

## Map Mash-ups: What looks good must be good?

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### 1. Introduction

The Web 2.0 revolution, ‘Digital Earth’ vision and recent technological advancements enabling the general public to easily capture location-based data through, for example, smart phones, have all had a major impact on the culture of web-based mapping. Development of web mapping applications has been made simpler and can be achieved at little or no cost by the availability of free mash-up technology and mapping APIs. Map mash-ups can be developed and accessed by any web-enabled citizen without the need for programming, mapping experience or geographic knowledge and as a consequence the number and range of users and uses of map mash-ups has grown exponentially.

There is currently little research-based guidance to aid the amateur or “citizen” producer or user of map mash-ups and a paucity of information on how to design a mash-up so as to correctly and convincingly convey the data and ‘truth’ of any scenario presented. Equally for the general user there is minimal guidance on how to evaluate the correctness, currency or value for extrapolation / general applicability of the map mash-up data presented. Designers are exposed to the risks of producing a product which fails to convey the message intended, which conveys the wrong message or which irrespective of the integrity of the data is not trusted or conveys an impression of low credibility purely due to the design and visualisation techniques adopted. At the same time, good design or an intuitive flair for effective communication through graphic material can give a level of credibility and generate user trust which is not warranted by the data presented.

The purpose of the research presented in this paper is to examine the main factors that impact users’ credence and trust in map mash-up information. The research investigated the relationship between users’ judgment and critical elements of map design. It concludes that unless active design measures are taken the viewer of a map mash-up will instinctively assume that “what looks good must be good”. This finding held even for geography-trained users of map mash-ups. The research also concluded that merely tagging the presented map mash-up with metadata, referencing the source of included datasets, is insufficient to change most users’ perceptions of the credibility of a mash-up. As a consequence our research is now pursuing lessons learnt in the field of media advertising and marketing on how to communicate a message to non-specialist consumers of a service.

## 2. Research Context

The massive availability of spatial information, downloaded at very little cost and with few limitations placed on access, provides a major social and technological advancement: although such material could be produced by individuals who have no knowledge or authority or credentials with regard to such things. This opportunity has led to increased concerns being expressed over the issue of believability and quality of information being conveyed. Hence, research on trust and credibility have become a major factor in the realm of web information quality (David and Jason, 2008) and human-computer interaction (HCI) (Fogg and Tseng, 1999). This issue has been widely debated in areas such as e-commerce applications, health information, online media (news) and collaborative applications.

The emergence of user-generated spatial content such as in the application of OpenStreetMap and map mash-ups pose similar issues of concern pertaining to trust, credibility, reliability and quality of information produced in such products. A small number of researchers have investigated part of this particular issue e.g. Bishr and Mantelas (2008), Haklay (2010), and Stark (2010). Skarlatidou et al. (2010) have also investigated how web users trust the online map provided in a government domain. However, very little is understood about how web users evaluate the credibility (believability) of online map information, particularly in terms of the map mash-up medium. Therefore, the research questions for this present study are: (i) how web users evaluate the credibility of online map mash-up information; (ii) what elements on the map mash-up influenced their believability (trust) judgements?

The study proceeded by means of experimental questionnaires. The online map based questionnaire was chosen as a method to stimulate users in the context of making judgements based on their perceived credibility between two map mash-ups and obtain users' responses based on open and closed ended questions. This method was adopted from the HCI study of Fogg et al. (2003).

## 3. Sample

The sample in this study was a group of young adult web users aged 18 to 35. The sample drawn by applying a 'convenience' (volunteer) sampling technique (Black, 2009) to members and non-members of the University of Nottingham. The self-completed questionnaires were distributed online using the student portal and mailing lists. This sample might suffer from poor coverage of young (< 18) and middle aged ( $\geq 35$ ) web users. The sample was split into two groups of respondents: geoliterate and non-geoliterate users. The groups were coded based on the background information (academic and professional courses attended or still ongoing) given by the respondents under user demographics. Geoliterate users were respondents who had a background in geography, cartography, remote sensing, land surveying or geographic information science: the remainder were classified as non-geoliterate users.

