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How a minority language relates to place attachment and nature connection: the case of Welsh

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ABSTRACT

Linked to awareness of a history of suppression in Wales, locals' place attachment is intertwined with a deep sense of appreciation towards Welsh language and culture. However, direct links between the ability to speak Welsh, strength of place attachment, and connection to the natural environment have not been systematically explored previously. We conducted a nationally representative study ($n=2082$) to examine relationships between Welsh language variables, nature connectedness, place attachment, and perceptions of language-environment connections. Results revealed that Welsh-English (bilingual) speakers have a stronger self-assessed connection to nature in general (15.7% increase) and show higher place attachment than (monolingual) English speakers in Wales (17.1% increase). Participants from South-East Wales showed significantly lower nature connectedness than those in both Mid & South-West Wales (8.9% decrease) and North Wales (11.9% decrease). Moreover, Welsh speakers tend to see a link between language and environment while English speakers do not, with the difference amounting to 38%. Our results highlight language as an essential factor that feeds into the ways in which people connect with nature—an important finding for those promoting sustainable behaviours in Wales and beyond, calling for considerate and inclusive linguistic practices as decisive for any engagement with the public.

KEY POLICY HIGHLIGHTS

- Language is relevant to concerns about the natural environment in multiple ways, affecting how people conceptualise their surroundings
- As a minority language, Welsh connects its speakers closely with their local environment, cultural heritage and history, leading to increased place attachment
- Within Wales, people who speak Welsh feel more closely connected to nature than those who do not
- Non-Welsh speaking residents of Wales do not tend to recognise the significance of language in relation to nature
- The language-nature link has strong potential to feed into educational and policy practices in Wales, elevating the relevance of the natural environment for heritage and place

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1. Introduction

The notion of place attachment is linked with a wide range of environmental and social facets (Hamzei et al., 2020), where language plays a role in conveying place names, spatial information and associations with places. The close relation between language and environmental concerns is further examined in Ecolinguistics (Steffensen, 2025; Stibbe, 2015) and Environmental Linguistics (Harrison, 2023), addressing how words and concepts, discourses, narratives, and stories influence and interact with the way we deal with the natural environment. This ties in with long-standing debates regarding the influence of language on thought, going back to the well-known Sapir-Whorf hypothesis stating that each language is associated with its own world view, possibly even determining its speakers' thought patterns (Sapir, 1929;

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Whorf, 1956; see Wolff & Holmes, 2011 for a nuanced review). A host of studies following this 'Whorfian tradition' establishes how specific concepts and lexical repertoires affect speakers' ways of thinking in domains that are represented in different language in different ways, such as colour terminology affecting perceptions of colour (Kay & Regier, 2006) or grammatical properties affecting the way events are conceptualised (Slobin, 2011). While this line of work continues to inspire controversial debates about the extent to which languages can affect our ways of thinking, it has undoubtedly led to a general awareness of the intricate relations between language and thought (Pavlenko, 2016). However, languages not only capture and guide ways of thinking, but also serve as markers of cultural identity (Mu, 2015), carrying traditions and intangible cultural heritage (Aktürk & Lerski, 2021).

Recent empirical research not only offers compelling examples in the environmental domain but also demonstrates how cultural concepts and ideologies are transmitted differently by languages. Harrison (2023) demonstrated how environmental concepts engrained in indigenous languages such as Tuvan shape many areas of life. A cross-country analysis revealed that countries with languages whose grammar forces speakers to distinguish between the present and the future are associated with higher carbon emissions, although this effect disappears with increasing renewable energy consumption (Du et al., 2026). Reports of the same ecological event in the same bilingual media outlet differed systematically between French and Wolof, reflecting different ideologies, offering different solutions and framing different actors as responsible (Rohmer, 2023). A comparison of climate change picture books revealed systematic differences in key metaphorical framings in Chinese vs. American culture, expressed in image-text combinations (Yuan, 2026). Research on Traditional Ecological Knowledge demonstrates how language encodes place-based knowledge systems; ways of knowing the world that are tied to specific landscapes, climates, and lifeways, building on Sapir's (1912) insights on the intricate ways in which indigenous languages encode environmental knowledge. The decline of minority languages therefore threatens the culturally embedded knowledge of local environments, climate patterns, and sustainable practices (Hill et al., 2002; Maffi, 2005).

Consistent differences across cultures in ideological framings can also be found within a language (English), as reflected through media discourse that reflects each culture's specific view on ecological matters (Saleem & Rehman, 2026). Languages such as Taino incorporate these world views and connections to the environment via complex biocultural naming conventions (Fisk, 2025), enhancing awareness of human-land relations based on the structure of language itself. Abundant literature empirically addressing the Sapir-Whorf hypothesis over several decades provides evidence that such structural differences also affect non-linguistic (such as perception-based) task performance (e.g. Baier et al., 2023; Levinson, 2003), in line with the widely held 'grounded cognition' assumption that neural systems directly store information about experienced concepts and categories also found in word meanings (Kemmerer, 2023). Based on this strong and multifaceted evidence regarding the importance of language for environmental thinking, preserving linguistic diversity is seen as directly relevant to enhancing environmental sustainability (Harrison, 2023).

However, previous research does not reveal whether a specific language might relate to place attachment in specific ways, and how this relates to connections to the natural environment more generally, depending on the language one speaks. This paper addresses this gap by systematically examining the relationship between language, nature and place attachment, using a survey that is representative for the population in Wales (Carone et al., 2025). This is motivated by a range of indications that the Welsh language, which is spoken alongside English by about a quarter of the population in Wales,¹ connects people intricately with their environment; our own observations made when working with communities in North Wales strongly support this intuitive understanding. The Public Map research project (www.publicmap.org), of which this research is a part, supports people on Anglesey in North Wales by providing opportunities to put what matters to them on a jointly developed and publicly shared multi-layered map, thus facilitating local planning processes and regional policy development. Participatory projects of this kind require communicating via the language (and register or style) that people are comfortable with across different areas of society.

In Wales, Welsh is a minority language that for a long time was actively suppressed by the English (Davies, 2014) but now benefits from active governmental priority support (Löffler, 2024; May, 2000). Linked to highly sensitive awareness of this history, people's place attachment is often intertwined with

a deep sense of appreciation towards Welsh language and culture, which in people's discourse (Tenbrink & Williams, 2022) and in poetry (Jarvis, 2021) are associated with the environmental beauty and strong links to local cultural heritage; intertwined with the heritage of colonisation by the English. Inclusive, collaborative projects such as the Public Map would therefore be inconceivable without strong Welsh-medium engagement. The Public Map team support the development of digital community-created maps of their area, a process that raises important questions about the differences between data gathering in different languages, considering the contested cultural associations of places (Ioannou et al., 2023). As a Green Transition Ecosystems project funded by the Arts and Humanities Research Council, the aim of the project is to promote green transitions behaviours, which is also the underpinning ethos behind the research in this paper.

As the Welsh language and culture is recognised to be under threat (St Leger, 2024), exacerbated by environmental changes, local climate change discourse frequently includes discussion of language along with other cultural heritage aspects, motivating people's engagement towards resilience (Roberts et al., 2023). Community groups acting for the environment appreciate the opportunity to join up as a unified culture, speaking the same (minority) language, aligning their thoughts and purposes for the benefit of their home area which shapes their identity in many ways—in line with the recognition that the Welsh language is kept alive by joint actions (Evans et al., 2022; Hodges & Prys, 2019).

As such, the key role of the Welsh language for Welsh culture and heritage is well recognised (Braber & Howard, 2023; Young et al., 2017), along with acknowledgement of its significance for place attachment and identity (Jones, 2019). The notion of a specific connection between the Welsh language and the environment is supported powerfully by a popular publication by Graves (2024), which resonates with subjective testimonies that the environment cannot be described adequately without using Welsh due to the rich concepts associated with Welsh environmental terminology, also reflected abundantly in place names (Richards, 1967; Thomas, 1973). Beyond resonating with research on Traditional Ecological Knowledge as explored above, Graves (2024) argues that in Wales this connection between language and the environment concerns more than knowledge: according to Graves, it is a deeply engrained part of people's identity and history, shaping the Welsh culture in a significant, yet intangible way. Graves (2024) emphasises the unique relationship to the local landscape that characterises Welsh culture, in a way that, he believes, differs from other European cultures; he refers to 'the deeply held conviction that the land and its people are inextricably intertwined', as expressed by Welsh terms like 'brodorol' which is only roughly translated by 'indigenous'—'describing our own culture's status on its own territory'.

Links between environmental awareness and Welshness (language and culture) are supported by many Welsh-community led initiatives towards a sustainable future,² contrasting with historical English imperialist perspectives that expose the injustice of prevalent extraction practices (Johnes, 2019). Accordingly, there is a growing tendency to recognise the importance of language in policies around communities, bridging the work of the Welsh Language Commissioner with that of the Future Generations Commissioner, whose task is to put the groundbreaking Wellbeing of Future Generations Act for Wales³ into practice. The sense of urgency conveyed by reports such as St Leger (2024) and the Future Generations Report⁴ (2025) reflects not only the threat of climate change to language and culture in Wales, but also the substantial contribution to societal resilience that comes from rootedness in history, traditions and cultural coherence, conveyed and transmitted from generation to generation via language—again, notions that are strongly felt by the communities contributing to the Public Map Platform (<https://publicmap.org>). Our qualitative observation of Public Map activities (Beech & Tenbrink, 2026) highlight the key role of the Welsh language, as part of the culture, in strengthening connections to place, reinforcing local identity, and motivating care for the local environment.

