UK) and Wales, one of the four UK nations, has a particularly interesting pattern of national identities (Saville, 2021a). Following its conquest in the 1200s, Wales was annexed into the, then, English state in the 1500s, but, as Jones remarks, Welsh national identity has survived for centuries 'without the protective buttressing of a state" (Jones, 1992, although political devolution in the late 90s has since brought elements of statehood). Symbols of Welsh nationhood retain social and political potency today (Larner et al., 2022).

Residents of Wales have a plausible claim to at least two identities: Welsh and British. Furthermore, 21% of the Welsh population were born in England and a further 7% born outside the UK, which may be associated with other identities (Office for National Statistics, 2022). In total, 63% of the population identify as Welsh, including 8% who identify as both Welsh and British. A further 11% identify as English or English and British and 18.5% identify as British only (Office for National Statistics, 2022). Thus, although a majority identify as Welsh, over a third do not.

National identity varies markedly across Wales, with lower rates of Welsh identification along the border with England and the highest areas in former coal-mining areas in the south, but there is also more fine-grained variance (see Fig. 1). Wales has two heartland regions: *y Fro Gymraeg*, the primarily rural stronghold of the Welsh language down the west coast; and the coalfield, home to a charismatic working-class Welsh identity. The inhabitants of the remainder of the country, sometimes called 'British Wales' (Balsom, 1985), often identify as Welsh, but may regard their areas as further from these two idealised forms of Welshness (Evans, 2019).

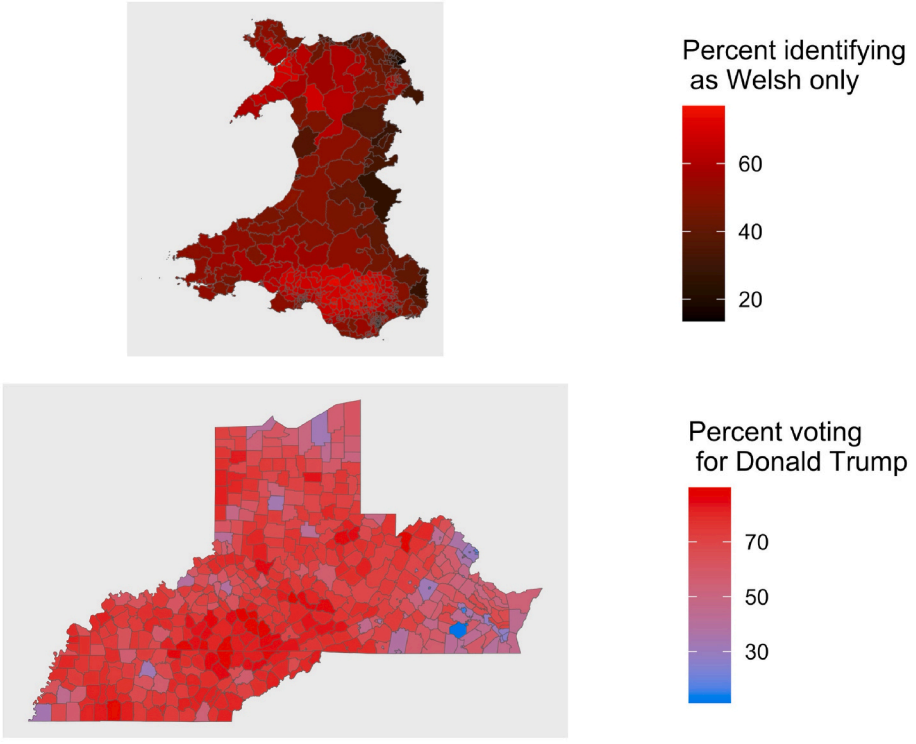

Fig. 1. Maps of the percentage of 2021 UK Census respondents who gave their national identity as Welsh only in each Welsh MSOA (top panel) and percentage of voters in each county voting for Donald Trump in the 2020 US presidential election, in the five states surveyed for the present study (bottom panel).

3. Political partisans in the USA

The divide between Democratic and Republican voters in the US represents more than policy differences. Political partisanship has fused with wider cultural cleavages into what have been termed 'mega-identities' (Klein, 2020). Antipathy towards partisan rivals has grown since the 1980s (Abramowitz and Webster, 2016) and participants in behavioural, economic, and even aesthetic decision-making tasks have been shown to favour co-partisans over opposing partisans (Iyengar and Westwood, 2015; Nicholson et al., 2016).

Views on Covid-19 have been absorbed into this divide, with Democrats favouring stricter social distancing policy and Republicans adopting a more covid-sceptical stance, which was associated with the tone of coverage in partisan media (Motta et al., 2020). This extends to vaccination, with substantial partisan gaps in vaccination rates (Zhang et al., 2022).

4. The present study

Here, we use data from an international survey project to examine whether the relationship between vaccination status and two salient social identities – national identity in Wales and partisan identity in the US – varies as a function of the proportion of the local population who share said identities. We expect survey respondents who live in areas where their group are in the majority to be more likely to be vaccinated than those in areas where they are in the minority.

5. Methods

5.1. Permissions

This project was approved by the ethics committee of the School of Psychology and Sports Science at Bangor University.

5.2. Surveys

Survey fieldwork was conducted in December 2021. At this stage in both Wales and the US, all adults had been offered an initial course of a vaccine and the campaign to deliver third booster doses was underway but incomplete (US Department of Health and Human Services, 2024; Welsh Government, 2021). Data were primarily collected for a project on vaccine hesitance on coalfields (Saville et al., 2023) so both surveys oversampled coalfield areas, details below.