Table 1 show the independent variables used in each experiment. These variables, adopted from Fogg et al. (2003) and a pilot survey (conducted earlier), were designed as a list of factors that might influence users judgement in a set of multiple choice and ranking questions (ranked based on the level of importance). Table 2 shows the respondents' demographic information for each survey.

**Table 1:** Factors explored in each experiment

	Visual cues (peripheral factors)	Metadata (critical factors)
<b>Experiment 1</b>	Colour (colour convention, colour coding) Symbol (clarity, symbol convention) Visual attractiveness	Map producer (logo)
<b>Experiment 2</b>	Colour (scheme) Design Look (professional, amateur) Usefulness (fit for purpose)	The supplier of foreground spatial data (textual descriptions) The affiliated organisation with the Website (logo)

**Table 2:** The respondents' demographic information for each experiment

	Number of respondents		Age	
	Geoliterate users	Non-geoliterate users	18 to 21 years	22 to 35 years
<b>Experiment 1 (n = 133)</b>	31	102	62 %	38 %
<b>Experiment 2 (n = 102)</b>	43	59	33 %	67 %

Figure 1 shows the dataset (map mash-up) used in Experiment 1. The red circles highlight the elements that differ between the two maps. In this experiment, respondents were required to suggest the safest route for ambulance access from the map mash-up that they chose as having more believable information.



Figure 1: The map mash-up used for Experiment 1.

### 3. Results

#### 3.1 Analysis of Experiment 1

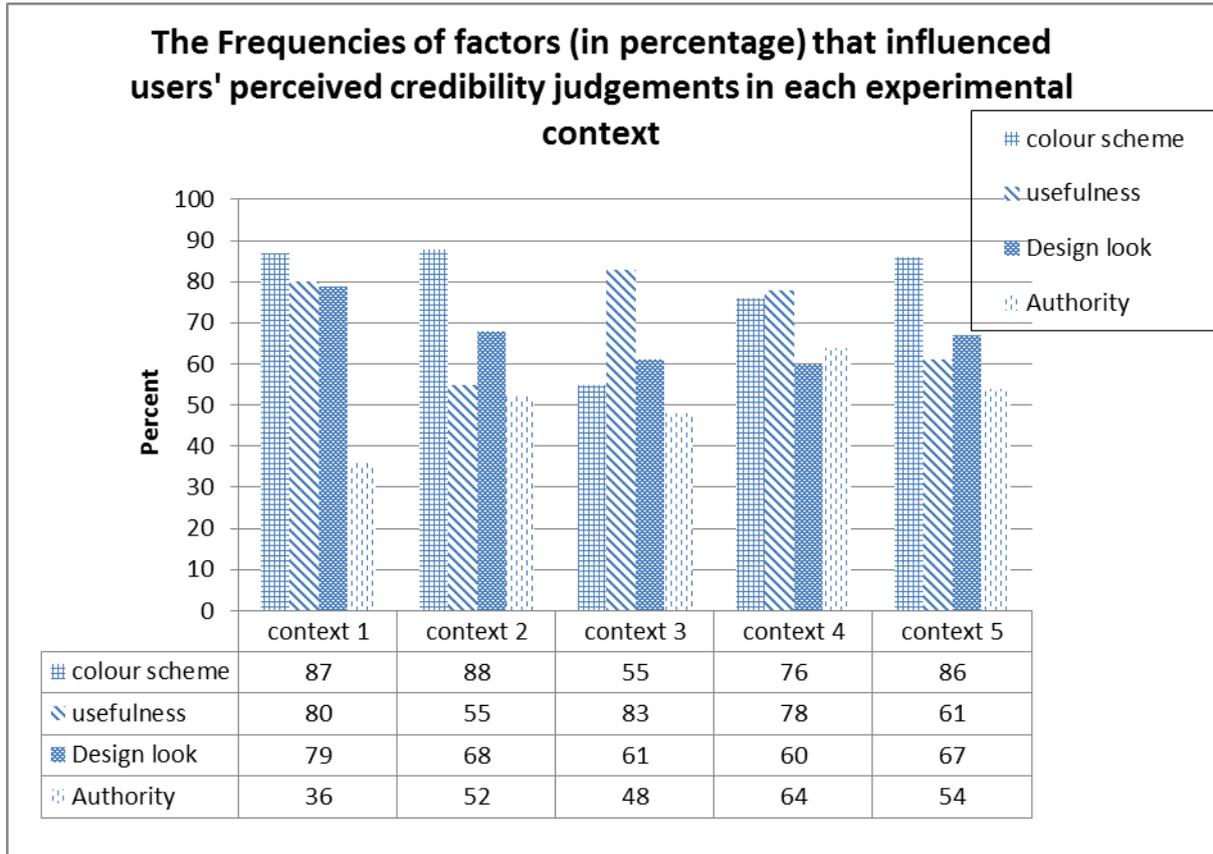
Respondents' decisions were most influenced by symbol type (94%) and colour coding (92%); followed by visual attractiveness (75%) and label of map producer (author) (38%). There is no evidence to suggest that geoliterate and non-geoliterate user responses are statistically different on the question of map producer. From the Mann-Whitney statistical test (Field, 2009:550), the importance levels of map producer element rated by the geoliterate users (median = 1.0, 95% confidence interval (CI)= 1.0 (not important) to 2.0 (slightly important)) did not differ significantly from the non-geoliterate users (median = 1.0, 95% CI= 1.0 to 1.0); Mann-Whitney test (U) = 1440.5, z-score (z) = -0.8, effect size (r) = -0.07.

