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Evaluation of Design Operators for multi-published map delivery

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Abstract

The landscape of map design has changed rapidly over the last few years. This has occurred mainly due to the release of major multi-scale map products, such as *Google Maps*, *Here*, *Bing* and *Mapbox*. These products, providing the possibility to generate seamless multi-scale maps have ushered in a new way of exploring the Earth and man's impact on it – through the provision of timely and accessible map products. When provisioned with such products, users can pan and zoom their way around our planet, search for places and features with Elastic search technology to quickly and easily discover new information about geography.

Considering how this new wave of spatial technology has enhanced the provisions available in our digital resources 'toolbox', we seek to determine whether the need for a hard copy map or atlas has died. Will one ever need to open a paper atlas again, to pass an enquiring finger across an unpronounceable mountain range, or thumb through an index searching for mysterious and wonderful places?

Publishers continue to invest in the publication of hard copy atlases, particularly those aimed at students. We see that the challenge presented to publishers is how to engage their readers across both print and digital media, offering fast and dynamic digital maps, whilst, simultaneously, teaching students the skill of reading maps, understanding how and why they use different projections and how they can locate geographical features using an alpha-numeric and latitude and longitude grid.

As part of a broader research project that is investigating a conceptual workflow for multi-publishing student atlases, a smaller research component is also being undertaken, which supports the major research effort. This research is attempting to discover some standard 'design operators' that can be applied to design features (fonts, symbols and line weights) on print maps to convert these across to a digital map design. One of the impediments in design consistency is the variability of device screen resolutions - from display monitors to handheld devices. We are seeking to ascertain whether a 'design operator' that takes into account these variable screen resolutions might be applied.

This paper outlines the preliminary research done to date and the methodology underpinning a user survey that was conducted to investigate design operators for multi-format (and multi-media) published maps.

Keywords: design: multi-publishing: multi-scale mapping: cartographic design: design operator

Introduction

The major objective of this research is to develop a conceptual workflow for multi-published student atlas production. As part of this broad research topic major questions have emerged, such as: *What is the most effective point size for text on digital maps? What scale factor should symbols and line styles be multiplied by when moving from print to digital?* and *What factor does screen resolution of devices have when creating digital atlases?*

It is thought that the outcomes from this research will provide significant information in the Australian context, as there has been little research done in student atlas production (in Australia). Recent research conducted was mainly done by Dr Rod Gerber (1993) and later by Dr Cristiane da Silva Ramos (2012) during her PhD research.

Internationally, research has been undertaken to develop design operators for tile map designs (Roth,, *et al,* 2011), known as 'ScaleMaster'. The research outlined here builds on the ScaleMaster model by investigating design operators that are dependent upon the user's screen display resolution. With the plethora of devices available to consumers, and the rise of BYOD (Bring Your Own Device) in education and the workplace, it is important for cartographers to understand which 'multipliers' are relevant when creating maps that are designed be read using many media and on multiple devices. Understanding this element is critical for developing a conceptual workflow of atlas design and production.

It is envisaged that the results of this research will be used to inform the developers of future student atlas publications in Australia, and internationally. The ultimate beneficiaries from this research will be school students – the users of these products. No doubt the research will also contribute to the general knowledge relating to atlas and map production across various media in more broad terms.

As Australian atlas publishers are in a transition phase, moving from hardcopy student atlases to digital student atlases, or developing combinations of the two, developing innovative and timely production methodologies will be critical to support their production effectiveness and, thus, future profitability.

It is important to note that this paper only provides preliminary results and observations from a user survey being conducted at the time of writing. Final results will be published in a later paper.

Research Goal

The specific topic of enquiry for this research is to investigate how close, or similar, a digital map design can be to a print map design, accounting for the variability in users' display types – be they PCs or laptops, tablets, smart phones or other devices. By applying variable 'design operators' to map fonts, symbols and line weights and viewing these on different devices, some conclusions might be determined about which 'operator' works best, and for which feature at a particular screen resolution.

Research Method

The survey to determine the suitability of the conceptual 'design operators' relies on qualitative feedback from two focus groups: one focus group that comprises members who are considered to be highly knowledgeable in the field of cartography and second focus group made up of geography teachers who are knowledgeable and cognisant of the requirements for 'good' cartographic design for maps and atlases used by secondary school students.

In consultation with the Statistical group in the School of Mathematical and Geospatial Sciences at RMIT University, a survey was designed to achieve measurable outcomes from qualitative questions.

Three design components were selected (font size, symbol size and line weight) and compared in a matrix of nine variables with the 'design operator' altered in one of three ways:- presented at 1x multiplication factor, a 2x multiplication factor or a 3x multiplication factor. The resulting matrix of design components and 'design operators' is shown in Table 1.

