

## New Entanglements between Instrumental, Shared and Mental Maps in the Exploration of Urban Space: an Experimental Project

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### Abstract

The new access to cartographic tools (beyond specialist uses) produces new collective shared configurations and new, further mental individual and collective representations. With several years' experiments of interactions between participants in remote cities, the aim of the research presented here is a better understanding of entanglements between instrumental, shared and mental maps. More specifically the question is to know how new instrumental uses renew shared mental representations of urban spaces. How are mental maps constructed in situations of interaction with connected and dynamic uses? Consecutively, how are they developing when shared? The aim is to understand new forms of entanglements between egocentric, allocentric and distributed spaces in the mobile perception of urban space.

**Keywords:** Mental Maps, Urban Space, Experimental project

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### 1. Definitions

Mental mapping means the internal representation specific to each individual – or group of individuals – that is constructed during or after moving around in a physical or virtual space (these are not concept maps). The notion of mental map was introduced by Tolman in 1948 and then studied and debated by a number of authors until today. It will be a matter of grasping it in its collective dimension and, more precisely, as a transfer from the individual to the collective. The term “instrumental mapping” refers to the external tools devised by Man to be located while moving about. In recent years, instrumental mapping has considerably developed regarding the general public, through the use of connected smartphones and access to GPS location in a mobility situation. Through what could be grouped under the term “mobile technologies” has occurred a twofold movement,

both individual and collective, in the uses of instrumental mapping for a wider audience.

These new possibilities, the increasing use and development of these techniques, have considerably renewed the experiences of shared maps. These can be understood as simultaneously sharing an instrumental use and – consecutively – a collective mental representation. This collective sharing is all the more significant as its objective goes beyond the purely instrumental (finding the address of a person to meet her) to fill recreational purposes as well (to perform a number of movements within an invented territory).

### 2. Objectives

This Through these early definitions, the tightening and entanglement between these three types of maps can readily be understood.. Accessing cartographic

instruments (which goes far beyond specialist use) produces new forms of collective sharing and, at the same time, new mental representations, both individual and collective. Based on several years of experience of putting participants in interaction situations in distant spaces, the aim of this research project is a better understanding of this tightening and these entries, by capitalizing on an experimentation of recreational uses and on the artistic achievements already made:

<http://www.fictions-et-interactions.org/Workshops.html>  
<http://www.institut-acte.cnrs.fr/fictions-interactions/2016/12/09/workshops-2013-2017/>

More precisely, the issue is how new instrumental uses renew our shared mental representations. How do mental images develop in an interaction situation while using connected and evolving maps? Consecutively, how do they develop when shared? There will be new forms of entanglements between egocentric, allocentred and distributed spaces.

### 3. Scientific Achievements in the Field

#### 3.1. History

The notion of mental map was introduced by Tolman in 1948. Tolman hypothesized that while moving in space, organisms construct an internal mapping. Tolman suggests a cognitive map is a spatial representation of the environment constructed by an individual, enabling them to move and act in this context. It is based on different types of information from their environment and also on those relating to their internal perception (proprioception) of their own movements. Since then, the notion has been updated and we now consider that hippocampal structures play a major role in cognition and spatial memory (see Chen *et al.*, 2013, Hartley *et al* 2007, Iara *et al.*, 2007, Maguire And Spencer *et al.*, 1999, Maguire *et al.* 2000, O'Keefe 1999, Rivard *et al* 2004, Spiers *et al.*, 2001), although the notion of spatial map remains controversial (see Bennett 1996, Kumaran and Maguire 2005, 1993). Beyond this controversy, there is no doubt individuals can retrospectively construct a more or less precise map of a space they have moved in.