### 3.2 Analysis of Experiment 2

Frequency analysis was applied to the results. Figure 2 indicates the results in percentage format according to the experimental context. Each context in this experiment was different in terms of colour scheme, symbol design, supplier of foreground data and site affiliation (these two factors are referred to as “authority element”) (See Table 3). In this experiment, respondents were required to choose a map mash-up to assist their navigation on a self-guided campus tour and had to select and rank those factors that influenced their decision.

**Table 3:** The series of maps used in Experiment 2

<b>Context 2</b>		
Site was affiliated with:	Ordnance Survey	University of Nottingham
<b>Context 3</b>		
Foreground data supplier:	City Council	Students' Union
<b>Context 5</b>		
Site was affiliated with:	Starbucks Coffee Shop	Google



**Figure 2:** The frequencies of factors that influenced users’ perceived credibility judgement according to the experimental contexts.

These findings show that visual cues (colour scheme and design look) were the most frequent elements that users measured as a basis in their credibility judgements in each experimental context. A higher percentage on the usefulness aspect indicates the occurrence of cognitive judgment on the assessment. Table 4 indicates the findings according to the constraint on the context.

**Table 4:** The results according to the constraint on the experimental map

Map constraint	References	Results
The two comparable maps (mash-ups) were significantly different in terms of the use of colour scheme on the map	Context 2 and Context 5	Average of 80 % of samples decisions were influenced by the colours and 50 % influenced by the authority element
The comparable maps were in the same level of visual appearances (for example the aspect of colour scheme and design look were not an issue if the two maps were using combinations of dull colours on the features)	Context 3	Average of 50 % of the samples decisions were influenced by the authority element (map producer), whilst 50 % of them influenced by the color, but approx. of 70% of sample credibility judgements were based on their perceived of map usefulness

#### **4. Discussion**

The two surveys indicate that most respondents used visual cues to assess the credibility of map information. The selection and combination of colours, the design of map features and overall presentation influenced the initial perception of users on a map at the first time of contact. The colour scheme applied to the map appears to be the main factor in influencing user decisions. This may be because it also plays an important role in assisting users in reading a map. It provides a greater impact on users' understanding on the displayed information. This is also in line with the study done by Fogg et al. (2003:58) which posits that looking good is often interpreted as being good and therefore credible because visual cues are highly noticeable.

