Age Matters: Demographic-based Perceptions of Included Location Information

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Abstract

Understanding how individuals perceive the importance of location information is critical for improving the communication of spatial data. This study investigates how demographic factors, particularly age, affect the perceived significance of location in different contexts. Using survey data from 101 UK-based participants, we analysed responses to questions assessing the informativeness of location relative to other contextual data (e.g., time, source, quantity) in scenarios involving pollution and sexual crime statistics. The results indicate that age is a key determinant in evaluating location information, with older participants placing greater emphasis on location for pollution data, while gender emerged as more influential in the context of sexual crime. Education showed minimal impact. These findings suggest that location perceptions vary between different age groups and contexts, with implications for tailoring location-based information presentation to diverse audiences. Future research should explore adaptive strategies for communicating spatial data across demographic groups to enhance comprehension and decision-making.

1. Introduction

Location data play a critical role in providing context to observed phenomena, influencing how they are interpreted and understood (Teevan et al., 2011), (Ranasinghe and Kray, 2018), (Pertzov and Husain, 2014). What is less clear, however, is whether individuals themselves consider location as more significant than other types of data. Studies have shown that missing location data can have a particularly deleterious impact on analysis (e.g., (Arbia et al., 2017), (Seif et al., 2017), (Shin et al., 2020) or (Yokoi, 2018)). Indeed, this missing data may have the potential to be life-threatening in some cases (Hand, 2020). Even so, it is unclear whether individuals themselves consider the absence of location data to be particularly harmful to their decision-making. In particular, would the decisions made on the basis of available information change if location data were missing?

There is also the question of whether the importance given to location information differs between demographic groups. Although location data is typically regarded as fundamental owing to its role in providing context, its perceived significance may vary between individuals. While some people may consider such information essential, others may assign it less importance, highlighting how perceptions of location may vary across individuals. If such an effect exists, it has clear implications for the communication of spatial information. This is especially the case where this information has a high potential impact, such as avoiding a hazard or accessing assistance.

Differences have already been found between demographic factors which may affect spatial cognition. Spatial thinking and perception have been found to differ between younger and older individuals, especially in situations such as reading maps or finding directions (e.g., (Spiers et al., 2023), (Lester et al., 2017), (Yamamoto and DeGirolamo, 2012)). Nowadays younger individuals tend to prioritise digital platforms when accessing location-based data in comparison with older people (Wakabayashi, 2019). Age may also affect the level of individuals' spatial awareness that location data can convey or represent. In a study of spatial tasks it was found that older people had more difficulties with spatial memory-related activities than did younger, and that this was related to nonspatial cognitive ability (Richmond et al., 2018). Gender was also found to have an effect (Spiers et al., 2023), with males seemingly having an advantage over females.

There also appears to be a link between spatial and numerical thinking (Newcombe et al., 2017), suggesting that the same factors that affect processing numerical data may also impact spatial thinking. Indeed, spatial thinking is now considered to be a significant influence on student's success in science, technology, engineering and mathematics (STEM) studies (Ishikawa, 2016). It is, therefore, possible that differences in educational attainment may also show up in differences in spatial thinking. Indeed, (Spiers et al., 2023) also found an advantage in the performance of spatially-related tasks for those with higher educational attainments.

It follows that any investigation of demographic factors that may affect individuals' perceptions of the importance of location data should focus on the potential impacts of differences in age, gender and the educational level. This study, therefore, explores the relative importance individuals place on location as opposed to other data factors. It also investigates the role of age, gender and education play in the evaluation and perception of location data. It is structured as follows: beginning with a description of the dataset and analysis method, the results are outlined and discussed, before concluding with the findings and future possible research extensions.

2. Method and Data

There are many approaches that can be used to investigate these questions, such as structured interviews or technology-based experiments. In this paper a survey approach is used, focussing on two questions from an investigation into the perceptions of missing data.

Demographic breakdown of survey participants				
Category	Type	Percentage	Type	Percentage
Gender	Male	50	Female	50
Age	18–44	47	45+	53
Education	University	30	Not University	70

Table 1. A table showing the breakdown of the 101 survey participants by key demographic categories.

2.1 Data

A total of 117 UK-based individuals participated in a survey conducted in 2023 on an online platform, of which 101 completed the survey. This survey was designed to examine the effects of missing data on decision-making. To ensure gender balance, 50 women and 51 men were included. Demographic variables were grouped into binary categories to support comparison across groups: Female and Male, Young (18–44) and Old (45+), and Graduate and Non-graduate (see Table 1).

