**Exploring the Diversity and Distribution of LGB+ Communities: Sexual Identity, Demographics, and Marital Legal Recognition.**



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***A Data Visualisation Report***

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**3225** Words

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# **Knowledge Building**

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Discrimination and homophobia are still a prevalent epidemic of the modern world, plaguing both the safety and inclusivity of people who identify as LGB+ (those who identify as anything other than straight or transgender) in society, that should come standard for all people no matter their sexual orientation, sex, age, or race. Whilst the UK has made significant progress into the treatment and rights of LGB+ people (with UK acceptance of homosexuality rising from 74% in 2002 to 86% in 2019 (Poushter & Kent, 2020)), 20% of the UK LGB+ population reported experiences of discriminatory acts of verbal harassment and physical violence (Government Equalities Office, 2018).

Where you live can significantly affect the rate of discrimination, both at a national level, and worldwide (Flores, 2019). In general, it is understood that homophobia and LGBT (those who identify as Lesbian, Gay, Bisexual, or Transgender) discrimination in the UK differs based on location, with those living in larger towns/cities facing less discrimination than those in small towns/cities (Stonewall, 2018). In particular, cities such as London, Brighton and Hove, Manchester, and Birmingham have all been documented to be places considered to be more LGBT friendly (Acton, 2021), with sources noting increased numbers of LGBT community spaces, bars, and clubs.

Specifically, an important area of concern is that of LGBT student safety and inclusivity (Russell et al., 2021). With 20% of LGB+ students hiding their sexual identity from their family (Stonewall, 2018), an inclusive university environment can be pivotal in allowing LGBT students to thrive, not only socially, but academically and emotionally as well (Cardinal, 2021). With over 1 in 5 UK LGB+ students having been the victim of homophobia from other students, 1 in 14 students facing discriminatory remarks by university staff based off of their sexual orientation, and 19% of LGB+ students reported to have been excluded by other students (Stonewall, 2018), it is reasonable to assume that location/university choice with greater LGB+ student representation can be a significant factor in academic well-being, having a strong support structure, and facing lesser discrimination.

Therefore, the topic chosen for this data visualisation project was ‘Exploring the Diversity and Distribution of LGB+ Communities’. The composite visualisation specifically looks at important demographic information as well as key insights into the best and worst places to live in the UK in respects to LGB+ representativity in order to answer the research question:

**Where are the best (and worst) places to live for LGB+ representativity?**

The datasets used to create the composite visualisation above was that of the ONS 2021 Census LGB+ age & sex, and occupation datasets (ONS, 2023) (ONS, 2023b) and the Our World in Data same-sex marriage 2020 dataset (OWiD, 2020). These datasets were chosen as they housed up-to-date data that could be combined to paint a strong narrative for the target audience of young people, particularly students. I felt the visualisations created from these datasets could provide this target audience with key important demographic information, as well as insights into potentially better places to live either for university, or in the future post-university.

A number of key insights from the composite visualisation are shown in table 1:

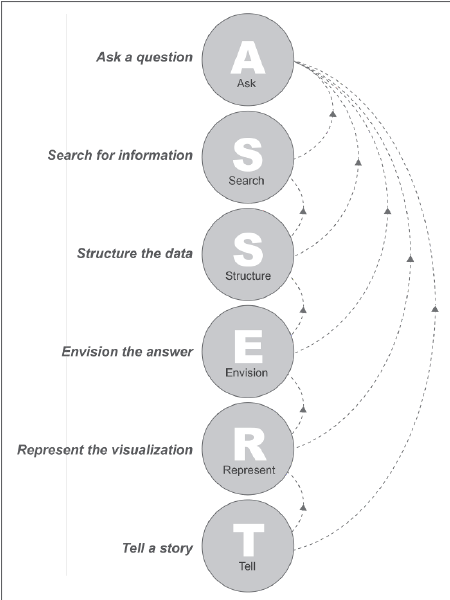
|  |  |
| --- | --- |
| No. | Insight |
| 1 | From the first two visualisations (a stacked bar chart and bar chart, ‘A’ and ‘B’ respectively), they show that heterosexuals make up the large majority (89.4%) of sexual orientations, with LGB+ making up just over 3% of the demographic, and that gay/lesbian and bisexual made up the majority of the LGB+ demographic (48.7% and 40.6% respectively). |
| 2 | From the doughnut charts on the LGB+ age and sex demographics, the visualisations show that a larger proportion of young people (aged 16-24) identify as bisexual over gay/lesbian (40.5% and 17.8% respectively), whilst a larger proportion of older people (aged 25 through 75+) identify as gay/lesbian over bisexual. Likewise, a larger proportion of bisexual people are female, while a larger proportion of gay/lesbian people are male. |
| 3 | The majority of LGB+ makeup in the UK is low (both UK choropleths are mainly blue), however there are select Local Authority Districts (LADs) that show higher proportions of LGB+ people and higher numbers of LGB+ students. Likewise, these LADs seem to corroborate between choropleths, showing that places with higher proportions of LGB+ people also tend to have higher numbers of LGB+ students. |
| 4 | The paired bar charts for the choropleths result a number of more ‘desirable’ places for LGB+ people, such as Brighton and Hove and London, and then Leeds, Manchester, and Birmingham for students specifically. |
| 5 | Sheffield is the 5th most populated area for openly LGB+ students (with 5770 students)! |
| 6 | Brighton and Hove both has a high makeup of LGB+ people, as well as LGB+ students, appearing in both bar charts. |
| 7 | Castle Point has the lowest proportion of LGB+ people (just 1.6% of the LAD). |
| 8 | From the world map visualisation, the majority of the world still does not legally recognise same-sex marriage. |
| 9 | Continental patterns can be recognised, with Europe and North America more likely to be accepting of same-sex marriages, whilst Africa and Asia are less likely. |