Welsh fieldwork was conducted by YouGov, with recruitment through their participant panel, who signed up to receive surveys for points to be exchanged for money. The target sample was a combined 3500-person sample quota-sampled to be representative of the 18+ population of Wales in terms of age, sex, and education (and their interactions); social grade; political attention; region; party membership; 2019 general election vote; and 2016 EU referendum vote, plus a 500-person non-representative 'boost' sample recruited from areas of Wales with post-1959 history of coal mining. The realised total sample was 4187. Note that although the coalfield 'boost' sample were not quota-sampled to be representative, the use of weights should make the sample representative of Wales in terms of the characteristics listed above.

US fieldwork was conducted by Response:AI, who recruited respondents from Central Appalachian states of Kentucky, Virginia, West Virginia, Tennessee, and Ohio. Respondents were quota-sampled across three modes, see below, to be representative of these states for gender, age, race, education, and income. Post-1982 coal-producing counties were over-sampled, but the overall sample was designed to be representative when sampling weights were used. Recruitment combined three modes: 3560 from Lucid Marketplace, a panel of prospective survey participants, rewarded with money or shopping vouchers; 1190 from geodemographically targeted advertisements on Meta; and 61 by live-interviewer random-digit telephone survey; for a total of 4864 respondents.

In both surveys, data from respondents who gave suspicious response patterns (*e.g.* 'straightlining', completing very quickly), or whose internet provider addresses were associated with survey fraud were removed. These are not included in the above numbers.

5.3. Sample size justification

Sample sizes were based on power calculations conducted to test for differences in vaccine hesitant attitudes in coalfield vs. non-coalfield regions (Saville et al., 2023) One goal of this project was to assess whether risk factors for vaccine hesitance (poverty, social isolation) were stronger in coalfield areas, so the sample was powered to detect a doubling of the strength of a risk factor on the coalfield, compared to off it. Our proposed interaction includes a continuous, rather than discrete, geographical exposure, but our analyses should be powered to detect moderately strong cross-level interactions.

5.4. Measures

5.4.1. Survey data

The survey questionnaire covered vaccination status; attitudes towards Covid-19 and vaccination; trust; information sources on Covid-19; social capital and belonging; economic circumstances; and voting history. The full text of the questionnaire can be found at https://osf.io/4ewta/ but items analysed for the current paper are described below.

Vaccination status was assessed by asking "*Have you received a COVID -19 vaccine?*", with the possible responses in Wales: "*Yes, I've had at least two doses of a vaccine*", "*Yes, I've had a single dose of a vaccine*", "*No*", and "*Prefer not to answer*"; and the following responses in the US: "Yes, I've had at least two doses of a two-dose vaccine (e.g. Pfizer/Moderna)", "Yes, at least one dose of a single-dose vaccine (Johnson & Johnson)", "Yes, a single dose of a two-dose vaccine (e.g. Pfizer/Moderna)", "No", and "Prefer not to answer".

In Wales, national identity was measured using the item "*How would you describe your national identity? Please choose all that apply*", with the non-exclusive options: "*Welsh*", "*English*", "*Scottish*", "*Northern Irish*", "*British*", "*Irish*", "*Polish*", and "*Other (please specify)*".

In the US, vote choice was measured using the question: "*In the 2020 Presidential election, did you vote for?*", with the response options: "*Joe Biden*", "*Donald Trump*", "*Someone else*", and "*I didn't vote*".

The surveys also included items on gender, age, race/ethnicity, education, income, place of birth, and health conditions conferring vulnerability to Covid-19. Where response options were recoded for analysis, this is described below in the analysis section.

5.4.2. Geographical data

Welsh survey data were linked to data on the proportion of people in each respondent's area of residence who identified only as Welsh according to the 2021 UK Census[1]. Area of residence was operationalised as the middle super output area (MSOA), a unit of census geography with a population of 5,000–15,000. Data from the Welsh Government on the proportion of each MSOA in receipt of benefits for low income in 2019 were also linked.

US survey data were linked to county-level data on the proportion of votes cast for Donald Trump in the 2020 presidential election and data from the Appalachian Regional Commission on the proportion of households living below the poverty line between 2014 and 18, normed to a percentage of the average rate for the whole US.

[1] The original version of this analysis was conducted with 2011 Census data, as 2021 Census data were not yet available. We report the version using 2021 data as the survey was much closer to this census, but the two analyses give very similar results

5.5. Analysis

Generalised linear mixed effects models were fitted using the glmmTMB package (Brooks et al., 2017) for R (R Core Team, 2019). Random intercepts were fitted for each MSOA (Wales) or county, nested by state (US), residuals were weighted by survey weights, and vaccination was operationalised as those having received the full original vaccine course (two doses, or one for the Johnson & Johnson vaccine).