Against this background and considering the above observations on the suggested links between Welsh language and the environment in Wales, there is reason to hypothesise that *speakers of Welsh have a stronger relationship to the natural environment compared to citizens in Wales who do not speak Welsh*. Our study addresses this hypothesis via a nationally representative survey that first identified participants' Welsh-language abilities, place attachment, and general connections to nature separately in order to address possible links between them, and secondly explored participants' perceptions of such links. In doing so, to get a clear sense of what speaking Welsh means in this context, it addressed Welsh-language abilities both in a binary way modelled on the Census (Office for National Statistics (ONS), 2022) question

‘Can you speak Welsh?’ and via more nuanced-Likert scale questions. The survey offered a choice to respond in Welsh or English, allowing people to choose their preference when doing the survey. In the following, we consider the reasoning behind choices for our survey scope and design in depth, in light of relevant literature.

2. Methodological motivations

Place attachment has been researched intensely for more than half a century from a variety of perspectives, aiming to gain insights about what connects different people to places, what types of place features lead to stronger place attachment, and what the processes are that attach people to places (Levinson, 2003). Perhaps related to the tendency for academic research to be published in the ‘global language’ English (Montgomery, 2013), the factor of language as a place-related element is typically missed, even when considering place attachment in natives vs. non-natives (e.g. Hernández et al., 2007). However, there are multiple relationships between language and place (Tenbrink, 2020b). In their review of facets of place attachment, Hamzei et al. (2020) included ‘linguistic facets’ as aspects that facilitate knowledge sharing about places, most notably via place names and other linguistic elements that allow referring to places. In Wales, many place names are in Welsh and carry rich meaning about place, such as references to specific plants or traditional agricultural methods (Thomas, 1973). The fact that such meanings are missed by non-Welsh speakers provides one good reason for assuming that language matters when considering place attachment. Wider research on Welsh terminology that relates people to places corroborates the view that, in Wales, language is inextricably linked to people’s identity, history and—on that basis—place attachment (e.g. Adams, 2024; Graves, 2024).

Language matters in other ways, too: it is one key medium through which place attachment is assessed; this mostly happens via surveys asking questions about how respondents relate to place (Levinson, 2003). However, specific questions (especially those with Likert-scale responses) naturally constrain what people will think and convey about their place attachment; to gain insights about a wide range of facets that matter in this respect, it is often felt necessary to ask many questions, motivated by academic literature highlighting the multidimensionality of the notion. In consequence, as language is not often in focus in this field of literature, questions about the role of language are rare. In contrast, free-text options convey people’s unconstrained responses in a far less biased way, opening up ways of accessing human thought systematically via analysis of key linguistic features and concepts (Jackson et al., 2022; Tenbrink, 2020a). Thus, language matters both as a unique medium of conveying place attachment (Tenbrink, 2020b), and as an element that connects people with places as a key aspect of their identity and history (Jones, 2019; Shaw, 2001).

In recognition of the value of free-text responses, Tenbrink and Willcock (2023) developed a systematic procedure for scoring place attachment that required asking one single question (‘Please describe your local area, in terms of what it means to you personally’) that invited participants to develop their own thoughts about their local area. While their work did not focus on language as a factor for place attachment, it highlighted a range of ways in which linguistic concepts convey connections to place to different degrees, ranked by Tenbrink and Willcock (2023) from ‘weak’ to ‘very strong’, factored into an overarching place attachment score through weighting.

Our current study adapts this procedure. Its focus on Wales leads to a higher inclusion of Welsh speakers, thus allowing for recognition of the language factor which remained obscure in Tenbrink and Willcock (2023) UK-wide work. While speakers of various Celtic languages are spread across the UK,⁵ the vast majority of British inhabitants are English monolingual speakers (Sebba, 2017). Such dominance of a majority language is likely to overshadow place attachment and identity effects for indigenous populations around the world (Shaw, 2001).

In addition to attachment to a specific place, connectedness to nature and responsibility for nature are recognised as factors that relate to humans’ wellbeing as well as engagement in nature-friendly behaviour and sustainable practices (Madera et al., 2024; Sheffield et al., 2022). In Wales, a range of institutions, most prominently Natural Resources Wales, support these factors in appreciation of the widely recognised value and beauty of Wales’ natural environment (Jones et al., 2023), sometimes formalised through ‘social prescribing’ healthcare delivered through organisations such as Medrwn Môn on

Anglesey (Ynys Môn). However, some studies have suggested that generic notions of natural environment may be too abstract for people to link to nature in a personal way (Beery & Wolf-Watz, 2014); nature connectedness should therefore be promoted via place-based engagement (Christens et al., 2025). In this study, we therefore ask not only about the specific relation that participants have to places in Wales, but also about more general feelings of nature connectedness and responsibility for nature.

The view that being a Welsh speaker may link to place attachment in Wales appears to suggest a binary division between those who speak Welsh and those who don't. Similarly, the Census by the Office for National Statistics, which serves as the basis for assessing the vitality of the Welsh language in Wales, traditionally asks a four-fold binary question: 'Can you understand, speak, read or write Welsh? Tick all that apply.' Associated discourse examining progress towards the target of a million Welsh speakers by 2050 typically refers to 'speaking Welsh' only. The reality, of course, is far more complex; Welsh language skills range continuously from zero to fully fluent, with intermediate stages of learning, and variations such as using Welsh confidently with friends but not in formal contexts. Anecdotally our work with Public Map has revealed a reluctance to admit a 'fluent' level of Welsh which is traditionally associated with formal language. As the notion of 'speaking Welsh' is central to our study, we decided to include both a binary question 'Do you speak Welsh?' and a more nuanced self-assessment of oral and written abilities, aiming to gain insight as to the threshold at which respondents would regard themselves as a Welsh speaker, in the context of this study.

Finally, we aimed to assess not only the direct relationship between Welsh-speaking abilities and place attachment as well as nature connection, but also the extent to which people in Wales *believe* that there is a connection between Welsh language and nature, addressing indications, stories and widespread intuitions that point to such a relationship (Graves, 2024). To this end, we asked people to explain this relationship (if any) in their own words, followed by a set of Likert-scale questions exploring diverse aspects that may manifest the relationship, such as feeling particularly connected to nature when Welsh is used or when encountering Welsh place names. The insight that the Welsh language is a deeply significant part of its speakers' identity and intangible cultural heritage in Wales (Howell, 2013) suggests that Welsh speakers, at least, may perceive the Welsh language as important in relation to place, and—by extension—to nature more generally. Conversely, those that do not connect to the place via language would be less likely to identify a relationship between the two.

Altogether, our research questions are as follows.

1. What level of self-assessed Welsh language abilities in spoken and written language is sufficient to motivate self-identification as a 'Welsh speaker' (in the wording and classification of the Census, Office for National Statistics (ONS), 2022)?
2. Does being a self-identified Welsh speaker relate systematically to the degree of connectedness to the natural environment in general, and to the degree of place attachment to one's local area?
3. How do people in Wales perceive the relationship between Welsh language and the natural environment in Wales? Do they feel that hearing or using Welsh affect their sense of connection or responsibility for nature? Do Welsh-language abilities, place attachment, or connectedness to nature affect these perceived relationships?

3. Methods

Our study addressed the relation between Welsh-language abilities, place attachment, and connections to nature in general among the population in Wales, using a sample that is nationally representative, to the extent possible, by age, gender, region, and socioeconomic status. Region is important as Welsh language abilities and everyday usage differ fundamentally across regions (Jones, 2012), alongside the diversity of Welsh language dialects, with a pronounced North-South distinction. As we aimed to put our findings on Welsh-language abilities into context of the Census data (Office for National Statistics (ONS), 2022), we included both a yes/no question as in the Census, and a Likert-scale question exploring participants' more nuanced self-assessed Welsh language skills. The survey was administered bilingually in

Welsh and English (below we present the English version) to allow participants to respond in their preferred language.

3.1. Data collection

Building on well-proven methodologies of data collection including Tenbrink and Willcock (2023), our highly controlled approach enabled us to reach a nationally representative sample efficiently whilst avoiding biased contributions by people specifically interested in the topic or impositions on participants' privacy. We engaged the online platform FindOutNow to achieve anonymous, fast-track data collection towards a nationally representative stratified sample of ~2,000 respondents from across Wales. The company distributed the survey using Pick My Postcode, a free, online postcode lottery that provides extra credit for survey participation (to be redeemed if winning the postcode lottery), which includes electronic written consent. While this mechanism does not allow for extended ethical statements for individual surveys, the platform's terms and conditions site⁶ states that

'Participating in any research is entirely up to you and is not required'. Additionally, Pick My Postcode's 'services and the Website are for use by members 18years old and over only. [They] do not market to users under the age of 18 and do not intentionally collect data on users under the age of 18'

Ethics approval was granted by the Ethics Committee of Bangor University (25/02/2025, TT1 2024-25). Our survey questions were as follows.

1. Please describe your local area, in terms of what it means to you personally.
2. Can you speak Welsh? (yes/no)
3. On a scale of 1–7, where 7 is highest/most:
 - a. How would you rate your Welsh speaking and listening abilities?
 - b. How would you rate your Welsh writing and reading abilities?
 - c. How connected do you feel to nature (the natural environment in general)?
4. How would you describe the relationship between the Welsh language and the natural environment in Wales—if any?
5. On a scale of 1–7, where 7 is highest/most, how much do you agree with the following:
 - a. The Welsh language is closely related to the natural environment in Wales.
 - b. I feel more connected to nature in areas or situations where Welsh is used than where/when English is used.
 - c. Reading or hearing Welsh place names makes me feel connected to nature.
 - d. Hearing or using the Welsh language makes me feel more responsible for nature.
 - e. Hearing or using the Welsh language makes me feel more connected to nature.
 - f. Places where the Welsh language is connected with the natural environment are particularly attractive to me.
7. Are there any ways in which hearing or using the Welsh language makes you feel more connected to the natural environment (local or in general), and are there special places where this happens? Please explain.