#### 3.2. The Matter of Mental Maps: from the Individual to the Collective

A series of experiments have highlighted the ability of organisms to use three sources of information during their moving processes: dimension, orientation and movement; using three mechanisms: integration of the trajectory (based on the proprioceptive data related to body movements, see Etienne and Jeffery 2004); orientation to landmarks (highlights in the environment); and geometric calculations based on spatial dimensionality (Taylor and Tversky 1992, Tom & Tversky 2012, Tversky 2003,

2004). Though these can function separately (see Etienne and Jeffery 2004, Cheng & Newcombe 2005), they can also work together to construct, on an *a posteriori* basis, maps that integrate three different cognitive scales: body space (incarnated and situated cognition, egocentric perception); the space around the body (situated cognition, egocentric and allocentric perceptions); and the space where they move about (allocentric perception and sometimes extended cognition) (see Tversky 2001, Berthoz 2005). With respect to the above distinctions, especially between incarnated and situated cognitions, integration of the trajectory may be considered as part of the body space and incarnated cognition, while the use of points of reference refers to the space around the body and the situated cognition. Finally, the use of geometric orientation can be considered as mobilizing the space around the body in located cognition or in the navigation space. An interesting point regarding the devices studied and considered in this project is the impact and availability of these different sources and scales to use and construct maps, because they belong to the regime of shared cognition (similar maps) or distributed cognition (different maps resulting from partial or contradictory data). Spatial cognition involves both incarnated and situated cognition, but can also go beyond that (maps can be based on a series of successive perceptual environments and encompass more than what the subject can perceive at a given time.

#### 3.3. Contexts for Instrumental Mapping: from the Individual to the Collective

Instrumental maps will be considered here, through various applications allowed by digital interfaces in mobility situation, using geo-location (or not). The most important ones are: 1) The standard applications for major operators such as Google Map, Orange, WhatsApp, Skype; 2) More specialized applications, but still targeting the general public for dedicated applications such as MotionX GPS Tracker, Foursquare; 3) Experimental applications, such as those developed by ORBE, which are the basis for the experiments undertaken for several years by the Fictions & Interactions team: <http://www.fictions-et-interactions.org/Workshops.html> (aided and supported by ORBE: <http://orbe.mobi/>). The latter allows several types of interactions: 1) collective and / or individual, 2) audio and / or visual, 3) programmed in advance (with a scenario, available on a server, to be delivered to participants) 4) in direct and / or deferred interaction. Beyond these various examples of cartographic applications, this project will primarily focus on applications allowing geo-located and interactive exchanges while looking for the most relevant tools.

#### 3.4. The Issue of Shared Mapping

While the issue of mental and instrumental mapping is receiving sustained attention and abundant literature,

shared mapping clearly does not get as much. D. Hervé, J-H Ramarosan, A. Randrianarison and F. Le Ber (2014), develop this question in some depth, but in a study context that excludes connected and interactive digital maps. Can participatory mapping be carried out according to the “classical” rules of instrumental mapping (Palsky 2010)? Do they come from expert uses (SIG), from the use of actors on the ground, or from the collaboration between these two? However, this opposition between types of instrumentation is not fixed because: “For example, Jackson *et al.* (1994) detail the collective drawing of maps on the ground and explain how drawing maps opens the way for collective [...] management. Capturing the drawing on the ground or on paper – by photographing it – allows incorporating an electronic version in a SIG. The screen support has given rise to proposals for participatory SIG (Cinderby, 1999) or SIG designed by actors (D’Aquino *et al.*, 2002b)”.

## 4. Scientific Locks and Medium-term Research Axes

### 4.1 The Matter of Mental Maps and Collective Mental Maps

In the brief overview of the issue of mental maps, we recalled the controversial history of mental maps, and concluded undoubtedly, however, that individuals can retrospectively construct a more or less precise map of a the space they have been moving in. This does not exclude, however, a number of important problems, recalled in particular by Colette Cauvin (1999) in her article “Towards an approach to intra-urban spatial cognition”. 1) The difficulty of dissociating “the acquisition process of cognitive mapping, which leads to each individual having an image of the space concerned, which we call the ‘cognitive representation’ from the concrete product of this representation, i.e. its ‘outsourcing’, which we call ‘cognitive map’ here. 2) It reminds us, with R. Kitchin (1994), of four stances related to the cognitive representations of space: a) they are explicit, ie they are maps, b) they are analogue, ie they are like maps, c) they are metaphors, i.e. they function as if they were cards, d) they are hypothetical constructions and are in fact a fiction practice”. To these basic questions is added the difficulty of synthesizing a set of renditions of individual cards as a “single” collective map.