The survey questions examined how participants interpret and prioritise different types of missing information, such as location, date, quantitative data, and the organization issuing the information. These questions may present evidence that indicates the importance of location, and any differences in this importance between different demographic groups. Additional research (such as qualitative interviews), however, would be needed to investigate the motivation behind these results.

While the full survey had 13 questions, the present study focuses specifically on two questions that examine the perceived importance of missing location data among other contextual factors. The two questions asked respondents to evaluate the importance of location information in two scenarios: one concerning pollution, the other sexual crime. Each question presented several contextual factors, including location, to be rated on a scale from 0 (not at all important) to 10 (extremely important). While age and gender generally are likely to matter in the perceptions of crime, these questions facilitate the evaluation of location against other potential contextual factors. The questions were:

1. The pollution question – Please score the following options depending on informativeness when it is added to the following statement “Air pollution contributed to 11.65% of deaths” - the options being:
   (a) *in 2022* (date);
   (b) *in London* (location); and
   (c) *reported by the Institute for Health Metrics and Evaluation, Global Burden of Disease* (organisation).
2. The sexual crime question – Please score the following piece of information (location, time, quantity, reference) that you need or wish to understand the situation better when they are added to the following statement “Sexual crimes increased by 15%” - the options being:
   (a) *in your country* (location);
   (b) *since 1971* (time);
   (c) *from 13,131 to 15,049* (quantity); and
   (d) *reported by police* (reference).

2.2 Analysis

The demographic data on the survey respondents allowed an examination of how different groups viewed the importance of location vis-à-vis the other variables present in the data. This was done by subtracting the average score of the other variables in each question from the score for location. This approach is based on that of Net Promoter Score; a technique commonly used in marketing and business surveys (Nunan, 2024). These scores were then normalised for different demographic slices by dividing the individual scores by the category totals.

As these scores ranged from –7 to +7 an interval of 2 was used to create 7 net importance score rankings. Demographic comparison groups for Age, Education and Gender and their combinations were then created. The frequency of each response for each demographic group within these rankings was then calculated, tabulated and plotted. This information is shown in Tables 2 to 9. The median scores for each demographic group are also shown in these tables.

The information from these analyses was then confirmed by the use of the non-parametric Pearson Chi-squared test (McHugh, 2013) on the non-normalised data. Owing to the small counts present in several cells of these tables, the tables were consolidated into three categories, -7 to -1 (the negative ranking), 1 (as the neutral ranking) and 1 to 7 (the positive ranking). Even so, several of the tables did not meet the requirements for a valid test owing to insufficient counts in one or more cell. The results of these analyses are given in Tables 10 and 11, where the unreliable results are marked with an asterisk (*). These unreliable results are also indicated in the text.

3. Results

As can be seen from Table 2, Age was found to be the most significant factor in evaluating the importance of location for the pollution question, something that was confirmed by the Pearson Chi-squared tests (see Table 10). In this case Age had a p-value of 0.0040, compared to 0.1164 for Gender, or 0.7250 for Education. This means that there was little difference found between the genders or for different educational attainments. Figure 1 shows the relative importance of location for the two Age subdivisions for this question.

In the combined factors, Age again appears to be significant in the combination of Age and Gender but not so when combined with Education (see Tables 3, 4 and 10). In this case the Chi-squared p-value was 0.0175 for Age & Gender, but 0.3978 for Age & Education. Gender & Education had an p-value of 0.0644. The combination of Age and Gender is illustrated in Figure 2, which appears to show that Age is a stronger influence than gender, something suggested by the single variable analysis. Note that these p-value statistics must be treated as indicatory only, owing to the low counts present in some table cells.

Pollution information question: Frequency of responses						
Ranking	Female	Male	Young	Old	Graduate	Non-graduate
-7	0.00	0.00	0.00	0.00	0.00	0.00
-5	0.06	0.00	0.06	0.00	0.03	0.03
-1	0.26	0.18	0.32	0.13	0.27	0.20
1	0.54	0.55	0.38	0.69	0.50	0.56
3	0.14	0.20	0.19	0.15	0.13	0.18
5	0.00	0.06	0.04	0.02	0.07	0.01
7	0.00	0.02	0.00	0.02	0.00	0.01
Median	0.06	0.06	0.06	0.02	0.07	0.03

Table 2. A frequency table showing the relative importance of Location against other question parameters for the survey question assessing pollution contextual information.