In Wales, vaccination was predicted using whether respondents identified as Welsh (yes or no, ignoring whether they identified with other identities), the proportion of their MSOA that identified as Welsh only (z-scored), and the interaction of these two variables, with the latter being the term of interest. We fitted two models including putative confounders: a demographically-adjusted model which also included respondents' age, gender (male, female, prefer to describe another way, prefer not to say), ethnicity (White; Asian, Black, Mixed, Other and prefer not to say; recoded from more fine-grained categories following UK Office for National Statistics guidance as low sample sizes in smaller ethnic groups led to issues with model convergence); and a sociodemographically-adjusted model which included age, gender, ethnicity, household income (in bands, see tables), education (degree-level qualifications, non-degree-level qualifications, no qualifications, prefer not to say; recoded from more fine-grained options due to issues with model convergence), whether respondents had a health condition which would have prioritised them for a vaccine (a severe lung condition; severe kidney disease; Down's syndrome; blood or bone marrow cancer; a condition or medication putting one at high risk of infection, or suppresses the immune system; a problem with the spleen or a removed spleen; or a heart condition; recoded as: yes, at least one of the above; no, none of the above; prefer not to say), where respondents were born (Wales, England, Scotland, Northern Ireland, outside the UK, prefer not to say), and the MSOA-level measure of low income rates.

In the US, the models predicted vaccination status using respondents' reported vote in the 2020 election (Joe Biden, Donald Trump, Someone else, I didn't vote), the proportion of the county voting for Donald Trump (z-scored), and their interaction, which the latter being the term of interest. We fitted two models with putative confounders: a demographically adjusted model which also included respondents' age, gender (male, female, other), race (White/Caucasian, Black/African American, Asian or Pacific Islander, Native American, Arab/Middle Eastern, Other/mixed race), and Hispanic ethnicity (yes, no); and a socio-demographically adjusted model which included age, gender, race, Hispanic ethnicity, income (in bands, see tables), education (see tables), priority health condition, and the normed county-level poverty

Table 1
Characteristics of Welsh sample, stratified by quartiles of MSOA-level Welsh only identity.

MSOA Welsh only identity quartile		Bottom quartile (13.5–47.5%)	Second quartile (47.5–57.4%)	Third quartile (57.4–67.3%)	Top quartile (67.3–77.0%)
N		1050	1048	1035	1032
Fully vaccinated (%)		92%	92%	92%	91%
National identity (N & %)	Not Welsh	602 (57.3)	501 (47.8)	412 (39.8)	371 (35.9)
Gender (N & %)	Male	512 (48.8)	508 (48.5)	486 (47.0)	453 (43.9)
	Female	532 (50.7)	534 (51.0)	538 (52.0)	570 (55.2)
	Prefer to self-describe	3 (0.3)	2 (0.2)	7 (0.7)	5 (0.5)
	Prefer not to respond	3 (0.3)	4 (0.4)	4 (0.4)	4 (0.4)
Age (mean & SD)		52.02 (17.73)	52.70 (16.85)	52.19 (16.30)	51.69 (15.65)
Ethnicity (N & %)	Asian	10 (1.0)	9 (0.9)	8 (0.8)	4 (0.4)
	Black	4 (0.4)	3 (0.3)	1 (0.1)	1 (0.1)
	Mixed	13 (1.2)	11 (1.0)	11 (1.1)	1 (0.1)
	Other	3 (0.3)	2 (0.2)	0 (0.0)	1 (0.1)
	Prefer not to say	7 (0.7)	7 (0.7)	1 (0.1)	7 (0.7)
	White	1013 (96.5)	1016 (96.9)	1014 (98.0)	1018 (98.6)
Household income (N & %)	Under £5,000	17 (1.6)	25 (2.4)	21 (2.0)	17 (1.6)
	£5,000 to £9,999	38 (3.6)	48 (4.6)	47 (4.5)	40 (3.9)
	£10,000 to £14,999	97 (9.2)	69 (6.6)	90 (8.7)	76 (7.4)
	£15,000 to £19,999	71 (6.8)	82 (7.8)	98 (9.5)	97 (9.4)
	£20,000 to £24,99	105 (10.0)	102 (9.7)	74 (7.1)	96 (9.3)
	£25,000 to £29,999	94 (9.0)	74 (7.1)	86 (8.3)	95 (9.2)
	£30,000 to £34,999	62 (5.9)	68 (6.5)	61 (5.9)	87 (8.4)
	£35,000 to £39,999	62 (5.9)	63 (6.0)	65 (6.3)	72 (7.0)
	£40,000 to £44,999	56 (5.3)	47 (4.5)	51 (4.9)	44 (4.3)
	£45,000 to £49,999	45 (4.3)	41 (3.9)	50 (4.8)	32 (3.1)
	£50,000 to £59,999	57 (5.4)	57 (5.4)	49 (4.7)	76 (7.4)
	£60,000 to £69,999	46 (4.4)	47 (4.5)	43 (4.2)	31 (3.0)
	£70,000 to £99,999	40 (3.8)	61 (5.8)	47 (4.5)	48 (4.7)
	£100,000 and over	26 (2.5)	17 (1.6)	20 (1.9)	10 (1.0)
	Don't know	57 (5.4)	48 (4.8)	53 (5.1)	39 (3.8)
	Prefer not to answer	177 (16.9)	199 (19.0)	180 (17.4)	172 (16.7)
Education (N & %)	Don't know/Prefer not to say	29 (2.8)	36 (3.4)	47 (4.5)	38 (3.7)
	No formal qualifications	63 (6.0)	46 (4.4)	59 (5.7)	70 (6.8)
	Other	534 (50.9)	558 (53.2)	566 (54.4)	557 (54.0)
	University	424 (40.4)	408 (38.9)	366 (35.4)	367 (35.6)
Income deprivation (mean %, SD %)		12.92 (7.01)	13.90 (7.35)	16.54 (6.26)	18.13 (5.17)
Health conditions (N & %)	No	880 (83.8)	861 (82.2)	858 (82.9)	827 (80.1)
	Yes	144 (13.7)	163 (15.6)	152 (14.7)	182 (17.6)
	Prefer not to say	26 (2.5)	24 (2.3)	25 (2.4)	23 (2.2)
Place of birth (N & %)	Wales	418 (39.8)	551 (52.6)	675 (65.2)	709 (68.7)
	England	553 (52.7)	418 (39.9)	299 (28.9)	275 (26.6)
	Scotland	15 (1.4)	13 (1.2)	11 (1.1)	6 (0.6)
	Northern Ireland	5 (0.5)	11 (1.0)	4 (0.4)	7 (0.7)
	Outside the UK	56 (5.3)	53 (5.1)	41 (4.0)	32 (3.1)
	Prefer not to answer	3 (0.3)	2 (0.2)	5 (0.5)	3 (0.3)