	FONT	SYMBOL	LINE
A	1	1	1
B	1	2	2
C	1	3	3
D	2	1	2
E	2	2	3
F	2	3	1
G	3	1	3
H	3	2	1
I	3	3	2

Table 1. Matrix of design operators.

The method of research used to test the goal stated previously was to survey a group of approximately 50 professionals in the cartographic and geographic teaching communities. The survey was made available on-line for participants to complete on their personal computing device.

After discussion with Statistics group, it was determined that a sample size of around 50 people would be adequate for compiling meaningful statistical results from the survey. (The research is still underway and, once adequate responses are received, the resultant data will be analysed with the assistance of the RMIT Statistics group).

Similar Research

The research design is similar, though not exactly the same, as that undertaken by Phillips, *et al.* (1990). This research surveyed two separate groups of map readers, one highly skilled (drawn from a cartographic conference) and another group of unskilled students. Phillips' survey looked at variance in cartographic symbol design (specifically cuttings and

embankments on topographic maps) and offered alternatives. Respondents were given a time limit to answer each question.

Survey Design

The survey asked participants to download and print on their everyday home or work printer a colour version of a sample atlas map, in this instance a map of Queensland that could be used in a printed student atlas. This map was specifically produced for this purpose and is typical of atlas products produced for Australian school atlases. This printed sample was used as a reference to determine how effectively the digital design matches the print design (Figure 1).

Participants were first asked to determine the screen resolution of the display with which they were viewing the survey (as noted previously, the survey was delivered via a Web site. http://dpi.lv/ which displayed the resolution of the user's monitor in pixels per inch (ppi). As a secondary step in the calculation of the resolution, participants were asked to measure using a ruler the size of a square in millimetres. This second step was used to confirm if they included the correct figure in the first question.

The second part of the survey required the respondents to view 9 images of the same digital map (of Queensland), each image containing a slight variation in either the font size, symbol size or line weight (Figure 2). Various images had a 'design operator' applied to each of these features and respondents were asked to assess, qualitatively, how well each image matched the printed version of the map. Respondents were asked to assess the quality based on a Likert-scale of 1 to 10, with one being least effective and 10 being most effective.

Respondents results would vary based on the screen resolution of the device they were viewing the survey on.

Data was recorded using direct electronic entry via the survey website, typeform.com. During data collection, data was stored on the Typeform Website servers. typeform.com allows for a simple analysis of results and records the types of devices used to complete the survey.This was the main reason why typeform.com was chosen to host the survey.

Survey Participants

The inclusion criteria for the participants was to elicit information from a sample group of attendees at two major map/atlas conferences to held in Melbourne, Australia during August 2014. These were the International Map Industry Association conference, attended by cartographers, publishers and map retailers from the Asia-Pacific region; and the Geography Teachers Association of Victoria conference. It was determined that participants from these two groups would provide a pool of educated professionals with sufficient skills to allow them to make judgements on atlas design needed to provide survey integrity.

Participants were all over the age of 18, with no particular gender bias, they participated voluntarily and were not compensated or induced for their participation in the survey.

Participants will be informed of the results of the survey, which will also form part of a Masters' degree's thesis and a paper and conference presentation. Participants were informed about this via the Information screen provided to them when their input was solicited.

Figure 1. Original student atlas map design for print survey participants were asked to review.