3.2. Freetext data analysis

Question 1 elicits participants' degree of place attachment via an open question rather than a Likert scale, which would not do justice to the multi-faceted nature of place attachment (Hamzei et al., 2020). As expressions of place attachment vary across languages (see e.g. Adams, 2024, on the deep meaning of the Welsh word 'cynefin'), it was especially important in the context of the present study to allow

participants to freely express their sentiments in the language they chose to respond in (English or Welsh). The elicited free-text responses allowed us to identify strength of place attachment based on lexical items, adopting a methodology for calculating a place attachment score introduced by Tenbrink and Willcock (2023). Specifically, we identified lexical items in the freetext data that indicated place attachment along dimensions such as beauty, social links, and local assets, and categorised them according to their strength of place attachment (adapted and extended from Tenbrink & Willcock, 2023, who asked the same question to assess place attachment in their survey). Each category included English and Welsh-language equivalents occurring in the data. Table 1 provides an overview.

To avoid subjectivity and errors in coding by using this operationalisation, we used Excel to automatically search and count instances of each of these lexical items, following a few necessary minor adjustments such as correcting obvious spelling errors and making sure that strings of letters such as 'lot' were not counted unless they were used in a context indicating the corresponding degree of place attachment. This was especially important in the case of negation, for instance when somebody says that 'not a lot' is nice in their local environment.

To obtain the place attachment score which served as the basis for subsequent calculations, we weighted and added up the scores (following Tenbrink & Willcock, 2023), as shown in Equation 1):

$$\text{Place attachment score} = (\text{count of weak indicators} * 1) + (\text{count of medium indicators} * 2) + (\text{count of relatively strong indicators} * 3) + (\text{count of strong indicators} * 4) \quad (1)$$

3.3. Statistical procedures

All statistical analyses were conducted in R (version 4.5.1) using the Survey package (Lumley, 2004). The survey package incorporates sampling weights into all calculations, ensuring that results reflect the Welsh adult population rather than just the sample composition. Survey weights were applied to correct for differences between the sample and population distributions of age and gender, up-weighting underrepresented groups and down-weighting overrepresented groups so that the final estimates reflect the demographic composition of Wales. A survey design was specified with strata defined by combinations

Table 1. Exhaustive list of place attachment indicators in the free-text responses to question 1.

Weak indicators (primarily descriptive rather than evaluative, or people rather than place oriented): close / agos, gerllaw, place to live / lle i fyw, friends/friendly / caredig, clen, community / cymuned, comfortable, neighbors/ neighbourhood / cymdogion, convenience/t / cyfleus(ter), hwylus, ok(ay), alright, park, quiet / tawel, distaw, llonydd, clean, tidy, rural / gwledig, familiar/y / teulu, safe / diogel, saff, village, countryside / cefn gwlad, valley, suitable, sea, coast / arfordir, urban, open / agored, forest, garden, cool, easy, fine, decent, sociable / cyfeillgar, quaint, small / bach, trees / coed, mountain / mynydd, beach / glan y mor, away from, wild, near, doorstep / stepen drws, histor- / hanes, cultur- / diwyllian-, diverse, varied / amrywiol, enough / digon, walk / am dro, life / bywyd, afon [river/estuary]	Medium indicators: great, nice / neis, pretty / pert, character, nature, picturesque, peace / heddwch, leafy, unspoilt, scenic, relaxing, good / lle da, free, happy / hapus, pleasant / braf, welcom, lot, like / hoffi, green, tranquil, interesting / diddorol, calm, scenery, anywhere	Clearly place oriented and positive but not highly emotional: home / cartre/f, adra/e, beauty/iful / prydferth, hardd/wch, special / arbennig, gwych, lovely / hyfryd, view / golygfa/eudd,, idyllic, oasis, unique / fel un, plenty, memory/ies, best, grew up, root(s), important / pwysig, proud / balch, Welsh, language / Cymraeg, Cymreig, fy iaith	High place attachment: love / caru, refuge, fantastic / godidog, wonderful / bendigedig, lucky, incredible / anhygoel, heritage, quintessential, sanctuary / cynefin, wouldn't (want to live anywhere else) / byth, awesome, ideal, precious, perfect / gorau, bliss, amazing, heaven / paradwys, nefoedd, belonging, stunning, magic, heart / calon, outstanding / eithriadol, exception(al) , hiraeth [longing]
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Red colour indicates the definition, bold black signals *post-hoc* changes to the place attachment score established by Tenbrink and Willcock (2023) based on our data set, and green signals Welsh-language equivalents found in the data (note that due to the linguistic feature of mutation, first letters in Welsh change according to context, which meant that various versions were used in the search). Some words (such as 'okay') would be used and counted in both English and Welsh.

of gender (male, female, neither) and age category (18–29, 30–39, 40–54, 55–64, 65–74, 75+), with pre-calculated weights incorporated to adjust for quota-based sampling. Survey weights were calculated using the following target quotas to make the sample representative of Wales by age and gender: Gender (Male: 47.9%, Female: 51.6%, Neither: 0.5%); Age (18–29: 17.9%; 30–39: 15.4%; 40–54: 23.2%; 55–64: 17.0%; 65–74: 14.4%; 75+: 12.2%).

Survey-weighted generalised linear models (GLMs) were employed to examine relationships between Welsh language variables, nature connectedness, place attachment, and perceptions of language-environment connections. All models were fitted using the form:

$$g(E[Y_i]) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{ki}$$

where $g()$ is the link function, $E[Y_i]$ is the expected value of the outcome for observation i , and $X_{1i} \dots X_{ki}$ are the predictor variables.

For binary outcomes (self-identification as a Welsh speaker), a quasibinomial family with a logit link function was used. For outcomes measured on bounded rating scales (nature connectedness, place attachment, language proficiency ratings, and perception items on 1–7 scales), a quasipoisson family with log link function was used; this approach is appropriate for discrete, bounded data that do not meet the assumptions of linear regression. The quasi-variants of these families were selected to accommodate overdispersion typically observed in survey data, whereby variance exceeds that predicted by standard binomial or Poisson distributions.

All models controlled for age, gender, socioeconomic group, and geographic region. Socioeconomic classification used the standard binary split between ABC1 (middle/upper) and C2DE (working/lower) based on the National Statistics Socioeconomic Classification grades. Survey language choice (Welsh vs. English) was included as an additional covariate in models examining the effect of Welsh speaker status on nature connectedness and place attachment. Including region as a covariate in all models helps account for potential differences in nature access or availability across Wales (e.g. the more urbanised South-East may have less accessible natural environments than other regions), reducing the likelihood that observed associations between Welsh language and environmental connection are confounded by geographic co-occurrence of Welsh speakers and nature-rich areas. Regional classification followed the Welsh Government National Development Framework (Welsh Government, 2020), with respondents assigned to one of three regions based on postcode area prefix: North Wales (LL, CH postcodes), Mid & South-West Wales (SA, LD, SY postcodes), or South-East Wales (CF, NP postcodes). North Wales served as the reference category. Models examining perceptions of Welsh language-environment relationships included Welsh speaker status, nature connectedness, place attachment, and their two-way and three-way interactions as predictors. See [Supplementary Materials](#) for full list of GLM specifications.

Due to high multicollinearity between speaking/listening and writing/reading proficiency ($r=0.89$; VIF >27 when both included), effects of each proficiency dimension were estimated in separate models. Variance inflation factors confirmed that Welsh speaker status and survey language choice could be reliably estimated together (VIF <3) despite their moderate correlation ($r=0.33$).

All models report regression coefficients (β), standard errors, p-values, and 95% confidence intervals. Survey-weighted means with 95% confidence intervals are presented in figures to show unadjusted group differences, complementing the covariate-adjusted estimates from the GLM analyses. For models using the quasipoisson family, coefficients were exponentiated and converted to percentage change for interpretability, calculated as $(\exp(\beta) - 1) \times 100$. Pearson correlation coefficients were calculated to assess bivariate relationships between continuous variables.

4. Results

We obtained a sample of 2,082 respondents with a gender distribution of 1,248 female, 786 male, and 48 neither. Age was distributed as follows: 18–29: 101, 30–39: 305, 40–54: 598, 55–64: 548, 65–74: 372, 75+: 158). Socioeconomic groups were ABC1: 999, C2DE: 465, and unknown: 618, and regions were:

North Wales: 536, Mid & South-West Wales: 703, South-East Wales: 841, and unknown: 1. In the following, we report the results addressing each of our research questions in turn.

- 1) What level of self-assessed Welsh language abilities in spoken and written language is sufficient to motivate self-identification as a 'Welsh speaker' (in the wording and classification of the Census)?