rate.

5.6. Transparency and openness

This study was not pre-registered. The survey data linked to geographical data to reproduce our findings are not publicly accessible, as participants were told than fine-grained geographical data would not be shared. Survey data without geographical data are available from the first author who is very happy to support further use. The survey questions are available at: https://osf.io/4ewta/.

6. Results

6.1. Wales

Table 1 shows the Welsh sample composition, stratified by MSOA-level Welsh-only identification quartiles. Data were excluded from 22 respondents (<1%) who had missing data for one or more variables (mainly vaccination).

In both the demographically-adjusted and sociodemographically-adjusted models those who did *not* identify as Welsh were less likely to be vaccinated the greater the proportion of their neighbourhood's residents who identified as Welsh only, relative to those who identified as Welsh, as represented by the interaction term. Fig. 2 gives modelled marginal effects for the socio-demographically-adjusted model and Table 2 gives odds ratios from the model.

We wanted to assess whether respondents who were minorities in their areas were less likely to be vaccinated because of a lack of confidence in the effectiveness of the vaccine, rather than, as we hypothesise, being less motivated by benefits to third parties. To do this, we reran the sociodemographically-adjusted model, including responses to selected survey items as predictors in the model. If the sentiments expressed in the items explained our findings, this would abolish any interaction term we found. The items were *"Being vaccinated makes you much less likely to get seriously ill from Covid", "I trust the science behind the COVID-19 vaccines", and "People have a responsibility to their community to get vaccinated"*. The first two items capture confidence in the vaccine while the last represents endorsement of the social benefits of vaccinations. Separate models were run for the three items and the response options for each item were "*Strongly agree*", "*Agree*", "*Neither agree nor disagree*", "*Disagree*", "*Strongly disagree*", and "*Prefer not to answer*", the first of which was the reference category and the others were included as dummy variables.

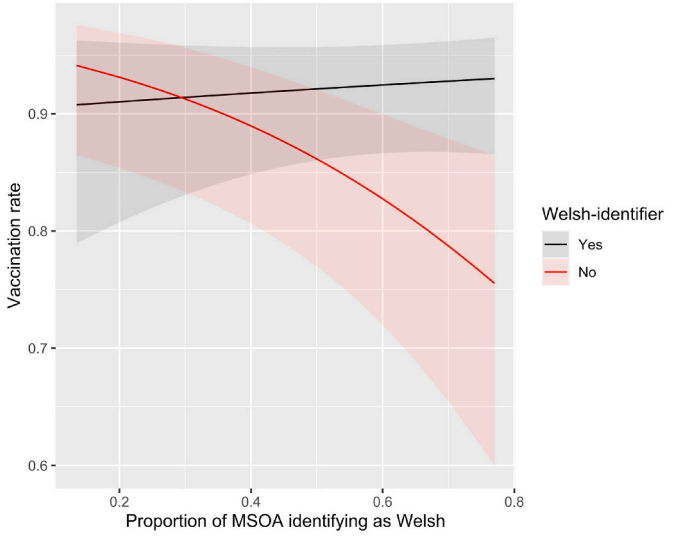

Fig. 2. Estimated marginal effect of individual-level Welsh identification by proportion of Welsh-only identifiers in respondents' MSOA in the sociodemographically-adjusted model of the Welsh data.

Confidence intervals of the interaction term did not overlap with 1 when including the first two items, measuring vaccine confidence (OR = 0.738, $OR_{CI95\%}$ = 0.547-0.997; OR = 0.641, $OR_{CI95\%}$ = 0.461-0.892 respectively), but did when including the item on responsibility (OR = 0.776, $OR_{CI95\%}$ = 0.550–1.019).

Several further sensitivity analyses were run. Firstly, the same results were found when defining vaccination as having at least one dose, rather than being fully vaccinated. Secondly, the same results were also found when using 2011 Census data, rather than 2021 data, for the area-level exposure. Indeed, the original analyses were run using these data, prior to the release of 2021 census data, but given that the 2021 census date was much closer to the fieldwork, we report analyses using these data. Thirdly, the main analysis did not consider what sorts of non-Welsh national identities drove the effect. We reran the analysis with three additional response options to the national identity question as the individual-level exposure in place of Welsh, keeping the area-level variable as Welsh-only identification: English, British, and 'other'. We found that both English and British identifiers were less likely to be vaccinated in more Welsh-only identifying MSOAs. The same trend existed for those giving an 'other' national identity, but confidence intervals overlapped with 1, likely due to the small size of this group (N = 139). Fourthly, running the analysis without sampling weights did not alter the results. Fifthly, in case the analysis was confounded by ethnicity in a way not captured by adjusting for a main effect of ethnicity, we also ran a model which included interaction terms between ethnicity and the proportion of 'Welsh only' identifiers in each MSOA, and our interaction term of interest remained after this adjustment.