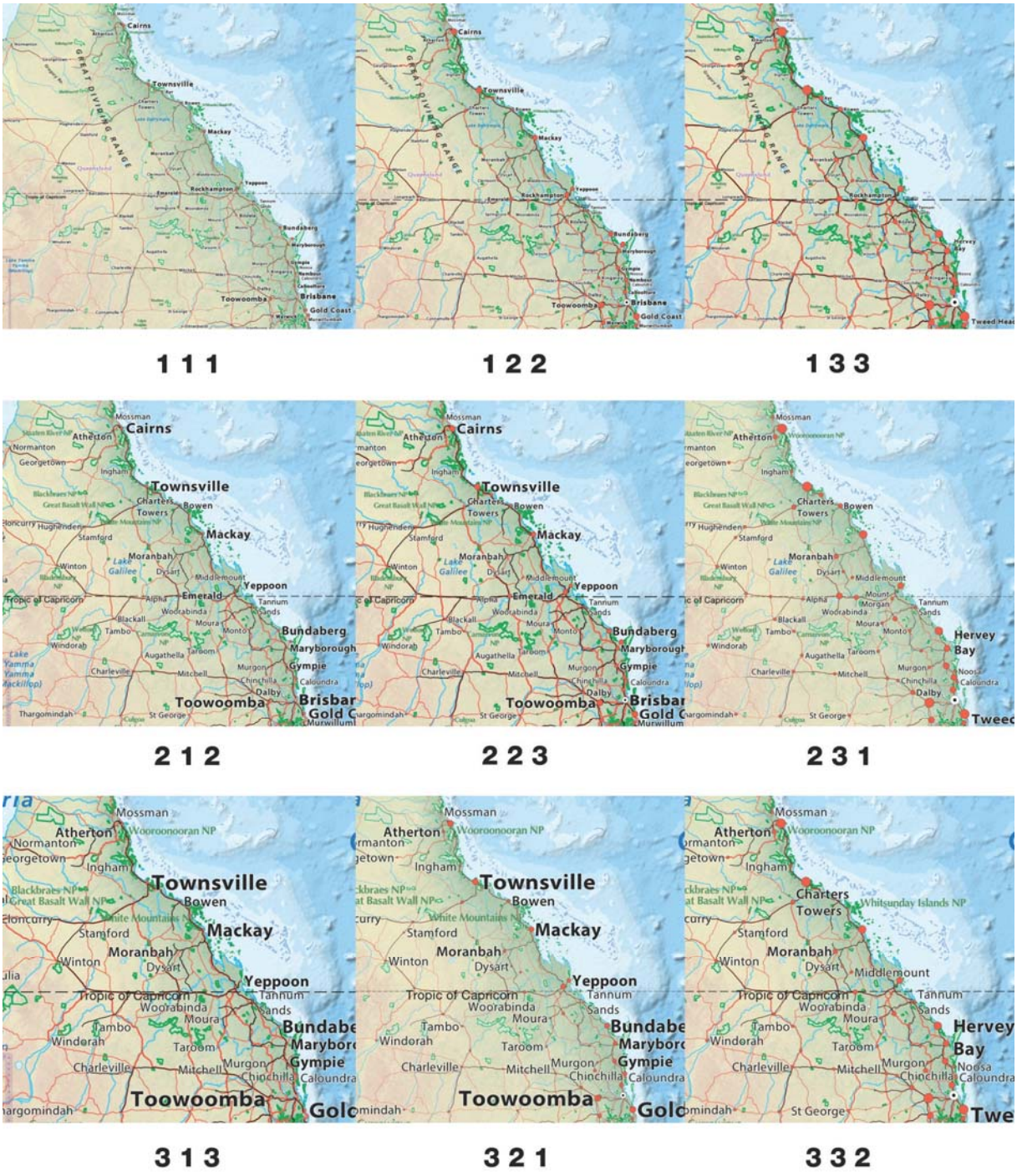

Figure 2. The 9 versions of the digital map of Queensland with the various 'design operators' applied.

At the time of writing the survey is still underway with the desired number of 50 participants still to be achieved. The Typefom survey tool provides some useful analytics about survey visitations and, even though the existing sample size is small, we can draw some conclusions about the survey design and how it might be improved.

Up to October 2014, there have been 60 unique visits in total – 32 from PCs and laptops, 3 from tablets, 2 from smartphones and 23 other (these have not been specified by Typeform).

Of the 32 visits from PCs and Laptops only 7 (22%) went on to complete the survey, and took an average time of 16 minutes and 33 seconds. This average time to complete the survey was a surprise. However the reason for this may be due to the fact that one participant took 42 minutes to complete, whilst another completed the survey over a period of one week, leading to a skewing of the average time figure. Most participants spent between 3 and 5 minutes to complete the survey, which was much less than the 10 minutes suggested in the survey's introduction.

Of the results thus far, 25% of respondents stopped their survey at the invitation screen and did not participate further.

A mixture of operating systems were used to view the survey - 33% *Windows 7*, 17% *Windows 8*, 25% *Mac OSX*, 17% *Apple iOS* and 8% *Android*.

Most participants (33%) referred to their occupation as 'cartographer', whilst others were variously 'GIS Consultant', GIS Analyst', 'Publisher' or 'Project Engineer'.

At the time of writing the hard data regarding the responses to the 'design operators' questions has not been analysed.

Conclusion

Without analysis, we can draw little from the results so far, however there are some lessons to be learned from the technology used for the survey and the method and structure of the survey. The typeform.com website was a very useful tool for tracking the technology used to complete the survey, which will assist in the analysis of the survey results.

Anonymous, user-driven surveys offer no incentive for the user to complete the survey, which could be seen as a weakness, as can be seen in the length of time some respondents took to complete the survey.

Given the fact that 25% of participants didn't progress past the introduction page could indicate the length of the page and the perceived effort required to read it may have been off-putting for some.

Very few responses were received from attendees at the GTAV conference. The assumption that professionals from this pool would be receptive to the questionnaire was flawed, whereas professionals from the IMIA conference were keener to participate, perhaps because the subject matter was more aligned with their professional thinking. The GTAV attendees may have found the topic too technical and outside their field of expertise.

Whilst we are still awaiting the outcome of the survey results, we believe that the survey should provide some insights into effective point sizes for text on digital maps, what scale factors can be applied to symbols and lines and what impact does screen resolution of devices have in map design.

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