People who said they speak Welsh had an average speaking/listening rating of 4.53 out of 7 and an average writing/reading rating of 4.27, whereas the average for those who said they don't was 1.73 for speaking/listening and 1.61 for writing/reading (Figure 1). GLM analyses, controlling for region, age, socioeconomic group, and gender, showed that both proficiency measures strongly predicted self-identification as a Welsh speaker (speaking/listening: $\beta=0.91$, $p<0.001$; writing/reading: $\beta=0.85$, $p<0.001$). The probability of self-identification increased from approximately 4% at minimal proficiency (level 1) to over 90% at fluent proficiency (level 7), crossing the 50% threshold between levels 3 and 4 (Figure 1). In other words, whilst people differ in their self-classification based on the level of their abilities, the binary classification splits the nuanced responses approximately half-way, as it should.

A regional breakdown based on postcode areas (details accessible via the WISERD data portal⁷) indicates visually that the majority of participants in the North speak at least a little Welsh (Figure 2), but few speakers rate themselves to be highly proficient even if their answer is Yes. Note that due to low numbers in some segments, these numbers are indicative only. Nevertheless, the obvious regional differences across Wales motivates a closer look at the geographic distribution of response patterns, which will be addressed further below.

- 2) Does being a self-identified Welsh speaker relate systematically to the degree of connectedness to the natural environment in general, and to the degree of place attachment to one's local area?

After controlling for survey language, region, age, gender, and socioeconomic group, people who classify themselves as Welsh speakers show significantly higher nature connectedness than those who do not (Figure 3a; $\beta=0.15$, $SE = 0.03$, $p<0.001$), representing a 15.7% increase (95% CI: 10.0% to 21.8%). Welsh speakers also produce free-text responses regarding place attachment that yielded higher scores, though this effect was not statistically significant (Figure 3b; $\beta=0.15$, $SE = 0.08$, $p=0.054$), representing

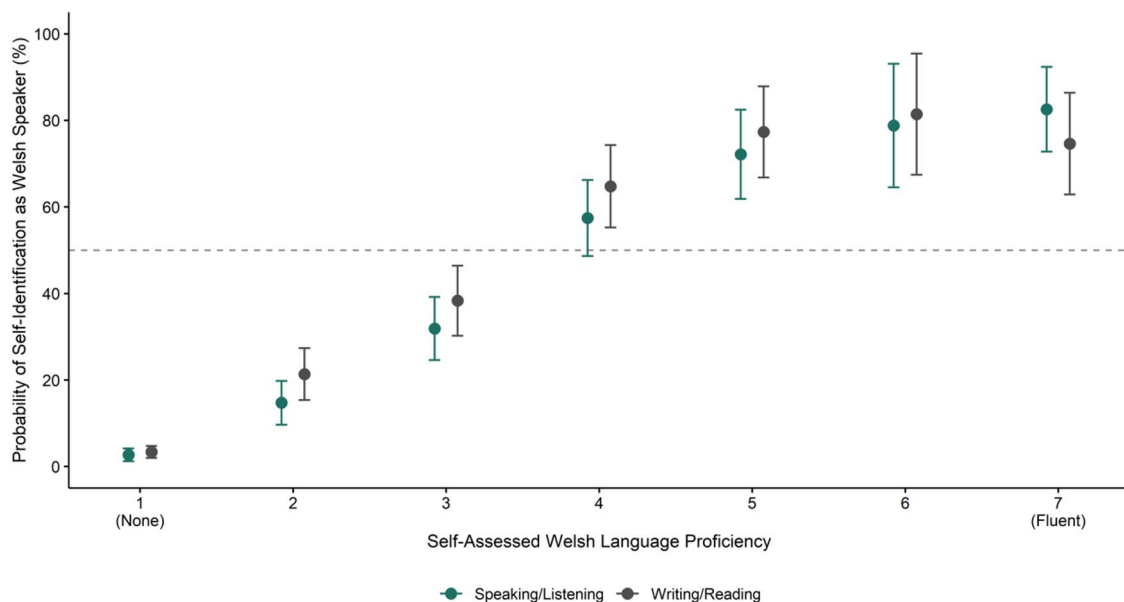


Figure 1. Probability of self-identification as a Welsh speaker by self-assessed language proficiency. Points represent survey-weighted proportions at each proficiency level (1=no ability, 7=fluent); error bars represent 95% confidence intervals. Teal: speaking/listening proficiency; grey: writing/reading proficiency. Dashed horizontal line indicates 50% threshold. Both proficiency measures show nearly identical patterns, reflecting their high correlation ($r=0.89$). $N=2,082$.

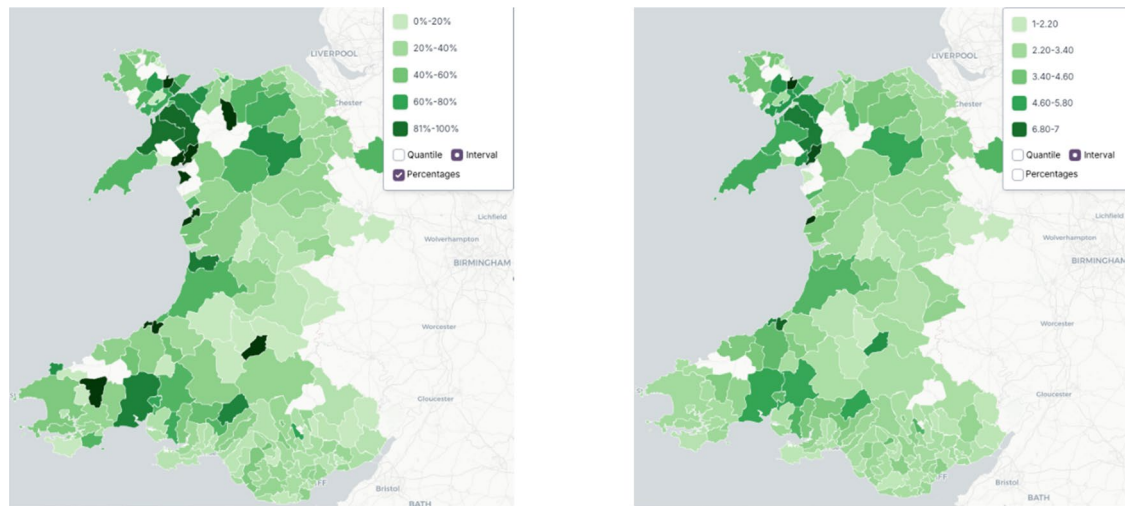


Figure 2. Comparison of binary (left) and Likert-scale based Welsh language speaking skills (right).

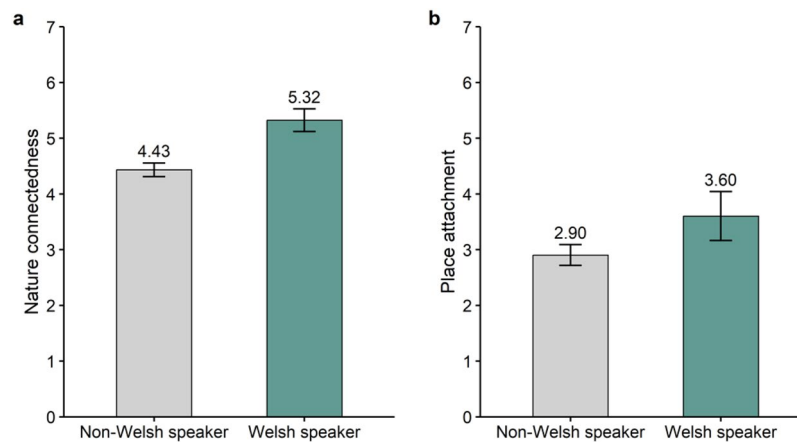


Figure 3. Nature connectedness (a) and place attachment (b) by Welsh-speaking status. Nature connectedness is measured using a validated 7-point scale assessing emotional and cognitive connection to the natural environment; place attachment is measured on an unbounded scale derived from open-ended descriptions of local area. Bars show unadjusted survey-weighted means with 95% confidence intervals ($n=498$ Welsh speakers, 1,584 non-speakers). Welsh speakers showed significantly higher nature connectedness ($\beta=0.15$, $p<0.001$) and marginally significantly higher place attachment ($\beta=0.15$, $p=0.054$) than non-Welsh speakers after controlling for survey language, region, age, gender, and socioeconomic group.

a 16.6% increase (95% CI: -0.2% to 36.2%). Our results furthermore show that men feel less connected to nature than women ($\beta = -0.06$, $SE = 0.02$, $p=0.016$), representing a 5.8% decrease (95% CI: -10.2% to -1.1%) in nature connectedness. In addition, respondents assigned to the lower socioeconomic group (C2DE) produce free-text responses regarding place attachment that yielded significantly lower scores ($\beta = -0.2$, $SE = 0.027$, $p=0.007$), representing an 18.1% decrease.

In addition to participants' self-assessed status as a Welsh speaker and their scored abilities, the language in which respondents chose to complete the survey also relates to nature connectedness and place attachment; participants who completed the survey in English despite self-identifying as Welsh speaking occupy an intermediate position between non-Welsh speakers and those who completed the survey in Welsh, both for nature connectedness and place attachment (Figure 4). Among Welsh speakers, completing the survey in English rather than Welsh is associated with significantly lower nature connectedness ($\beta = -0.11$, $SE = 0.03$, $p<0.001$), representing a 10.2% decrease (95% CI: -15.3% to -4.8%) after controlling for Welsh speaker identity, region, age, gender, and socioeconomic group. The pattern for place attachment is similar, with significantly lower scores for those completing the survey in English ($\beta = -0.35$, $SE = 0.12$, $p=0.002$), representing a 29.7% decrease (95% CI: -44.0% to -11.7%).