### 4.2. The Issue of Participatory Maps

Among the 3 types of mapping mentioned, instrumental mapping has, with SIG, undergone considerable developments in recent years. For their part, mental maps have received increasing attention since Tolman (1948). Participatory mapping is still studied very little. The latter can be considered profitable at the

intersection of mental and instrumental maps. They have for several years been the subject of empirical experimentation by the Fictions & Interactions team at the origin of this project. It is therefore a matter of benefiting from these experiences to both better analyze them and try to understand their roles at the intersection of mental and instrumental maps.

## 5. The methodology to be implemented

The implemented methodology will be developed in two stages. 1) In the short and medium term and on the scale of this call, the aim is to attempt to grasp and study collective mental maps as to the dimension of a single urban territory. 2) In the longer term, and taking advantage of the results of this first stage, it will be necessary to study these mental maps at the level of several territories with remote participants (as they have been experimented empirically until now). In all cases, it will be a matter of confronting 3 groups of subjects:

1) a collective mental map without instrumentation (control group) subjects, in urban exploration without cartographic equipment and without interactions between participants, 2) a collective mental map with instrumentation: group of subjects in urban exploration with cartographic equipment but without interacting with others 3) a collective mental map with instrumentation and participation: a group of subjects in urban exploration with a cartographic equipment allowing individual orientation and interactions with other participants.

The methodology to be established will aim to determine:

- Before the experiment 1) 3 groups of a 25 subjects of the same type (ages, training...), 2) a well defined urban area, easy to access and without excessively marked morphological characteristics, 3) Onboard cartographic instruments for groups 2 and 3, 4, with a choice of instructions to be proposed before and during the experiment, 4) instruments for recording individual and collective routes (video, GPS tracker, etc.)

- During the experiment: the role of the accompanying persons, the types of registration and the instructions concerning the boundaries of the territory.

- After the experiment:

- Tools for restoring mental maps: paper, graphic tablets, stop motion video, written narrations, oral narration (free interviews or conduits)

- Instructions to be produced for restitution mental maps

- The modes of analyzing the resulting data: spatial and / or temporal data in drawing up the pictures

Markers for mental maps in Lynch’s sense of the term, (for example lanes, boundaries, quarters,, reference nodes).

## 6. The different disciplines involved and their respective contributions to the project

The different disciplines involved and their respective contributions to the project are of 6 sources:

- *Spatial cognition*: analysis and synthesis of cognitions located and extended to the scale of collective and individual mental maps
- *Social cognition*: analysis of cognitions distributed and shared on the scale of collective mental maps:
- *Media located*: management and adaptation of map sharing applications:
- *Computer Science*: 1) - implementation, adaptation and maintenance of web and mobile devices:
- *Design (data design / data design, graphic design)*: (a) graphic and interactive enrichment of heuristic schematization (synthesis and design of collective mental map sketches); (B) creation of formalisms and cartographic models of data:
- *Geography, Geomatics*: choice of fixed or embedded mapping instruments, individual and collective, questions of restitution, analysis and synthesis.

## 7. Conclusion & Hypothesis

Though it can be doubted, it cannot be ruled out that it is impossible to reveal, in a sufficiently significant way, the differences between collective mental maps established without instrumentation, and those established with instrumentation and interactions. This great difficulty may be underpinned by insufficient analysis of the relevant characteristics (points of interest, paths, nodes, territory boundaries, or restitution of dimensions, orientations and movements). The issue of the effective synthesis of a set of individual maps may be one of the risks involved in this project. Finally, the aim of dynamically exploring mental maps may be challenged with the difficulty of synthesizing stop motion recordings or with analysing the verbal or written narratives allowing this dynamics to be restored. More concretely, the choice of the territories to be explored, subject groups and instruments may prove significantly difficulties.

Three kinds of hypothesis can be made: 1) about types of instrumental & shared maps, 2) about facilitation or contradiction between instrumental and mental maps, 3) about types of results and fall back.

1) As we mentioned, there are different kinds of instrumental and shared maps. They can be visual, audio or both visual and audio interactions. In these different kinds of instrumental and shared maps can correspond different consequences and kind of mental maps.