6.2. US

Table 3 shows the sample composition, stratified by county-level Trump vote quartiles and Table 4 shows odds ratios from the demographically and sociodemographically -adjusted models. Data were excluded from 35 respondents (<1%) with missing data for one or more variable (mainly vaccination).

As with the Welsh data, in both US models, the interaction term's confidence intervals did not overlap with 1. The vaccination rates of both Trump voter and Biden voters declined as the proportion of their county voting for Trump increased, but this decline was more pronounced for Biden voters than Trump voters, as shown in Fig. 3.

As with the Welsh data, we reran the sociodemographically-adjusted model three times with the survey items measuring vaccine confidence and social responsibility. Again, confidence intervals did not overlap with 1 when adjusting for either item measuring vaccine confidence (OR = 3.90, $OR_{CI95\%}$ = 1.29–11.85; and OR = 4.24, $OR_{CI95\%}$ = 1.42–12.67) but did when adjusting for the responsibility item (OR = 2.46, $OR_{CI95\%}$ = 0.766–7.87).

Again, we ran several further sensitivity analyses. Firstly, the results held when including partially vaccinated respondents in the vaccinated group. Secondly, they held when using county-level Biden vote as the geographical exposure, rather than Trump vote (due to third party candidates, these may not sum to 100%). Thirdly, results held in unweighted models.

7. Discussion

Using survey data from two countries and looking at socially salient identities in these contexts, we find novel evidence of a 'group density' phenomenon for vaccination. Respondents in the minority in their local area on the basis of these identities were less likely to be vaccinated, adjusting for likely confounders, than those in the majority. The results are consistent with vaccination decisions being influenced by whether prospective recipients feel that likely third-party beneficiaries are part of the same in-group as them. This is an example of social psychological factors shaping people's health behaviours at a crucial juncture, and

Table 2
Odds ratios from the Welsh models.

		Demographically-adjusted model			Sociodemographically-adjusted model		
		OR	OR 2.5%	OR 97.5%	OR	OR 2.5%	OR 97.5%
Cross-level national identity interaction		**0.72**	**0.57**	**0.91**	**0.68**	**0.53**	**0.88**
MSOA-level Welsh only identity		0.97	0.79	1.19	1.05	0.84	1.30
National identity	Not Welsh	0.57	0.45	0.72	0.44	0.32	0.62
Gender	Female	0.91	0.72	1.15	0.89	0.69	1.13
	Prefer to self-describe						
	Prefer not to respond	0.47	0.12	1.90	0.85	0.17	4.20
Age		1.05	1.05	1.06	1.06	1.05	1.07
Ethnicity	Black	0.04	0.01	0.28	0.04	0.01	0.28
	Mixed	1.53	0.43	5.28	1.67	0.43	6.51
	Other	0.80	0.11	5.53	1.17	0.12	11.52
	Prefer not to say						
	White	1.36	0.58	3.18	1.26	0.49	3.23
Household income	£5,000 to £9,999				0.51	0.25	1.05
	£10,000 to £14,999				1.18	0.59	2.38
	£15,000 to £19,999				1.61	0.80	3.24
	£20,000 to £24,99				1.99	0.97	4.09
	£25,000 to £29,999				2.77	1.29	5.92
	£30,000 to £34,999				2.52	1.14	5.56
	£35,000 to £39,999				1.55	0.73	3.28
	£40,000 to £44,999				1.77	0.80	3.96
	£45,000 to £49,999				1.99	0.84	4.72
	£50,000 to £59,999				4.82	1.96	11.83
	£60,000 to £69,999				4.24	1.83	12.93
	£70,000 to £99,999				4.27	1.67	10.81
	£100,000 and over				0.89	0.30	2.65
	Don't know				1.36	0.68	2.71
	Prefer not to answer				2.24	1.15	4.36
Education	No formal qualifications				0.51	0.26	1.01
	Other				0.64	0.37	1.10
	University				1.33	0.74	2.39
Health conditions	Yes				1.25	0.86	1.83
	Prefer not to say				0.24	0.13	0.43
Income deprivation					0.98	0.95	1.00
Place of birth	England				1.44	1.01	2.07
	Scotland				10.92	1.08	110.07
	Northern Ireland				0.48	0.14	1.65
	Outside the UK				0.77	0.45	1.33
	Prefer not to answer				1.35	0.17	10.44

shows how the pandemic exposed socio-political cleavages.

These results echo studies showing group density associations for mental health. These have focused on minority groups defined by ethnicity (Baker et al., 2021), but have also found group density phenomena for non-ethnic characteristics (Saville, 2021b; Saville and Mann, 2022; Schofield et al., 2016). Vaccination is an interesting health behaviour in this context, however, where possible third-party benefits may be an explicit part of decision-making.