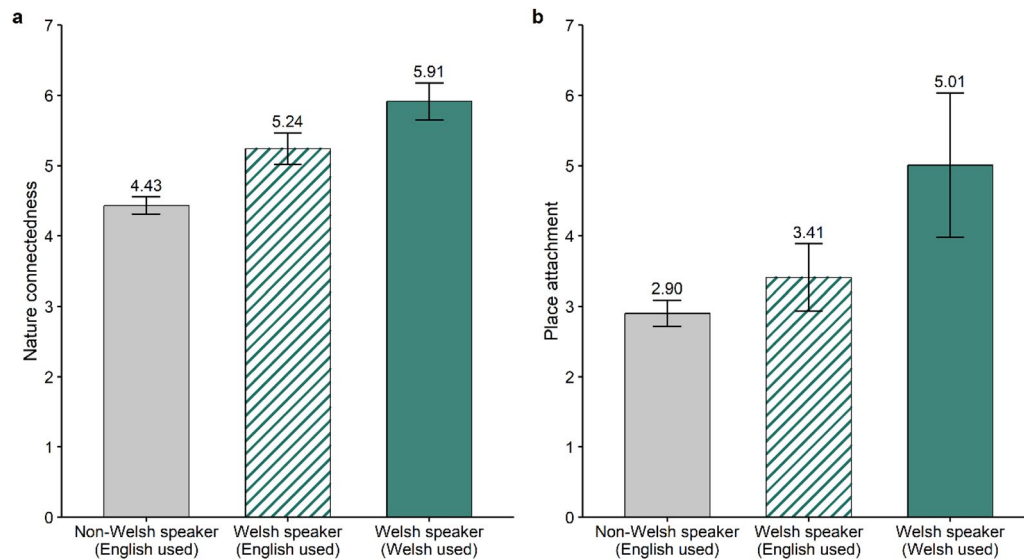


Figure 4. Nature connectedness (a) and place attachment (b) by Welsh speaker status and language chosen to use when answering the survey. Bars show unadjusted survey-weighted means with 95% confidence intervals. Three groups are displayed: non-Welsh speakers who completed the survey in English (grey bar, $n=1,583$), Welsh speakers who completed the survey in English (striped bar, $n=426$), and Welsh speakers who completed the survey in Welsh (teal bar, $n=72$). Non-Welsh speakers who completed the survey in Welsh ($n=1$) were excluded due to insufficient sample size.

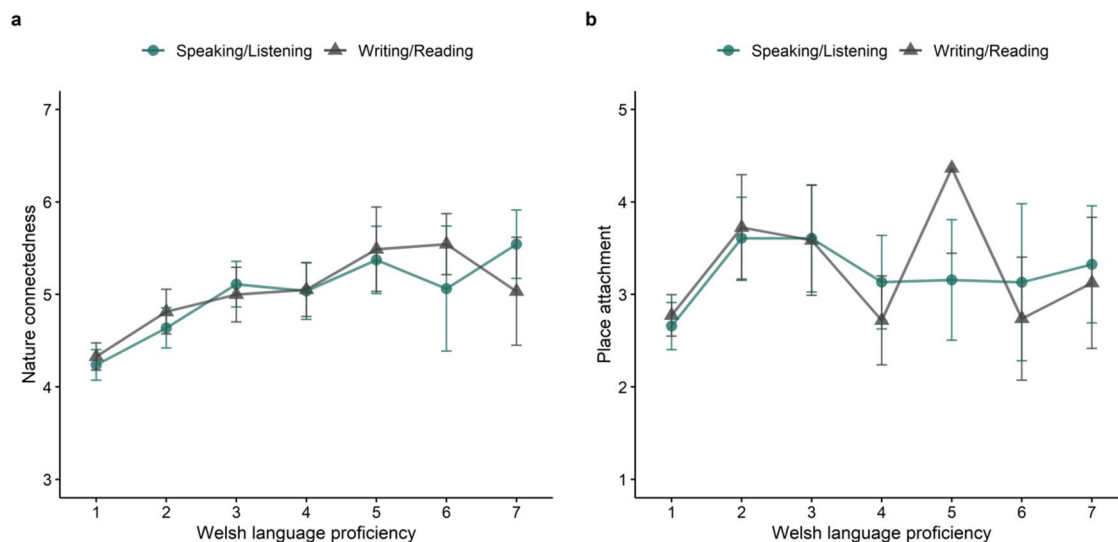


Figure 5. Relationship between Welsh language proficiency and environmental connection. Mean (a) connection to nature scores (scale 1–7) and (b) place attachment scores, by self-rated Welsh language proficiency level (1=no proficiency to 7=fluent) for speaking/listening (orange circles) and writing/reading (grey triangles) abilities. Points show unadjusted survey-weighted means with 95% confidence intervals ($n=2,082$).

Nature connectedness increases with self-assessed Welsh language proficiency (Figure 5a), as does place attachment (Figure 5b), though these represent weak linear relationships (speaking/listening: $r=0.22$ for nature connectedness, $r=0.09$ for place attachment; writing/reading: $r=0.18$ and $r=0.07$ respectively; all $p<0.001$). After controlling for region, age, gender, and socioeconomic group, higher speaking/listening proficiency is associated with significantly higher nature connectedness ($\beta=0.04$, $SE = 0.01$, $p<0.001$), with each one-point increase on the 7-point scale associated with 4.4% higher score (95% CI: 3.3% to 5.6%). Writing/reading proficiency shows a similar pattern ($\beta=0.03$, $SE = 0.01$, $p<0.001$), with each one-point increase representing a 3.4% higher score (95% CI: 2.1% to 4.8%). Place attachment shows comparable associations, though effect sizes are smaller and more variable: speaking/listening

proficiency ($\beta=0.03$, $SE = 0.01$, $p=0.015$) represents a 3.4% higher score per point (95% CI: 0.7% to 6.3%), while writing/reading proficiency shows a marginally significant pattern ($\beta=0.02$, $SE = 0.01$, $p=0.088$), representing a 2.5% higher score per point (95% CI: -0.4% to 5.5%).

Regional variation is evident for nature connectedness but not place attachment (Figure 6). After controlling for Welsh speaker identity, survey language, age, gender, and socioeconomic group, residents of South-East Wales show significantly lower nature connectedness than those in both Mid & South-West Wales ($\beta = -0.09$, $SE = 0.03$, $p<0.001$), representing an 8.9% decrease (95% CI: -13.9% to -3.7%), and North Wales ($\beta = -0.13$, $SE = 0.03$, $p<0.001$), representing an 11.9% decrease (95% CI: -17.0% to -6.6%). North Wales does not differ significantly from Mid & South-West Wales ($p=0.22$). Regional differences in place attachment were not significant (all $p>0.08$).

We tested whether the Welsh speaker and language use effects varied by region. For nature connectedness neither the Welsh speaker $\times$ Region interactions (all $p>0.06$) nor the Language $\times$ Region interactions (all $p>0.09$) were significant, indicating that the positive associations between Welsh language and nature connectedness are consistent across Wales. However, regarding place attachment scores the Welsh speaker effect was significantly stronger in South-East Wales compared to North Wales (Welsh Speaker $\times$ South-East Wales interaction: $\beta=0.38$, $SE = 0.18$, $p=0.031$), representing a 46.2% larger effect (95% CI: 3.6% to 106.3%).

3) How do people in Wales perceive the relationship between Welsh language and the natural environment in Wales? Do they feel that hearing or using Welsh affect their sense of connection or responsibility for nature? Do Welsh-language abilities, place attachment, or connectedness to nature affect these perceived relationships?

Overall, mean agreement to statements about perceived relationships between Welsh language and the natural environment ranged from 2.73 to 3.51 on the 7-point scale across the six perception statements (Figure 7). Agreement was highest for the general belief that Welsh is related to nature (Figure 7a: $M=3.51$, $SD = 2.08$) and for feeling more connected when reading or hearing Welsh place names (Figure 7c: $M=3.08$, $SD = 2.08$). Agreement was lowest for feeling more responsible when hearing or using Welsh (Figure 7d: $M=2.73$, $SD = 1.99$), feeling more connected when using Welsh (Figure 7b: $M=2.83$, $SD = 1.98$), and feeling more connected when hearing or using Welsh (Figure 7e: $M=2.75$, $SD = 2.01$). Attraction to places where Welsh and nature connect showed intermediate agreement (Figure 7f: $M=3.00$, $SD = 2.09$).

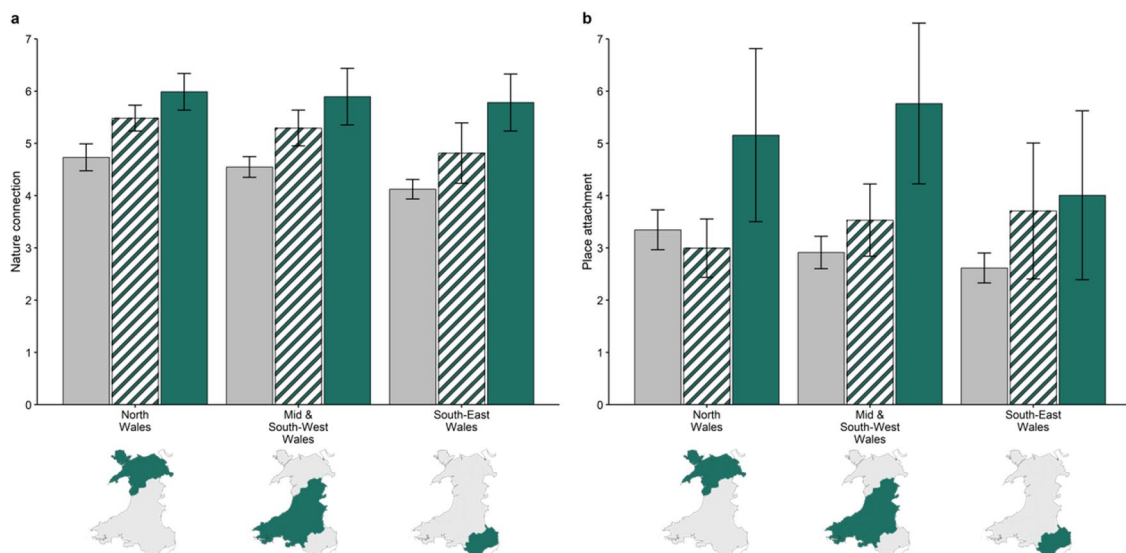


Figure 6. Nature connectedness (a) and place attachment (b) by Welsh speaker status, survey language, and region. Three Welsh speaker status groups are displayed: non-Welsh speakers who completed the survey in English (grey bars), Welsh speakers who completed the survey in English (striped bars), and Welsh speakers who completed the survey in Welsh (teal bars). Bars show unadjusted survey-weighted means with 95% confidence intervals.