*Table 1: A table of 9 insights extrapolated from the composite visualisation*

The key takeaway from the composite visualisation are the bar charts relating to the UK choropleths, as they give new knowledge into places that are potentially more accepting of LGB+ people, due to their larger representation in the LAD’s demographic. These insights line up with other reports that larger cities (specifically London, Manchester, Birmingham, and Brighton and Hove previously mentioned) are considered to be more LGBT+ friendly.

# **Theoretical Frameworks**

The ASSERT framework, developed at the University of Virginia (Ferster, 2023) (shown in figure 1) was used to construct the composite visualisation for the project.



*Figure 1: A diagram of the ASSERT framework (Ferster, 2023)*

For this project, initial exploration resulted in numerous questions to base the composite visualisation on, including ‘what effect does internet/social media usage have on human well-being?’ and ‘what is the history of artificial intelligence hardware and LLM model complexity?’. Upon further exploration, a lack of sufficient data, or a lack of a strong narrative meant that pursuing other questions was beneficial. The ONS 2021 Census datasets provided a multitude of demographic data on the UK population. Using the ONS census data was beneficial as the data was highly reliable, readily available, and open-source, housing a high-volume of multivariate data on the demographic of England and Wales. Therefore, a question of ‘where are the best and worst places to live for LGB+?’ was proposed. Upon further exploration of the 2021 Census sexual orientation data, information on profession including ‘full-time student’ influenced the decision to pivot the target audience of the visualisation towards young people, particularly students. Questions such as ‘what information would I want to know as a young LGB+ student about the LGB+ climate of the UK and the world?’ steered the direction of the visualisation considerations. This further resulted in the question of ‘if I was a LGB+ and wanted to visit a different country, where would I go?’, incorporating Our World in Data datasets.

Imported data was generally well structured, however cleaning of the data using the Tidyverse package allowed for suitable labels, filtering to contain only useful data, and combining relevant datasets into meaningful groups. Datasets were comprised of both categorical (sexual orientation, age, sex) and continuous data (count, percentage).

When envisioning the answer and visualisation, the composite visualisation was devised to have 3 general sections…

1. Showing broad good-to-know demographic information for young LGB+ people.
2. Showing specific new information on the LGB+ ‘hot-spots’ and ‘cold-spots’ in England and Wales, and showing places that are more and less likely to be accepting.
3. Showing the wider current climate of same-sex acceptance worldwide.

The final composite visualisation was built up of 9 individual visualisations: 4 broad visualisations (a stacked bar chart, a bar chart, and 2 doughnut charts); 4 detailed visualisations (2 UK choropleth maps and 2 bar charts); and 1 final whole picture visualisation (world choropleth map).

…telling a 3 part story:

1. That those who identify as non-heterosexual are but a small fraction of the UK population, and that their specific sexual orientation is but a fraction of the LGB+ demographic, building the picture that building communities and finding like-minded people (or compatible people in relation to dating) can be difficult.
2. That there are areas of the UK that have higher proportions of people/students that identify as LGB+, making it more likely to meet likeminded people, build communities, feel included, and face less discriminatory acts.
3. That there are places around the world that you probably don’t want to live as someone who identifies as LGB+.