Although we observe a similar interaction, directionally speaking, in the two samples, it is worth discussing the broader shape of the patterns we observe in Figs. 2 and 3. In Wales, it appeared to be specifically non-Welsh identifiers who showed a drop-off in vaccination rates as they became the minority, while Welsh identifiers showed much less of a slope. Potentially this is due to an inherent asymmetry where even Welsh identifiers who live in non-heartland 'British Wales' felt like their behaviour was symbolically on behalf of an in-group (*i.e.* the nation), while this symbolism did not apply for non-Welsh identifiers.

America was different to the Welsh context in that the studied identities were strongly polarised in terms of their views of vaccination. Trump voters were much less likely to be vaccinated than Biden voters and we see evidence of contextual effects, with all respondents being less likely to be vaccinated the more their county voted for Trump. Compatibly with our hypothesis, this slope was steeper for Biden voters than Trump voters. The main effect of county-level Trump vote is consistent with informational/norm-based influences on vaccination. However, the fact that this slope is steeper in Biden voters seems hard to reconcile with a purely group norm-based account, as social networks have been shown to be homophilic with regard to Trump/Biden support (Blanchar and Norris, 2021), so on a purely informational/norms-based account, we would expect this slope to be steeper for Trump voters. Thus the pattern we observe seems consistent with an effect of minority status overlaid on large effects of individual partisanship and county-level social norms.

Although we do not report them here, this paper comes from a broader project which included qualitative interviews (Saville et al., 2023). It is worth highlighting that a key theme in these data was 'vaccine individualism', where those who were unvaccinated viewed vaccination as a health decision to be made on an individual basis and regarded social pressure on them to get vaccinated as unreasonable, while those who were vaccinated often reported prosocial motivations to get vaccinated. It is unclear if these are best understood as insights to people's true motivations or as rhetorical framings used to justify their behaviour. More broadly, although the literature on health messaging and Covid vaccines suggests that messages based on altruism are not effective (Ruggeri et al., 2024), there is evidence that international differences in altruism, as measured by organ donation rates, are associated with vaccination rates (Hierro et al., 2023).

Alternative explanations for these results should be considered. One explanation is that they reflect different information environments for those who are minorities and majorities in their local area leading to differences in levels of vaccine confidence. For example, Biden voters living in more Trump-voting counties may be more exposed to, and influenced by, vaccine-sceptical opinions than those living in Biden voting areas, and indeed may regard the people holding such opinions as fellow members of socially salient in-groups – neighbours, friends, relatives, even if they are partisan rivals. We attempted to address this issue

Table 3
Characteristics of US sample, stratified by quartiles of county-level Trump vote.

County Trump vote quartile		Bottom quartile (11.2–46.7%)	Second quartile (46.7–65.2%)	Third quartile (65.2–75.7%)	Top quartile (75.7–89.8%)
N		1214	1234	1170	1211
Fully vaccinated (%)		74%	67%	62%	58%
Vote in 2020 (N and %)	Joe Biden	613 (50.5)	432 (35.0)	379 (32.4)	429 (35.4)
	Donald Trump	350 (28.8)	501 (40.6)	485 (41.5)	489 (40.4)
	Someone else	35 (2.9)	43 (3.5)	48 (4.1)	43 (3.6)
	I didn't vote	216 (17.8)	258 (20.9)	258 (22.1)	250 (20.6)
Gender	Male	472 (38.9)	528 (42.8)	539 (46.1)	697 (57.6)
	Female	742 (61.1)	706 (57.2)	631 (53.9)	514 (42.4)
	Other	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Age (mean, SD)		46.76 (16.46)	46.98 (16.71)	44.75 (16.54)	46.87 (16.37)
Race (N & %)	White/Caucasian	854 (70.3)	1047 (84.8)	1011 (86.4)	977 (80.7)
	Arab/Middle Eastern	4 (0.3)	1 (0.1)	1 (0.1)	4 (0.3)
	Asian or Pacific Islander	36 (3.0)	30 (2.4)	14 (1.2)	22 (1.8)
	Black/African-American	284 (23.4)	120 (9.7)	127 (10.9)	185 (15.3)
	Native American	6 (0.5)	12 (1.0)	7 (0.6)	13 (1.1)
	Other/mixed race	30 (2.5)	24 (1.9)	10 (0.9)	10 (0.8)
	Prefer not to answer	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Hispanic (N & %)		88 (7.2)	61 (4.9)	45 (3.8)	47 (3.9)
Household income (N & %)	Less than $10,000	80 (6.6)	66 (5.3)	81 (6.9)	90 (7.4)
	$10,001 - $20,000	100 (8.2)	101 (8.2)	117 (10.0)	105 (8.7)
	$20,001 - $30,000	122 (10.0)	155 (12.6)	134 (11.5)	131 (10.8)
	$30,001 - $40,000	122 (10.0)	145 (11.8)	109 (9.3)	95 (7.8)
	$40,001 - $50,000	104 (8.6)	102 (8.3)	98 (8.4)	93 (7.7)
	$50,001 - $75,000	202 (16.6)	223 (18.1)	168 (14.4)	166 (13.7)
	$75,001 - $100,000	192 (15.8)	219 (17.7)	181 (15.5)	313 (25.8)
	$100,001 - $150,000	216 (17.8)	173 (14.0)	254 (21.7)	189 (15.6)
	$150,001 or more	76 (6.3)	50 (4.1)	28 (2.4)	29 (2.4)
Education (N & %)	Less than high school	9 (0.7)	3 (0.2)	11 (0.9)	25 (2.1)
	High school incomplete	38 (3.1)	73 (5.9)	109 (9.3)	119 (9.8)
	High school graduate	278 (22.9)	347 (28.1)	472 (40.3)	563 (46.5)
	Some college, no degree	329 (27.1)	351 (28.4)	270 (23.1)	269 (22.2)
	2-year associate degree, college or university	150 (12.4)	153 (12.4)	112 (9.6)	95 (7.8)
	4-year college or university degree/ Bachelor's degree	241 (19.9)	204 (16.5)	138 (11.8)	89 (7.3)
	Postgraduate or professional schooling (no postgraduate degree)	30 (2.5)	13 (1.1)	9 (0.8)	14 (1.2)
	Postgraduate or professional degree	139 (11.4)	90 (7.3)	49 (4.2)	37 (3.1)
Poverty rate (% of US average)		103.76 (39.07)	96.63 (31.24)	112.80 (38.18)	144.62 (38.86)
Health conditions (N & %)	No	859 (70.8)	896 (72.6)	746 (63.8)	708 (58.5)
	Prefer not to say	15 (1.2)	17 (1.4)	12 (1.0)	14 (1.2)
	Yes	340 (28.0)	321 (26.0)	412 (35.2)	489 (40.4)