Pollution information question: Frequency of responses by Age and Gender				
Ranking	Female Young	Male Young	Female Old	Male Old
-7	0.00	0.00	0.00	0.00
-5	0.10	0.00	0.00	0.00
-1	0.32	0.31	0.16	0.11
1	0.39	0.38	0.79	0.63
3	0.19	0.19	0.05	0.20
5	0.00	0.13	0.00	0.03
7	0.00	0.00	0.00	0.03
Median	0.10	0.13	0.00	0.03

Table 3. A frequency table showing the relative importance of Location against other question parameters for the survey question assessing pollution contextual information.

Pollution information question: Frequency of responses by Age and Education				
Ranking	Young Grad	Old Grad	Young Non-grad	Old Non-grad
-7	0.00	0.00	0.00	0.00
-5	0.07	0.00	0.06	0.00
-1	0.33	0.20	0.31	0.10
1	0.40	0.60	0.38	0.72
3	0.13	0.13	0.22	0.15
5	0.07	0.07	0.03	0.00
7	0.00	0.00	0.00	0.03
Median	0.07	0.07	0.06	0.03

Table 4. A frequency table showing the relative importance of Location against other question parameters for the survey question assessing pollution contextual information.

Pollution information question: Frequency of responses by Gender and Education				
Ranking	Female Grad	Female Non-Grad	Male Grad	Male Non-grad
-7	0.00	0.00	0.00	0.00
-5	0.08	0.05	0.00	0.00
-1	0.23	0.27	0.29	0.12
1	0.54	0.54	0.47	0.59
3	0.15	0.14	0.12	0.24
5	0.00	0.00	0.12	0.03
7	0.00	0.00	0.00	0.03
Median	0.08	0.05	0.12	0.03

Table 5. A frequency table showing the relative importance of Location against other question parameters for the survey question assessing pollution contextual information.

Gender appears to be the most significant variable for the sexual crimes question, possibly owing to its subject matter (see Tables 6 and 11). The Chi-squared p-value for gender was 0.0264 as opposed to 0.2113 for Age or 0.7495 for Education. This is also illustrated in Figure 3.

Age again, however, appears to be important when it is combined with Gender (see Table 7 and Figure 4). The Chi-squared p-value for Age & Gender was 0.0231 whereas it was 0.0971 for Age & Education and 0.5547 for Gender and Education. Note that these p-value statistics must be treated as indicatory only, owing to the low counts present in some table cells. These results suggest that younger women are more concerned with the location of sexual crimes than is the case with older women or men of either age category. Given the subject matter of the question, this cannot be considered wholly surprising.

Sexual crimes information question: Frequency of responses						
Ranking	Female	Male	Young	Old	Graduate	Non-graduate
-7	0.00	0.00	0.00	0.00	0.00	0.00
-5	0.02	0.04	0.02	0.04	0.03	0.03
-1	0.16	0.27	0.19	0.24	0.17	0.24
1	0.38	0.49	0.38	0.48	0.50	0.44
3	0.24	0.16	0.17	0.22	0.20	0.18
5	0.16	0.04	0.19	0.02	0.10	0.08
7	0.04	0.00	0.04	0.00	0.00	0.03
Median	0.16	0.04	0.17	0.04	0.10	0.08

Table 6. A frequency table showing the relative importance of Location against other question parameters for the survey question assessing sexual crimes contextual information.

Sexual crimes question: Frequency of responses by Gender and Age				
Ranking	Female Young	Male Young	Female Old	Male Old
-7	0.00	0.00	0.00	0.00
-5	0.00	0.05	0.06	0.03
-1	0.10	0.26	0.38	0.23
1	0.35	0.42	0.44	0.51
3	0.23	0.26	0.06	0.20
5	0.26	0.00	0.06	0.03
7	0.06	0.00	0.00	0.00
Median	0.10	0.05	0.06	0.03

Table 7. A frequency table showing the relative importance of Location against other question parameters for the survey question assessing sexual crimes contextual information.

