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1. Introduction...*How do you feel?*

"How do you feel about a place?" is a question that is often asked. Mapping then analysing these often varied responses using traditional Geographical Information System (GIS) technology however, is difficult. Unlike map co-ordinates of a research area which are fixed, individual perspectives often do not conform to the response boundaries set by the software (Kulik, 2001).

Public Participatory GIS (PPGIS), has addressed this concern by allowing a more variety of responses which are unhindered by fixed co-ordinates or log-points (Huck et al, 2014). However, PPGIS software would still not be effective in areas with limited network connection or areas where individuals may not be proficient or comfortable with expressing their viewpoints via digital mediums (Elwood, 2006).

Our research focused on attempting to map the diverse perceptions of Leh, a city in the Indian Himalayas, and the surrounding Ladakh landscape. This was done using newly-created Paper2GIS software which changes the way geospatial data is collected by using 'paper' responses instead of digital inputs. This was extremely helpful in the research area of Leh which had limited wireless connectivity and where individuals may not be as familiar or comfortable with digitally inputting responses. It also addressed Elwood's (2006) aforementioned issue.

By applying temporal analysis to the spatial data mapped, even greater subtleties were extracted, revealing further 'hidden' layers of Leh.

2. Methodology...*qualitative & quantitative*

- 1. Specially created maps of Leh and the surrounding region with integrated QR codes were printed.
- 2. Interviews were conducted with individuals in Leh, with interviewees asked to draw responses on the maps. Interviews were semistructured to create "participatory discourse" (Cai et al, 2006, pp.291) between the qualitative and quantitative data. Interview questions included:
 - Where do you like to go in Leh?
 - Which areas have changed the most?
 - Which areas would you like to visit?
- 3. After data collection, the maps were photographed individually and converted via a bespoke algorithm embedded in the QR codes which extracted individual responses (illustrations) into QGIS software.
- 4. Extracted individual responses were collated onto one base map (raster layer) in QGIS, creating a visual representation of all collected responses. The map with all the collected responses is shown in Fig.1.
- 5. Patterns emerging from the collated responses, such as areas of darker or more intense shading, could then be analysed.

The 'Layers' of Leh – a temporal analysis of geo-spatial data





3. Of past... thoughts & transitions

"(Changspa) is losing agricultural land...everything has changed" [Respondent #13, travel agency operator]

The area of intense circling (Fig.2) appears to suggest a certain consensus amongst respondents. In fact, Changspa, the neighbourhood in question which was once an area of farmland redeveloped into a tourist hotspot of travel agencies and restaurants, is one which yielded the most 'conflicting' responses.

"Beautiful" [student respondent]

"Concrete houses are eating agricultural land" [Respondent #14, tour & hotel operator]

Changspa's redevelopment has met with both praise and criticism,. Criticism was particularly vocal amongst older individuals who have been more privy to change in Leh.

This area of shading therefore reveals hidden 'layers of Leh', ones that embody deeper issues of tourism and urban change; all unearthed through relatively simple interview questions.

Conflicting responses reflect the importance of temporality in understanding geospatial data. Crang (1996, pp.429) argues that a true understanding of a city can only be obtained by analysing it in the form of a palimpsest (Fig.3) – layers of diverse and urbanchanging embodiments.



Fig. 3 Leh's "Palimpsest" Photo Source: Authorzone



Sociological 'layers'

Urban (developmental) layers

Respondent: *"Where is Spitok...it's not here"* Interviewer: "Oh maybe it's on the other (surrounding *region) map*" [Respondent #2, restaurant owner]

The map of Leh used was based as closely as possible on the city boundaries, as the research team had not visited Leh or the region before. When asked about areas in Leh which they enjoyed going to, some respondents mentioned Spitok, the Hall of Fame Museum, and Magnetic Hill. However, these areas were further South-West than the boundaries of the map, and thus their responses mostly were recorded on the other 'surrounding regions' map. That being said, some respondents made approximate markings on the Leh map itself, such as the arrow (Fig.4).

"It's somewhere here..." [Respondent #7, restaurant owner]

This simple arrow is reflective of the 'vagueness' that geographical boundaries encounter due to different individual perceptions and areas (Varzi, 2001). When Spitok was mentioned, some respondents considered i a separate village, whereas others viewed it as part of Leh itself. It could be argued that the reason for these differing viewpoints is because ultimately, the boundaries of a city are not shaped by map lines or landmarks, but by diverse everyday experiences (Anderson, 1991).

Fig.1 Leh Basemap with collated responses



4. Of present...'unmapped' locations

Drawing on results from two previous sections, observations surrounding the future of Leh can be extrapolated.

Firstly, as Leh continues to develop and expand, its that Leh's already 'vague' boundaries likewise will change.

Secondly, due to this undergoing constant (re)-development, individuals' feelings about Leh will consequently also be affected

Consequently, the diverse and indeterminate nature of Leh's growth and development alludes strongly to the notion that physical or administrative boundaries are unable to provide a truly holistic understanding of a research area (Jones et al, 2008). Thus, Leh's layers are constantly in flux; undergoing constant change not simply in terms of physical urban borders, but through diverse everyday social-cultural experiences. The 'palimpsest' (Crang, 1996) of Leh is therefore continually expanding, continuously evolving.

6. Final Observations...*further research*

Krase (2012) notes that cities are in a constant state of both urban and socio-cultural flux. Concurrently, that there is a need to acknowledge the 'incomplete' nature of PPGIS nature due to constantly changing perceptions in response to socio-urban change (Coleman et al, 2009). To combat this, PPGIS research needs to be constantly re-visited and update to better understand the temporal effects of spatial data (ibid.)

Leh's 'layers' will continue to be shaped and changed with time. Hence, further research should be conducted to supplement the PPGIS data already created so as to better map and understand both the spatial and social evolution of Leh.



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5. Of future...*charting past & present*

"This entire section (surrounding area around Leh)...they (sic.) will become Leh City" [respondent #197, tour operator]

Fig.4. Blowup of Southwest Leh with arrow

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