with our additional analysis using the survey items on vaccine confidence and responsibility. If our findings were due to informational mechanisms, we would expect that adjusting for items measuring respondents' belief in the effectiveness or trustworthiness of the vaccine would abolish the interaction of interest, which it does not. Conversely, adjusting for respondents' responses to the item "People have a responsibility to their community to get vaccinated" does abolish the interaction, suggesting that the mechanism behind the interaction is to do with social norms. Thus, assuming the survey items are reasonable proxies for the constructs, the results are better explained by respondents in the minority being less persuaded by the social benefits of vaccination than them holding less vaccine confident attitudes. Furthermore, as mentioned above, it seems unlikely that local social influences would be stronger for Biden voters than Trump voters if they were purely informational. Nonetheless, differences in information environments are a competing explanation worth taking seriously.

Another possibility is that the results reflect compositional rather than contextual effects – are the Biden voters in 88% Trump-voting Owsley County, Kentucky similar to the Biden voters in 38% Trump-voting Fayette County, Kentucky? For example, respondents living in areas where they are in the minority might have chosen to live in these areas because they are less motivated by feeling like part of the community, which in turn could be negatively associated with vaccination. This seems a plausible competing explanation, but one which relies on similar unmeasured confounding occurring in the two contexts.

A third possibility is reverse causation. In the US, the vaccination campaign began after the presidential election, so straightforward reverse causation is impossible, but if vaccination is a proxy for broader attitudes towards Covid, which pre-existed the vaccines, it is plausible that such attitudes might have shaped vote choice, rather than vice versa. In Wales, the pandemic brought together the political questions of pandemic response and Welsh self-determination, as Welsh Government and UK Government policy on Covid-19 diverged. Thus, it is possible that those with different opinions on Covid-19 expressed these through the adoption or disavowal of Welsh identity. There is some evidence that Trump's vote was adversely affected in areas of the US with high case rates (Baccini et al., 2021), suggesting that Covid attitudes influenced voting, but no studies have looked at Covid shaping national identity in Wales. However, even if reverse causation were plausible for national and partisan identities, it is not clear why this would give rise to the observed geographical interactions, rather than being reflected in the main effect terms of our models.

Alongside these other explanations, it is worth considering some limitations of the study. Firstly, the cross-sectional design limits our ability to demonstrate causation. Pre-pandemic measures of national and partisan identities would have strengthened our design. Secondly, Trump voters are famously undersampled in surveys (Kennedy et al., 2018) and those who do respond may not be representative of those who do not. Thirdly, the US survey focused on a region which voted disproportionately for Trump – other than Virginia, all the states we

Table 4
Odds ratios from US models.

		Demographically adjusted model			Socio-demographically adjusted model		
		OR	OR 2.5%	OR 97.5%	OR	OR 2.5%	OR 97.5%
Cross-level vote interaction	**Donald Trump**	**4.31**	**1.62**	**11.52**	**5.35**	**1.96**	**14.62**
	Someone else	5.17	0.59	45.60	7.44	0.82	67.39
	Didn't vote	1.90	0.61	5.87	1.78	0.56	5.63
Vote in 2020	Donald Trump	0.12	0.07	0.23	0.11	0.06	0.21
	Someone else	0.14	0.04	0.53	0.11	0.03	0.42
	I didn't vote	0.14	0.07	0.28	0.18	0.09	0.37
County Trump vote		0.09	0.04	0.21	0.11	0.04	0.27
Race	Arab/Middle Eastern	3.73	0.36	38.20	5.08	0.45	57.52
	Asian or Pacific Islander	1.40	0.80	2.46	1.10	0.62	1.96
	Black/African-American	0.59	0.47	0.73	0.63	0.51	0.79
	Native American	1.00	0.40	2.52	0.99	0.39	2.51
	Other/mixed race	0.55	0.30	0.99	0.54	0.29	0.98
Hispanic		1.59	1.15	2.21	1.53	1.10	2.15
Gender	Female	0.52	0.44	0.60	0.61	0.52	0.71
Age		1.03	1.03	1.04	1.03	1.03	1.04
Household income	$10,001 - $20,000				0.86	0.61	1.23
	$20,001 - $30,000				1.03	0.73	1.46
	$30,001 - $40,000				1.18	0.83	1.69
	$40,001 - $50,000				1.23	0.84	1.78
	$50,001 - $75,000				1.32	0.94	1.85
	$75,001 - $100,000				1.42	1.01	2.01
	$100,001 - $150,000				1.81	1.30	2.53
	$150,001 or more				1.75	1.08	2.83
Education	High school incomplete				0.99	0.43	2.24
	High school graduate				0.63	0.29	1.38
	Some college, no degree				0.79	0.36	1.74
	2-year associate degree, college or university				0.79	0.36	1.78
	4-year college or university degree/Bachelor's degree				1.42	0.63	3.18
	Postgraduate or professional schooling, without degree				1.14	0.40	3.28
	Postgraduate or professional degree				2.39	1.00	5.71
Poverty rate (% of US average)					1.00	1.00	1.00
Health conditions	Prefer not to say				0.57	0.31	1.04
	Yes				1.40	1.19	1.65