Sexual crimes question: Frequency of responses by Age and Education Level				
Ranking	Young Grad	Young Non-grad	Old Grad	Old Non-grad
-7	0.00	0.00	0.00	0.00
-5	0.00	0.03	0.07	0.03
-1	0.13	0.22	0.20	0.26
1	0.47	0.34	0.40	0.51
3	0.13	0.19	0.33	0.18
5	0.27	0.16	0.00	0.03
7	0.00	0.06	0.00	0.00
Median	0.13	0.16	0.07	0.03

Table 8. A frequency table showing the relative importance of Location against other question parameters for the survey question assessing sexual crimes contextual information.

Sexual crimes question: Frequency of responses by Gender and Education				
Ranking	Young Grad	Young Non-grad	Old Grad	Old Non-grad
-7	0.00	0.00	0.00	0.00
-5	0.08	0.00	0.00	0.06
-1	0.08	0.19	0.24	0.29
1	0.46	0.35	0.41	0.53
3	0.15	0.27	0.29	0.09
5	0.23	0.14	0.06	0.03
7	0.00	0.05	0.00	0.00
Median	0.08	0.14	0.06	0.06

Table 9. A frequency table showing the relative importance of Location against other question parameters for the survey question assessing sexual crimes contextual information.

4. Discussion

From these results it appears that Age is a strong influence on the importance individuals place on location information. This factor appears to be more important than education or gender. It also appears that the context is very important – there was a stronger gender difference in evaluating information on sexual crimes than for pollution. The impact of Age on navigation, map reading, and similar tasks has already been established. These findings suggest that this impact also extends to the evaluation of the importance of location when assessing data.

This has implications for how information is presented, particularly when location is an important element. It suggests that standardised information presentation may not work equally well across age groups and that tailoring spatial data presentation for these groups could improve comprehension and engagement.

Chi-squared results for pollution question			
Variable	χ^2 statistic	degrees of freedom	p-value
Gender	4.302	2	0.1164
Age	11.019	2	0.0040
Education	0.643	2	0.7250
Age & Gender*	15.384	6	0.0175
Age & Education*	6.232	6	0.3978
Gender & Education*	11.894	6	0.0644

Table 10. A frequency table showing the relative importance of Location against other question parameters for the survey question assessing pollution contextual information.
The results for the variables marked * do not meet the minimum requirements for cell counts and so cannot be considered reliable.

Chi-squared results for sexual crimes question			
Variable	χ^2 statistic	degrees of freedom	p-value
Gender	7.269	2	0.0264
Age	3.109	2	0.2113
Education	0.577	2	0.7495
Age & Gender*	14.659	6	0.0231
Age & Education*	10.730	6	0.0971
Gender & Education*	4.915	6	0.5547

Table 11. A frequency table showing the relative importance of Location against other question parameters for the survey question assessing sexual crimes contextual information.
The results for the variables marked * do not meet the minimum requirements for cell counts and so cannot be considered reliable.

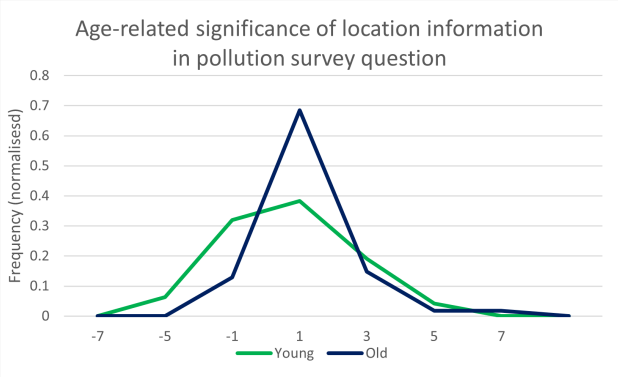

Figure 1. A plot of the impact of Age on the relative significance of Location against other question parameters for the survey question assessing pollution information.

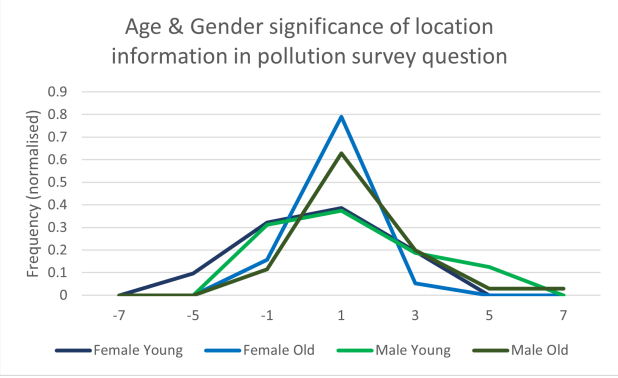

Figure 2. A plot of the impact of Age and Gender on the relative significance of Location against other question parameters for the survey question assessing pollution information.