However, according to David and Jason (2008), this effect would operate in the first few seconds of observation and contribute to the users' first impression of the online information; nevertheless as users proceed into scrutinising the contents, they would rely on cognitive levels of judgement. However, from this present study, even though users scrutinised the contents, it was less likely that the authority elements were being measured (considered). Respondents tend to measure the usefulness of information during this phase. This was indicated in the finding that on average 40% (Experiment 1) and 50% (Experiment 2) of respondents measured the authority elements on the map; whilst on average 70% measured the credibility judgement based on the usefulness of the map information.

The findings of this study are contradicted by the study of Skarlatidou et al. (2010). From that study, user trust of a website is due to the sources (data provided by government) even if the aesthetic and usability element on the map are poor. But this is not the case if the users did not notice the sources (authority) of the map information. Indeed, according to 'Prominence-Interpretation Theory' (Fogg, 2003), web users would judge the credibility of online information based on the element(s) that they noticed (looked prominent) on a website.

The present study assessed the impact between the authority of foreground data supplier and mash-up producer, but did not assess the influence of data accuracy at a user's level of judgement. This is because the dataset used on the experimental contexts were identical in terms of the accuracy of positioning, relative and logical; but was slightly different in terms of data completeness. Nevertheless, in the previous study of Scholz-Crane (1998), the majority of users were found to assess the accuracy and scope of information as it could be accessed visually and easily, rather than assessing the authority and currency, which required more effort and it was time consuming to check such items on the sidebar or read the textual description. The experiments conducted in this study did not provide evidence to suggest that substantial differences existed between the responses of geoliterate and non-geoliterate users in assessing map information credibility.

The findings of this study may contribute to the area of research that is investigating how people evaluate credibility of online information, specifically of online map (mash-up) information. However, the findings might be restricted to represent an assessment of young adult map users due to the range of ages in the sample. The findings also might be different if all respondents were required to have a deep engagement with the task; in a situation that needs them to perform credibility assessments critically in order to successfully achieve a certain objective, such as in a location based treasure hunt game or in a real-world critical situation. Therefore the findings of this study are restricted to suggest the main factors that might impact on map users' perceived credibility in lightweight and low risk applications; for instance in assessing a map (mash-up) to locate a house for rent, a restaurant to dine in, or a place to visit.

In conclusion, it is possible to increase the users' perceived credibility of a map (mash-up) by using techniques which get them to focus on the visual appearance aspect. Some map users critically determine the credibility of online map (mash-up) information, but it may only occur in certain circumstances and will depend on a person's level of shallow or deep engagement with respect to the

task in-hand and their ability (knowledge) to process each element. Indeed, a disincentivised group of users are at risk of obtaining inaccurate and unidentified information as their judgement is dominated by the visual appearance rather than any structured quality assessment or reference to quality / fitness for purpose metadata.

## 5. Future Work

Future research will propose a framework to support the development of automated online credibility assessment of map mash-ups. The research will focus on the basic components of the system, conceptual design and issues of implementation. Understanding of this framework could suggest, for example, the development of online automated credibility assessment on map mash-up information; this may reduce the required assessment tasks that occur in the manual credibility assessment process. Hence users could evaluate the credibility of map (mash-up) by making a quick decision based-on, for example, a traditional “traffic light” icon which embeds an automated and behind the scenes analysis of critical elements.

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## **8. Biography**

*Nurul Hawani Idris is a research student examining the credibility issues of online map (mashup) information. She holds a bachelor and a master degree in Geoinformatics (Science).*