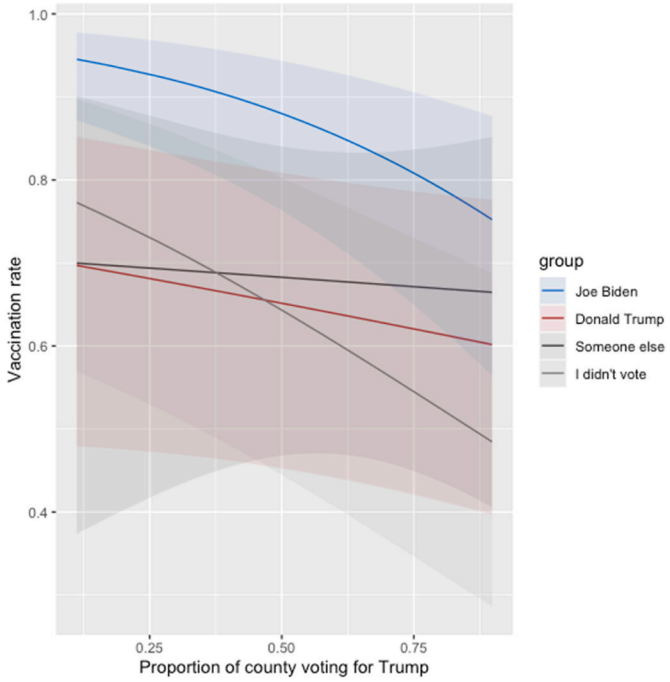

Fig. 3. Estimated marginal effects of vote choice by county-level Trump vote in the sociodemographically-adjusted model of US data.

surveyed voted for Trump, so counties voting for Biden represent enclaves. Examining the same phenomenon in regions where Biden won may also be instructive.

The study also had important strengths. Firstly, the use of survey data from two contexts, with different socially salient identities provides evidence for a general phenomenon, rather than one linked to the specific case of US political partisans or national identity groups in Wales. Secondly, the survey data in question was representatively sampled by professional survey companies. Thirdly, the analysis method allows us to examine the association between vaccination and outsider status implicitly, which has advantages when studying a topic where social desirability biases may apply and where people may not have full insight to the factors influencing their decisions.

It is also worth stating that the social identities in question were chosen due to their social salience and thus as examples of the sorts of identities which could give rise to the hypothesised effects. We do not wish to single them out specifically as groups who were unwilling to take public health measures for their fellow citizens. It is plausible that such patterns may be observed for many identities and our interest is in the consequences of minority status for health behaviour in a general sense. Understanding which identities may drive these phenomena is a fascinating question. National identity may be a salient social cleavage in the multinational UK but not in the US. Social psychological theories suggest that identity salience is highly contingent and can be driven arbitrarily (Brown, 2020; Tajfel and Turner, 1979) while theories from political sociology suggest that such social cleavages are often strategic (Posner, 2018). Our data do not speak to this question but the malleability of social identities and their significance for public health is an important issue for health communication.

In terms of implications, our results suggest that different audiences will hear appeals to protect 'the community' very differently, perhaps explaining the issues with this sort of messaging (Ruggeri et al., 2024; Steinert et al., 2022). Public health is, rightly, cognisant of structurally marginalised social groups, such as ethnic and sexual minorities. Our results suggest that marginalisation on a hyper-local level can also drive

disengagement from public health, and that a local perspective is important for identifying groups requiring particular attention from public health practitioners.

Vaccination, like all countermeasures against infectious diseases, is a social act and the present study demonstrates that its determinants are accordingly socially complex. Public health messaging strategies need to be designed for our fractured modern societies and different messages may be needed for difference audiences.

Ethics approval

This project was approved by the Bangor University School of Psychology and Sports Science Academic Research Ethics Committee.

CRediT authorship contribution statement

Christopher W.N. Saville: Writing – review & editing, Writing – original draft, Visualization, Supervision, Software, Resources, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Robin Mann:** Writing – review & editing, Writing – original draft, Conceptualization. **Anthony Scott Lockard:** Writing – original draft, Conceptualization. **Aidan Bark-Connell:** Writing – review & editing, Writing – original draft, Investigation, Conceptualization. **Stella Gmekpebi Gabuljah:** Writing – review & editing, Writing – original draft, Investigation, Conceptualization. **April M. Young:** Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Conceptualization. **Daniel Rhys Thomas:** Writing – review & editing, Writing – original draft, Methodology, Funding acquisition.

Data availability

The authors do not have permission to share data.

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