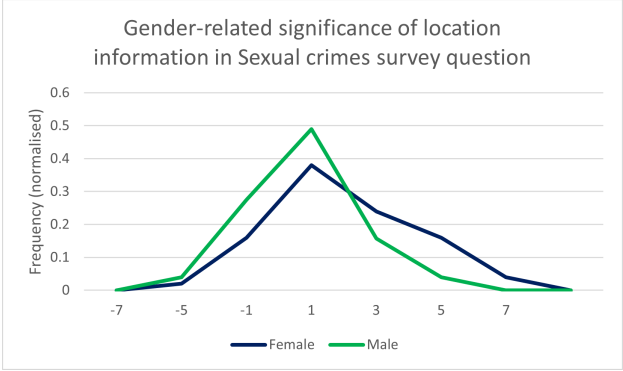

Figure 3. A plot of the impact of Gender on the relative significance of Location against other question parameters for the survey question assessing sexual crimes information.

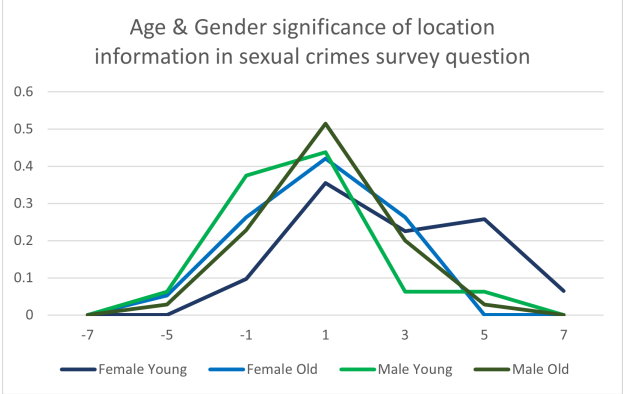

Figure 4. A plot of the impact of Age and Gender on the relative significance of Location against other question parameters for the survey question assessing sexual crimes information.

It also implies that missing location vis-à-vis other types of data may have a stronger impact on older individuals. The impact of missing location data has on analysis has already been noted.

What this suggests is that there is a differential impact on individuals. Whilst younger individuals may be concerned with other information characteristics – such as the issuing organization – a lack of location data has the capability to seriously affect older age groups.

Further, it shows the importance of assessing context when designing information for different community subgroups. This particular study included a question that had the potential to be gender-sensitive, and this was reflected in the results obtained. Taking context into account could improve communication strategies, especially when there are subgroups that are particularly sensitive to specific aspects – such as appears to be the case with younger women for the sexual crimes question.

Finally, educational attainment appears to have little impact on the perception of location importance. This appears true for both questions and for both genders and age groups.

Future research could examine these aspects in greater detail to gain a deeper understanding of these effects. This could include the perception of location information for a greater range of demographic subgroups as well as the impact of its omission. These studies need to also take into account contextual factors and how they can impact demographic subgroups. As mentioned earlier, additional research (such as qualitative interviews) could also focus on the motivation behind these results. One clear objective of this work would be to enable more effective communication of location-based data for a range of demographic subgroups and contexts.

5. Conclusion

This study has examined how individuals perceive the importance of location information vis-à-vis other types of information, and by extension, how impactful would be its absence. It found that older individuals appeared to rate location as more important information than other types, such as the issuing organization or the date. It also found that context seemed to be a significant influence on how location data is assessed. For example, younger women seemed to perceive the importance of location data to be much more significant when the topic referred to sexual crimes.

This has implications for how information is communicated, particularly when location is an important element. It suggests that standardised information presentation may not work equally well across age groups and that tailoring spatial data presentation for these groups could improve comprehension and engagement. It also shows how important context can be for the perception of location information. Future research could examine these aspects in greater detail to gain a deeper understanding so as to enable more effective communication of location-based data.

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7. Data availability

Given the human involvement in the survey, and our commitment to the ethical framework and data protection plans of the survey, as reviewed and approved by the Ethics Committee of the University of Glasgow, this survey data cannot be shared with anyone beyond the research team working on this study. However, the survey questionnaire and code developed for analysing the data can be made available on request.

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