Visualisation creation was carried out using R, with bar charts and UK choropleths plotted using the ggplot2 package, the doughnut charts plotted using the webr package, and the interactive world map plotted using ggplot2, plotly, and the shiny package to allow for interactivity with the map. ggplot2 is a visualisation package built on the concept of the grammar of graphics introduced by Leland Wilkinson (Wickham, 2010), using a set of components to build a complex visualisation, explained with relevance to the visualisations in this report:

1. Layer
   1. Data and mapping
      1. The data for the composite visualisation was built up of multiple variables including sexual orientation, age, sex, location, legal status with different visualisations utilising different data sources
      2. Bar charts mapped either sexual orientation on the x axis and percentage/count on the y axis (flipped because horizontal bar charts)
      3. Doughnut charts mapped sexual orientation to sex/age
   2. Statistical transformation
      1. Datasets housed individual counts for all sexual orientations. Statistical transformation was performed to summarise the counts of all non-heterosexual sexual orientations, with percentages being formulated from these counts
   3. Geometries
      1. Bar geometries (geom\_bar) were used in bar charts
      2. Simple feature geometries (geom\_sf) were used in choropleths
2. Scales
   1. All graphs defined a scale for colour aesthetic attributes
3. Coordinate system
   1. choropleths included coordinate systems by way of longitude and latitude values and multi-polygon geometry information to plot the UK visualisations. This information was extracted from the ONS website in the form of a shapefile (ONS Geography, 2022) to allow for their visualisation.
4. Facets
   1. The top + bottom 8 LADs for LGB+ bar chart was split into 2 facets to provide a visual distinction between the groups.
5. Themes and aesthetics
   1. theme\_minimal() or theme\_void() were used for all of the 9 visualisations to provide a clean aesthetic
   2. Adding labels, titles, figure legends
   3. Position and size of text, labels, and figure legends
   4. The rotation of the doughnut charts, and their shape (exploded donut for visual clarity of the largest category)
   5. Adding specific colour schemes to bar charts and choropleths (by use of manual selection, the Viridis package, and the ColorBrewer package)
   6. Adding interactive elements on the Shiny App
      1. Sidebar panel including selective inputs
      2. Main panel displaying the interactive map and figure legend

# **Accessibility**

Accessibility in visualisations simply refers to the ability to be able to access, understand, and interpret visualisations (Joyner et al., 2022), with their intentional design – such as their aesthetics (including factors such as colours, labels, font and font size choice, clarity, etc), interactivity, responsiveness, and descriptors (Elavsky et al., 2022) – aiming to tailor the design of graphs to make them accessible to the greatest amount of people, including those with impairments and disabilities.

There are a number of different conditions that can affect a person’s ability to interpret a visualisation, including visual impairments (that affect 3.44% of people worldwide (Ackland et al., 2017)), colour-blindness (that affect 300 million people worldwide (Clinton Eye Associates, n.d.)), and cognitive impairments. A lack of consideration of colour choices can hinder accessibility, with a colourblind person being unable to distinguish between colours on a visualisation that are too similar or that they have an insensitivity to (Muth, 2020), or someone with poor eyesight being unable clearly interpret low contrast colours (Muth, 2020) (W3C, 2016). Additionally, overcomplication of visualisations can potentially lead to a failure in interpreting/understanding visualisations by those who have cognitive impairments (Wu et al., 2021). Therefore, it is vital for a data scientist to consider visualisation choices to improve accessibility, to allow for their work to be viewed by as many people as possible.

Continuing on, an intentional design choice that hindered accessibility was that of the colour scheme of the world map, with a colour scheme of red, orange, light green, green. The colour scheme was chosen to paint a specific narrative, as the colour red has negative connotations (such as hatred, anger, aggression, war, etc (Cherry, 2020)) and green has a positive, down-to-earth connotation (Cherry, 2022). In addition, the colour red is perceived first by human eyes (Mihal, 2004), and therefore by using a saturated red colour (high saturation suggests a strong/impactful connotation), the eyes is drawn to the vast amounts of red on the map, illustrating to the user how much of the world does not legally recognise same-sex marriage.