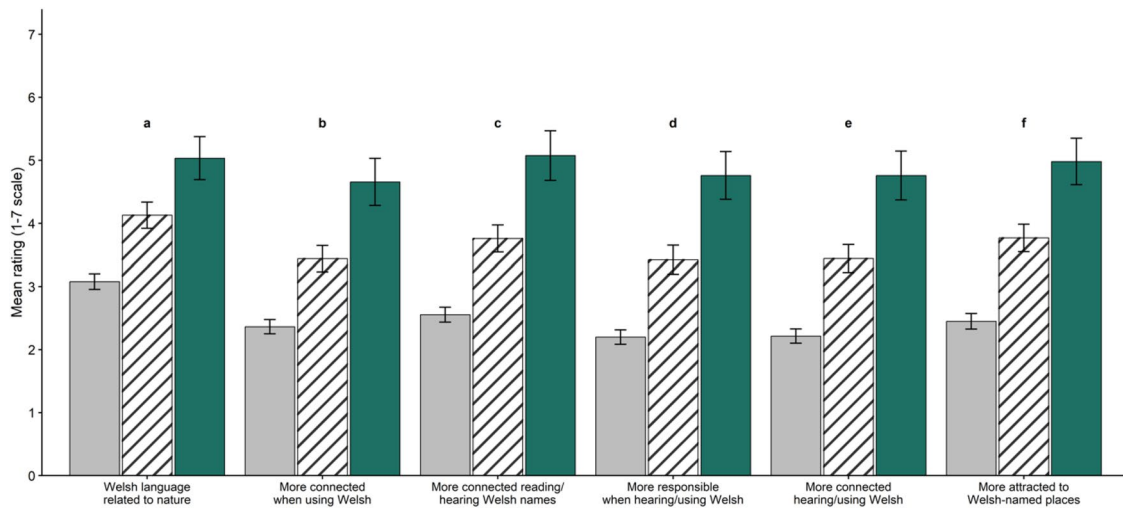


Figure 7. Perceptions of Welsh language-environment relationships by Welsh speaker status and survey language choice. Bars show unadjusted survey-weighted means with 95% confidence intervals. Three groups are displayed: non-Welsh speakers who completed the survey in English (grey bar, $n=1,583$), Welsh speakers who completed the survey in English (striped bar with white fill and teal diagonal lines, $n=426$), and Welsh speakers who completed the survey in Welsh (teal bar, $n=72$). Six perception items were rated on 1–7 Likert scales: (a) ‘The Welsh language is closely related to the natural environment in Wales’, (b) ‘I feel more connected to nature when the Welsh language is used’, (c) ‘I feel more connected to nature when reading or hearing Welsh place names’, (d) ‘I feel more responsible toward the natural environment when hearing or using the Welsh language’, (e) ‘I feel more connected to nature when hearing or using the Welsh language’, and (f) ‘Places where the Welsh language is connected with the natural environment are particularly attractive to me’.

After controlling for nature connectedness, place attachment, region, age, gender, and socioeconomic group, Welsh speaker status was significantly associated with four of the six perception statements. For the general belief that Welsh is related to nature (Figure 7a), Welsh speakers showed 38% stronger agreement ($\beta=0.32$, $SE = 0.16$, $p=0.040$, 95% CI: 1.5% to 88.4%). For experiential perceptions, Welsh speakers reported feeling 51% more connected to nature when using Welsh (Figure 7b; $\beta=0.41$, $SE = 0.16$, $p=0.011$, 95% CI: 9.9% to 106.5%), 49% more connected when reading or hearing Welsh place names (Figure 7c; $\beta=0.40$, $SE = 0.16$, $p=0.016$, 95% CI: 7.7% to 104.7%), and 47% more connected when hearing or using Welsh in natural settings (Figure 7e; $\beta=0.38$, $SE = 0.16$, $p=0.020$, 95% CI: 6.3% to 102.7%). Welsh speaker status was not significantly associated with perceptions of feeling more environmentally responsible when hearing or using Welsh (Figure 7d; $\beta=0.29$, $SE = 0.17$, $p=0.083$) or with attraction to places where Welsh and nature connect (Figure 7f; $\beta=0.30$, $SE = 0.16$, $p=0.065$).

Nature connectedness was significantly associated with all six perception statements: The general belief that Welsh is related to nature ($\beta=0.08$, $SE = 0.01$, $p<0.001$, 95% CI: 6.0% to 11.7%); more connected to nature when using Welsh ($\beta=0.08$, $SE = 0.02$, $p<0.001$, 95% CI: 5.5% to 11.9%); more connected when hearing or reading Welsh place names ($\beta=0.09$, $SE = 0.02$, $p<0.001$, 95% CI: 6.5% to 12.9%); more environmentally responsible when hearing or using Welsh ($\beta=0.08$, $SE = 0.02$, $p<0.001$, 95% CI: 4.5% to 11.7%); more connected when using Welsh ($\beta=0.08$, $SE = 0.02$, $p<0.001$, 95% CI: 5.2% to 12.2%); more attracted to place when Welsh and nature connect ($\beta=0.08$, $SE = 0.02$, $p<0.001$, 95% CI: 5.5% to 12.2%), with each point increase associated with 8.0% to 9.6% stronger perception.

Place attachment showed significant associations with four of the six perception statements, though effect sizes were smaller (The general belief that Welsh is related to nature: $\beta=0.05$, $SE = 0.02$, $p<0.001$, 95% CI: 2.4% to 8.7%); more connected to nature when using Welsh: $\beta=0.05$, $SE = 0.02$, $p=0.009$, 95% CI: 1.2% to 8.9%; more connected when hearing or reading Welsh place names: $\beta=0.05$, $SE = 0.02$, $p=0.003$, 95% CI: 1.9% to 9.1%; more attracted to place when Welsh and nature connect: $\beta=0.05$, $SE = 0.02$, $p=0.005$, 95% CI: 1.6% to 9.6%), with each point increase associated with 5.0% to 5.6% stronger perception. Place attachment was not significantly associated with perceptions of environmental responsibility (fit.11: $\beta=0.01$, $SE = 0.02$, $p=0.505$) or connection when hearing/using Welsh (fit.12: $\beta=0.03$,

SE = 0.02, $p = 0.112$). No interaction terms reached significance across any of the six perception models (all $p > 0.07$).

Free-text responses to survey question 4 ‘How would you describe the relationship between the Welsh language and the natural environment in Wales—if any?’ provide some elaboration of the participants’ thinking behind the numbers. More than a third of participants (the flexibility in this broadly defined category precludes an exact number) either did not answer the question at all or wrote a variant of ‘don’t know’, ‘don’t see a connection’, ‘none’, or ‘don’t understand the question’, in line with the overall relatively low agreement or awareness that there may be a link between language and environment. For some, it might be a matter of difficulty in articulating this relationship, as these answers do include some people who gave the relationship a high score in the Likert-scale question. Others vehemently reject the idea, e.g. ‘NONE WHATSOEVER I SEE AND FEEL with my eyes and hands not with my mouth!’, ‘Ridiculous question’, ‘it is folly to believe there is a relationship’, or ‘Wildlife doesn’t speak human languages’.

On the other hand, about 5% of participants referred to Welsh place names and bilingual signage, and there are more than 40 references to the beauty of the Welsh language and the environment, and about 30 referring to history. Some quotes are remarkable in showcasing some individuals’ thoughts, selected from those who gave the link between language and environment the highest score on the Likert scale: ‘Cwestiwn diddorol! Oes,mae na gysylltiad. Bron pob enw lle yn cynnwys disgrifiad o’r byd naturiol, ac mae na traddodiad gyfoethog o drafod byd natur yn ein cerddoriaeth’ [‘Interesting question! Yes, there is a connection. Almost every place name contains a description of the natural world, and there is a rich tradition of discussing the natural world in our music’], ‘The language is the language of the hills and valleys - they are intimately intertwined’, ‘Welsh history and its language is packed in myth and legend and it is all surrounded with the natural environment’, ‘Integral to the culture, history, emotional connections and geography of Wales’, ‘Just being out in nature feels welsh’, ‘The Welsh language describes our land and the natural environment. The two are inextricably linked. The country and land have more meaning in our language’, ‘Mae’r iaith gymraeg yn rhan o fyd nature Cymru’ [‘The Welsh language is part of the natural world of Wales’], ‘Mae’n berthynas bwysig iawn, mae’r iaith yn natur, ac mae natur yn cael ei ddisgrifio mewn ffordd hyfryd yn Gymraeg. Un o’r pethau dw i wedi mwynhau mwya wrth ddysgu Cymraeg ydy enwau natur - Mae’n nhw’n dangos y pwysigrwydd o natur i Gymry dros y canrifoedd.’ [‘It is a very important relationship, the language is nature, and nature is described in a beautiful way in Welsh. One of the things I have enjoyed most when learning Welsh is the names of nature - They show the importance of nature to Welsh people over the centuries.’]