Those with red-green colour-blindness (such as protanopia and deuteranopia – the most common colour deficiencies (Naifeh & Kaufman, 2023)) have insensitivities to red or green light, making the graph less accessible due to poor visual distinction between the colours. Therefore, 4 choices of colour schemes were added to aid in providing better accessibility. The addition of a greyscale colour scheme was added, as the Default and colourblind options were all diverging colour schemes of the ColorBrewer R package, meaning that printing these colour schemes in black and white would lead to minimal distinction between the categories. Therefore, the greyscale scheme followed a sequential black to white colour scheme to aid in visual clarity.

Graphical user interface, application, Teams

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*Figure 2a, 2b, 2c, 2d: Screenshots of the colour scheme choices of the world map visualisation of the report, including the dropdown menu, colourblind friendly 1, 2, and greyscale.*

Furthermore, a number of design choices were intentionally added to improve accessibility to the world map, including using a Shiny App to allow for interactivity (including zooming in and out), an alphabetised dropdown menu to allow for looking up specific countries, coloured labels when hovering over a country, and a figure legend that coordinated with different colour scheme choices.

Map

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Map

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*Figure 3a, 3b, 3c, 3d: Screenshots of accessibility designs of the world map visualisation, including interactivity, the dropdown country menu, and hover labels.*

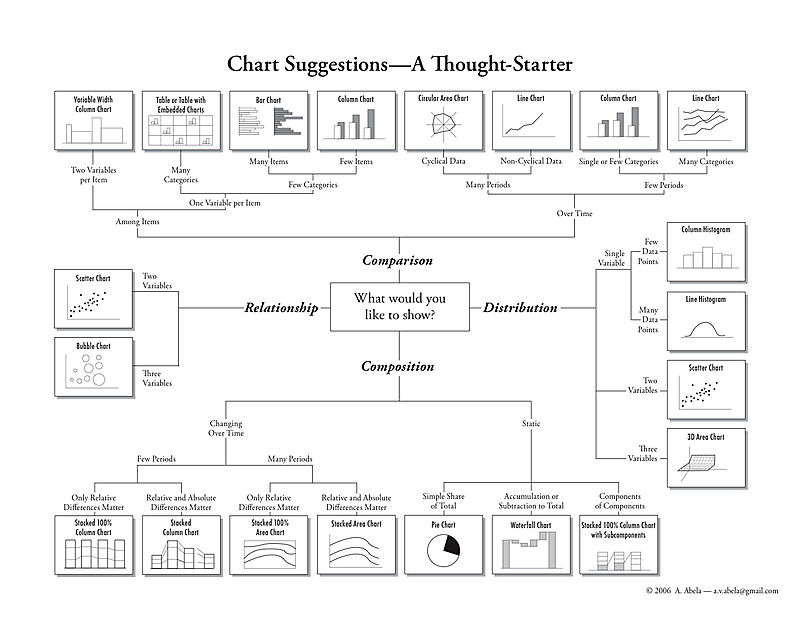
Overall, whilst some design choices led to reduced accessibility, consideration of this ultimately allowed for the creation of tools to aid with visualisation accessibility.

# **Visualisation Choice**

For the world map, I specifically chose a choropleth visualisation, as it served as a suitable choice for providing a visual narrative of the data on the legal status of same-sex marriage across different countries. The goal of the visualisation was to paint a narrative that ‘a large proportion of the world still did not recognise same-sex marriage’ and ‘these are the countries that are less favourable to visit or live in due to higher chances of discrimination’; whilst a line chart or a bar chart could have illustrated similar intentions, the choice of a choropleth map allowed for the use of different colours to represent the 4 categories and facilitates an easy comprehension of regional patterns and variations in the data. In the context of the legality of same-sex marriage, the use of a choropleth map conveys the spatial distribution of various legal standings, enabling swift comparisons between neighbouring countries or entire continents, which was desirable for the intentions of the visualisation.

A line chart could be a compelling alternative comparative visualisation to a choropleth map, substituting geographical analysis in favour of temporal analysis. A line chart visualising same-sex marriage legality at a country level could plot the number of countries that recognise same-sex marriage over time on one line, and have an additional line plotting the number of countries that do not recognise same-sex marriage. This could provide for an interesting visualisation as it would show a converging pattern, with the distance between legality and illegality closing. Whilst this is the case, this would likely better fit a narrative that rights for LGB+ have improved over time, and with no temporal component considered in this project, a choropleth seemed like a better choice for the narrative.