Free-text responses to the question ‘Are there any ways in which hearing or using the Welsh language makes you feel more connected to the natural environment (local or in general), and are there special places where this happens? Please explain’ are overall similar to the previous free-text question in spirit, with many expressions of non-understanding of such a connection alongside a high diversity of responses that link the Welsh language to the beauty (mentioned explicitly 45 times) of the environment, meaningful place names (44 times), history (30 times), and to the notion of home (31 times), as in: ‘Hearing the Welsh language being spoken makes me feel proud and more connected to my homeland’, and ‘Explains the origins historically of the area. My home Pontycymer Bridge over the Cymmer’.

5. Discussion

Our study systematically addressed the widespread intuition among the Welsh population that Welsh speakers have a special relationship to the natural environment. Along the way, we carefully considered each element of this intuition: What exactly is meant by Welsh speakers, does one have to be fluent to experience—and to acknowledge—this relationship? What is the nature of the relationship, is it a generic correlation (i.e. increasing nature connectedness with increasing Welsh language skills) or does hearing and using Welsh affect feelings of connectedness, responsibility and attraction? And does ‘natural environment’ mean nature in general, or specific place attachment to one’s home area with all its associated facets (Hamzei et al., 2020)? Could this differ according to region, as the Welsh language differs in prominence across the country? These considerations translated into our three research questions, which were operationalised into a rapid nationally representative survey administered by an expert company to a non-biased population across Wales.

The survey results demonstrate very clearly and consistently that, overall, the intuition is correct. While this general association between Welsh language and nature is evident in many ways throughout our data, there is an especially compelling correlation showing that feelings of both nature connectedness (self-assessed on a Likert scale) and place attachment (as expressed in participants' own words) increase as Welsh language abilities (self-assessed on a Likert scale) increase. This provides original evidence that speaking a specific language is strongly associated with a seemingly unrelated domain of life, namely how one relates to the natural environment.

Notably, in contrast to previous insights on the relationship between language and thought, there is no indication here that the association found in our data is due to linguistic relativity (Rosch, 2015), in which case speakers' thoughts would be affected by specific properties of the language itself. Whereas previous studies addressed cognitive constraints potentially imposed by a language (e.g. Kay & Regier, 2006; Slobin, 2011), we used social science methods to address sentiments and beliefs rather than thought processes. Our results add to the recognition that language plays a role in making sense of the world by demonstrating how access to a language that is historically and culturally connected with nature (Graves, 2024) links with people's feelings of connection to nature—in general and in relation to one's immediate environment, i.e. place attachment.

In line with previous research on Traditional Ecological Knowledge (Hill et al., 2002; Maffi, 2005) and in the framework of Ecolinguistics (Steffensen, 2025; Stibbe, 2015), this effect is likely to be supported by the use (rather than the structure or lexicon) of the language, e.g. transporting messages about local nature via Welsh place names, rich nature-oriented Welsh-medium literature, and poetry, including the famous Mabinogion stories (Davies, 2007) which are inextricably linked to the Welsh landscape and represent an important element of Welsh culture and heritage. We therefore contend that while our results do not directly inform the Whorfian debate, they do add an important dimension to the well-recognised importance of language in terms of heritage, identity and our place in the world (Edwards, 2009). Language—in this case, the ability to speak Welsh—provides access to a unique way of understanding the world, supported by the discourse, concepts and domains that are traditionally and commonly expressed in that language.

Language has been identified by UNESCO as a carrier of intangible cultural heritage⁸; a wide range of traditions, craft and arts are primarily accessible through the medium of language (Aktürk & Lerski, 2021). Often enough, this involves a minority language that may be threatened by extinction or marginalisation by a dominant national language. In the case of Wales, our results suggest that the Welsh language does not only carry important intangible cultural heritage but also a deep-rooted connection to nature in general and to one's local environment that is not necessarily manifest in any specific heritage tradition, but linked to Welshness in a more general sense (as suggested by Graves, 2024).

We will now consider the nuances of this general association, following the structure of our three research questions.

RQ 1: What level of self-assessed Welsh language abilities in spoken and written language is sufficient to motivate self-identification as a 'Welsh speaker'?

Results confirmed that despite the conventional binary split between people who speak Welsh and those that do not (e.g. informing progress towards the Welsh Government's target of a million Welsh speakers by 2050), considering Welsh language abilities in a more nuanced way reveals no clear cut-off point of ability where speakers would categorise themselves one way or the other. While the binary distinction did roughly split responses half-way, some speakers classified themselves as a Welsh speaker with very low scores, yielding an average rating of 4.53 out of 7 for speaking/listening, and vice versa, where those who said they did not speak Welsh had an average rating of 1.73 for their speaking/listening abilities. The difference between these two averages is smaller for writing/reading skills with 4.27 for Welsh speakers, 1.61 for non-Welsh speakers. This may be related to the increased challenges of written language, which in Welsh is traditionally associated with higher levels of formality (Thomas, 1982), with the effect that even proficient everyday Welsh speakers may choose English in the written medium if that seems more accessible.

RQ 2: Does being a self-identified Welsh speaker relate systematically to the degree of connectedness to the natural environment in general, and to the degree of place attachment to one's local area?

The general hypothesis of a systematic connection between Welsh language abilities and nature connectedness as well as place attachment is consistently supported by our data as discussed above. The differentiation of Welsh-language abilities based on RQ1, as well as the practical aspect of choosing to use Welsh to complete the survey, yields more nuanced insights. When considering the binary distinction only (i.e. a yes/no answer to 'Do you speak Welsh?'), Likert-scale based nature connectedness has a stronger statistical association to being a Welsh speaker than does place attachment as indicated by participants' freetext responses, where the association is only marginally significant. However, when considering the more nuanced Likert scales of Welsh language abilities, we found that each point on the scale is associated with increases in nature connectedness by 4.4%, and place attachment by 3.4%. Taken together, these results indicate that while the Welsh speakers' closer connection to the environment is valid both regarding nature in general and regarding one's specific home environment, the two phenomena are distinct. This is not only manifest in the different scoring methods employed in our study, but also related to the fact that (in contrast to nature connectedness in general) place attachment is multi-faceted (Hamzei et al., 2020). Conceivably, the higher effect size for nature connectedness may point to a link between language and nature, but not necessarily other dimensions of place attachment, such as functional facets or perceptions of a place as being interesting or friendly—nuances that warrant further exploration in future research.

Nevertheless, many of the facets associated with place attachment in the wider literature (e.g. Basu et al., 2020; Brown & Raymond, 2007), and accordingly expressed in the relevant terms identified by our place attachment scoring methodology, are related to the natural environment in diverse ways; for instance, Tenbrink and Willcock (2023) found higher place attachment scores for rural areas than for cities. In our study, respondents mentioned not only specific environmental aspects such as *beach*, *trees*, *mountain* and other terms that were scored as weak place attachment indicators, but importantly the associated emotions and effects of such assets on their emotional wellbeing, such as *pretty*, *calm*, *scenic*, *peace*, *idyllic*, *beautiful*, *sanctuary*, *precious*, *bliss*, *refuge* and other terms that due to their evaluative nature were scored as stronger place attachment indicators. The consistent pattern we find regarding how both general nature connectedness and individual place attachment are linked with language is therefore in line with previous research as referenced above, supporting once again the feasibility of our place attachment scoring method alongside highlighting language as a previously unidentified influencing factor for both dimensions of environmental connection.

In addition, Welsh speakers who chose English for this survey have significantly lower nature connectedness as well as lower place attachment than those who completed the survey in Welsh. While there may be a strong skills element here, with less confident Welsh speakers choosing English for the written survey, it is also a matter of choice. Due to the political history of English oppression in Wales, the Welsh language is associated with strong emotions and attitudes (Jones, 2019), with public display of bilingual information carrying significant weight (Coupland, 2012) as many Welsh speakers view the language as a marker of their identity, even in the case of equivalent English-language abilities. The choice of survey language may exemplify a situation in which Welsh speakers who completed the survey in English may not feel as strongly about the significance of Welsh as opposed to those who responded in Welsh. Altogether, this result confirms the association of Welshness with nature connectedness and place attachment in a different way.

Examining regional variation reveals another nuance, specifically considering possible differences between the English-dominated, primarily urban regions of South-East Wales (Jones, 2019), and the North which hosts the Eryri National Park and most of the regions generally recognised as the 'Welsh heartlands', i.e. regions where Welsh is used naturally by communities (Hornsby & Vigers, 2018). Our data show that residents of South-East Wales indicated significantly lower nature connectedness than those in both Mid & South-West Wales and North Wales. As nature connection is generally driven by the physical environment, urbanisation will reduce the nature connection for everyone equally; Welsh identity doesn't protect against this effect. However, being a Welsh speaker affects place attachment more in South-East Wales compared to North Wales, demonstrating stronger links to language, heritage and local

environment in the more urbanised areas. Conceivably, the lower density of Welsh speakers in South-East Wales makes the linguistic heritage feel even more precious. Generally, the positive associations between Welsh language and environmental connection are consistent across Wales, indicating that the specific regional features of the landscape where respondents resided are not directly responsible for this link.