Likewise, a bar chart could be a compelling alternative comparative visualisation to a choropleth map, with multiple visualisation choices to choose from depending on the desired narrative, shown in the taxonomy of visualisations figure 4. Similar to that of the line chart mentioned, a bar chart could be constructed to substitute the spatial narrative of the choropleth in favour of temporal analysis. On the other hand, a bar chart plotting 4 bar charts as the 4 categories of legal status of same-sex marriage with the axis being the number of countries could aid in providing a simple narrative that there are more countries that do not recognise same-sex marriage than do.



*Figure 4: A taxonomy of visualisation choices by category (Abela, 2008).*

A column chart visualisation choice could also be considered, to plot same-sex marriage legality data into continental groups, with grouping the data into continents allowing for the visualisation to retain visual clarity due to having fewer categories, and would allow for cleaner insights into regional disparities.

While the alternative visualisation methods have the potential to display relevant information, they lack the essential geographical context that is vital for understanding the landscape of same-sex marriage legality and providing individual information on countries whilst allowing for visual comparisons between both countries and continents. The choropleth map's capacity to merge data representation with geographic information renders it a more effective tool for showcasing the spatial relationships and regional disparities (Lochhead, 2021). Furthermore, linking back to the accessibility section, choropleth maps can be intentionally designed to be colourblind-friendly and therefore accessible to a broader audience, thus ensuring that the visualisation remains inclusive and easily interpreted by a diverse audience. Overall, a choropleth visualisation constitutes a justified choice for presenting data on same-sex marriage legal status, as it effectively communicates the information whilst emphasising the significance of geographic context.

# **Implications and Improvements**

One potential implication of the composite visualisation is its potential to be hijacked and misconstrued to cause harm. For example, as the visualisation shows insights into areas of higher proportions or higher numbers of students, this information could be used by those intending to discriminate to target areas with higher proportions of LGB+ people. Similarly, someone who is homophobic could use the visualisations to intentional move to areas of the country with lower proportions of LGB+ people/students. Ethical issues of privacy also arise as a result of this, with the graphical data potentially comprising locations with LGBT communities, potentially increasing the chances of discrimination in these areas. There are multiple ethical implications of mapping demographic data of minorities, an example of which was the 2012 NYPD mosque controversy where the undercover police mapped Muslim places of worship with the aim of having a source inside every mosque. This privacy concerns, with negative ethical implications that the police were treating an entire religious community as potential terrorists (AL JAZEERA, 2012).

Another ethical implication of the composite visualisation is for its potential misuse. With the current political climate around LGBT rights, whilst the visualisations are intended to paint a picture of areas where LGB+ might feel safer and more included, anti-LGBT far-right organisations could potentially take the visualisations (in particular the UK choropleths and their respective bar charts) and construe a negative narrative using them.

An underlying message of the visualisation was of inclusivity and community finding. Whilst this was the case, owing to the ever changing landscape of sexual orientations and gender identities, a limit of the data used only housing information on LGB+ could unintentionally make sexualities, or gender identities such as those who are transgender, not included in the dataset feel left out, which can be a particular issue when considering specific communities, such as the LGB Alliance having been criticised for being transphobic (Independent, 2019). Therefore, a potential improvement to the composite visualisation would be to join the used datasets with the ONS 2021 gender identity and produce visualisations or adapt current visualisations to include transgender people, in order to mitigate any potential negative political/ethical implications.

Additional improvements were realised over the course of this project. First, though the world map was built around accessibility in terms of interactivity (by using a Shiny App), the choropleths were not owing to their complexity resulting in long render times… Using a shiny app for the UK choropleth maps, as well as their respective bar charts could aid in visual clarity, allowing for zooming in and out, and hovering over Local Authority Districts to see their name and value. Additional using a Shiny App for these visualisations would have allowed for simplification of the overall composite visualisation, as a dropdown list could choose between the visualisation being viewed, reducing the number of graphs seen at once. In addition a dropdown list of LADs could have been created to allow for easy analysis of specific places in England and Wales, that was not very clear with the non-interactive version.

Additionally, if I were to start this project over, I would have chosen a different R package to plot the doughnut charts. Whilst the package was easy to use, it lacked granular visualisation choices such as choice of colour or rotation/inclusion of specific labels, overall contributing to a worse visual experience.

Another change to the report could be the omission of the demographic visualisations. Whilst they provided a good context for the other visualisations, and showed off additional visualisation choices, ultimately it added to the complexity of the overall composite visualisation and may have diluted the narrative that was trying to be told.

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