Our data also indicate that men feel less connected to nature than women. This is in line with wider research showing gender differences in nature connection (Rosa et al., 2023) as well as engagement for nature, which has been associated with motivation for sensory pleasures (Nurse et al., 2010), suggesting that nature enjoyment may be more important for women than for men. Finally, the lower socioeconomic group demonstrated significantly lower place attachment than the higher one, in line with abundant previous research showing similar effects of deprivation (e.g. Bailey et al., 2012).

RQ 3: How do people in Wales perceive the relationship between Welsh language and the natural environment in Wales? Do they feel that hearing or using Welsh affect their sense of connection or responsibility for nature? Do Welsh-language abilities, place attachment, or connectedness to nature affect these perceived relationships?

While RQ 2 established an objective relationship between people's skills and nature/place attitudes based on questions that addressed these aspects separately, RQ 3 asked to what extent people are aware of such a link, whether there are any perceived effects of it in their own experience, and whether their background affects these perceptions. Our results suggest that there is generally a relatively low awareness of the now established relationship between language and the environment. On average, the agreement with relevant statements was rated on the lower half of the 7-point Likert scale, ranging from 2.73 to 3.51 between statements, confirming that the questions were not simply reinforcing a stereotype that is widely and commonly accepted among residents of the country. On the contrary, freetext responses confirmed a widespread lack of consideration of such a relationship, with especially non-Welsh speakers sometimes indicating a disbelief that the question was even asked, and a complete lack of understanding as to what it might mean. While Welsh speakers showed a 38% higher agreement with the belief that Welsh is related to nature, this does not amount to a generally established stereotype. In this light, the significant associations we found under RQ2 clearly contribute a novel and, for many, surprising result.

Some Welsh speakers do however see it as being almost self-evident that there is a link between the Welsh language and the environment, beautifully expressed in freetext responses that highlight its nature. Comparing reactions to the various statements regarding perceptions, agreement was highest for the general belief that Welsh is related to nature and for feeling more connected when reading or hearing Welsh place names—especially in Welsh speakers. There was less agreement regarding feeling more responsible or connected when hearing/using Welsh, and attraction to places where Welsh and nature connect showed intermediate agreement. Welsh speaker status did not affect these perceptions. This indicates that the link, even where it is recognised, is not necessarily associated with perceived effects on people's own experience, except for the significance of Welsh place names, resonating once more with Graves (2024) insights regarding the existence and roots of the link between the language and the landscape.

Nature connectedness was significantly associated with all six perception statements, with each point increase associated with 8.0% to 9.6% stronger perception, indicating that people who already feel closer to nature have a stronger sense of the existing link between Welsh language and the environment. Complementing this general effect of connection to nature, place attachment (i.e. one's personal association to the direct environment) showed significant associations with four of the six perception statements (there was no association with perceptions of environmental responsibility or connection when hearing/using Welsh), though effect sizes were smaller. These details complete the overall pattern of links between language, environment in general and in one's own home area, and associated perceptions.

As our survey was conducted in the form of a rapid online data collection, a range of factors that may potentially influence our results could not be considered. This includes the length of time a person has lived in that place or elsewhere in Wales, connections to family in that place (or in Wales), their life stage, linguistic background and pathway of learning Welsh (if at all), access to greenspace, interest in outdoor activities and much else. In addition, our study highlights an important correlation but does not

address the factors that cause this correlation. Following Graves (2024) compelling argument, such factors would include the wealth of shared cultural history, the beauty and richness of Welsh nature reflected in place names and local histories, the embeddedness of Welsh-medium cultural traditions in landscape, and other factors that relate more to Welsh identity than to the language itself. There is more work to be done to fully understand how the role of language as a marker of cultural identity interacts with the Whorfian effect of linguistic structure affecting cognition. Our rapid survey inevitably collected some contributions that participants did not take the time to consider properly; indeed, some survey design decisions such as formulating all Likert-scale agreement questions in a positive way rather than mixing positive and negative statements (as is sometimes done to exclude bias) were made to avoid misreading during rapid responding. More in-depth qualitative research would be more reliable and reveal further nuances in attitudes and perceptions. Here, we prioritised national representativeness; follow-up work will be needed to address the nature, features and reasons for the identified link between Welsh language and environment in more depth, and to explore any negative associations or sentiments that might have been missed by our survey design. Also, we hope that this example from one minority language and culture will inspire further research addressing related effects in other contexts.

6. Conclusion

This research sought to address the following research questions:

1. What level of self-assessed Welsh language abilities in spoken and written language is sufficient to motivate self-identification as a 'Welsh speaker' (in the wording and classification of the Census)?
2. Does being a self-identified Welsh speaker relate systematically to the degree of connectedness to the natural environment in general, and to the degree of place attachment to one's local area?
3. How do people in Wales perceive the relationship between Welsh language and the natural environment in Wales? Do they feel that hearing or using Welsh affect their sense of connection or responsibility for nature? Do Welsh-language abilities, place attachment, or connectedness to nature affect these perceived relationships?

Results from our nationally representative survey suggest that the central hypothesis of this paper that there is a connection between use of Welsh language and the environment holds true, although the reasons underlying the correlation cannot be determined at this point: shared cultural identity, linguistic content associated with Welsh concepts, patterns of residence and landscape access (beyond controlling for region as done in our study), or other unknown factors could co-vary with Welsh abilities in ways that were not captured by our survey. Nevertheless, for proponents of the green transition this research is significant as it provides further evidence of the strategic importance of language for promoting sustainable behaviours (Holden & Airas, 2025). It relates to - but goes well beyond - the recognition that language is part of human identity and therefore needs to be considered when engaging with humans with different linguistic backgrounds, especially in the context of participatory approaches towards a sustainable future (Ortiz, 2018). Our results suggest that respecting the Welsh language links not only with people's deeply felt identity, but additionally to a special sense of connection to the natural environment - an important driver of sustainable behaviour. Future research should address the potential of similar effects for other minority languages, as well as the consequences of effects of this kind for culturally embedded practices, combining these novel insights with the wealth of literature on traditional ecological knowledge in indigenous cultures (Mohd Salim et al., 2023), towards a deeper understanding of the role of languages in mediating people's relationships to nature.

Our findings also open up a route into the teaching of Welsh that may make it more relevant to young people who are interested in environmental change. The WJEC, the Welsh examinations board, is currently replacing its curriculum with one based on sustainability skills. This research underlines the need, already underway in Wales, to connect the sustainability and Welsh educational agendas. In the work of the Public Map this research has led to a new strand of work on the connection between Welsh speaking, land, place names, field names and sustainable farming practices. Graves (2024) sets the

agenda for this in noting the way in which ancient farming practices were built on the naming of field systems. Perhaps most of all it underlines a need for sensitivity and care in the use of language, particularly in matters relating to the land.

Notes

1. <https://www.gov.wales/welsh-language-data-annual-population-survey-2024-html>.
2. Examples: DEG (<http://deg.cymru>) supports communities towards net zero, Natur Ni (<https://naturni.co.uk/>) connects people with nature and heritage; Y Pethau Bychain (<https://www.ypb.cymru/>) offers educational nature experiences.
3. <https://futuregenerations.wales/discover/about-future-generations-commissioner/future-generations-act-2015/>.
4. <https://futuregenerations.wales/cym/wp-content/uploads/2025/05/Future-Generations-Report-2025.pdf>.
5. Besides Welsh (mostly spoken in Wales) and Breton (Brittany), Irish Gaelic is mostly spoken in western Ireland and Scottish Gaelic in the West of Scotland. Other Celtic languages such as Manx (Isle of Man) and Cornish (Cornwall) are said to have died out as a natural language (Sims-Williams, 2017).
6. <https://help.pickmypostcode.com/article/103-third-party-surveys>.
7. <https://dataportal.wiserd.ac.uk/en/reports/shared/f262d975-3533-411e-8ee3-20cd26bf6c72>.
8. <https://ich.unesco.org/en/intangible-heritage-domains-00052>.
9. <https://help.pickmypostcode.com/article/103-third-party-surveys>.

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Ethical approval

Ethics approval was obtained through Bangor University (25/02/2025, TT1 2024-25). We engaged the online platform FindOutNow to achieve anonymous, fast-track data collection towards a nationally representative sample of ~2,000 respondents from across Wales. The company distributed the survey using Pick My Postcode, a free, online postcode lottery that provides extra credit for survey participation, to be redeemed if winning the postcode lottery. While this mechanism does not allow for extended ethical statements for individual surveys, the platform's terms and conditions site⁹ states that 'Participating in any research is entirely up to you and is not required'. Additionally, Pick My Postcode's 'services and the Website are for use by members 18 years old and over only. [They] do not market to users under the age of 18 and do not intentionally collect data on users under the age of 18'.

Author contributions

CRedit: **Thora Tenbrink**: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Validation, Writing – original draft, Writing – review & editing; **Matthew Scowen**: Data curation, Formal analysis, Methodology, Validation, Visualization, Writing – review & editing; **Simon Willcock**: Conceptualization, Formal analysis, Investigation, Methodology, Resources, Validation, Writing – review & editing; **Flora Samuel**: Conceptualization, Funding acquisition, Writing – review & editing.

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Data availability statement

The dataset generated and analyzed for the current study are available via the ReShare UK Data Service's online data repository at <https://reshare.ukdataservice.ac.uk/858371/>.

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