2) Audio-instrumental maps can facilitate visual and mental representation, and at the opposite visual instrumental maps can be confused with mental maps. Furthermore, absorption with instrumental and shared interactions can replace or contradict mental maps.

3) Types of results. The choice of territories to be explored, the subject groups and the instruments can constitute considerable difficulties. We propose four possible “fall back” that will be synthesized in the following way:

- a) Global objectives: Mental map from instrumental map compare to // mental map from shared map compare to // mental map without instrumentation
- b) Fall back 1: Mental map from instrumental map compare to / mental map from shared map
- c) Fall back 2: Mental map from instrumental map compare to / mental map without instrumentation
- d) Fall back 3: Mental map from shared map compare to / mental map without instrumentation.

## References

- [1] D’Aquino P., Seck M.S., Camara S., 2002b, Un SIG conçu par les acteurs : l’opération pilote POAS au Sénégal, *L’Espace géographique*, 2002-1, tome 31, 23-36.
- [2] Cauvin, Colette, « Pour une approche de la cognition spatiale intra-urbaine », *Cybergeo : European Journal of Geography Article 72*, 1999
- [3] Cheng, K., Newcombe, N., Is there a geometric module for spatial orientation? Squaring theory and evidence, *Psychonomic Bulletin & Review*, 2005, 12 (1), 1-23
- [4] Etienne, A. S., & Jeffery, K. J., Path integration in mammals. *Hippocampus*, 14(2), pp 180-192, 2004
- [5] Guelton, B., Editor, *Figures de l’immersion*, pur, septembre 2014
- [6] Guelton, B., Modes immersifs, entre fusion et tension, Guelton, B. Editor, *Figures de l’immersion*, pur, sept. 2014
- [7] Guelton, B., Editor, *Dispositifs artistiques et interactions situées*, 2016.
- [8] Guelton, B., Editor, *Dispositifs artistiques et interactions situées*, presses universitaires de rennes, 2016
- [9] Guelton, B., Spaces and Flows, Spatiotemporal Continuities and Discontinuities in the Construction and Experience of an Alternate Reality Game” in *Spaces & Flows*, Revue, Common Ground Publishing, Chicago, 2016.
- [10] Guelton, B., Editor, *Digital Interfaces in Situation of Mobility: Cognitive, Artistic and Game Devices*, Common Ground Networks, Chicago, 2017.
- [11] Hervé, D., Ramarison, J-H, Randrianarison, A., et Le Ber, F., Comment les paysans du corridor forestier de Fianarantsoa (Madagascar) dessinent-ils leur territoire ? Des cartes individuelles pour confronter les points de vue.” 2014 <https://icube-publis.unistra.fr/3-HRRL14>
- [12] Kitchin, Robert, M., Cognitive Maps: What are they and Why Study Them ? *Journal of Environmental Psychology (1994) 14, 1-19*, 1994
- [13] Lynch, K., *L’image de la cité*, Dunod, 1976
- [14] Palsky, G., Cartes Participatives, Cartes Collaboratives, La cartographie comme maïeutique, CFC (N°205 - Septembre 2010) <http://www.lecfc.fr/new/articles/205-article-5.pdf>
- [15] Taylor, H. A., & Tversky, B., Perspective in spatial descriptions. *Journal of memory and language*, 35(3), pp 371-391, 1996
- [16] Tolman, E. C., Cognitive maps in rats and men. *Psychological review*, 55(4), pp 189, 1948
- [17] Tversky, B., Cognitive maps, cognitive collages, and spatial mental models. In *Spatial Information Theory A Theoretical Basis for GIS* (pp. 14-24). Springer Berlin Heidelberg, 1993
- [18] Tversky, B., Some ways that maps and diagrams communicate. In *Spatial Cognition II* (pp. 72-79). Springer Berlin Heidelberg, 2000

- [19] Tversky, B., Spatial schemas in depictions. In *Spatial schemas and abstract thought* (pp. 79-111). 2001
- [20] Tversky, B., Structures of mental spaces. In *Proceedings 3rd International Space Syntax Symposium Atlanta* (pp. 12-1). 2001
- [21] Tversky, B., Multiple mental spaces. *Proceedings of Wittgenstein Society*. 2001
- [22] Tversky, B., Structures Of Mental Spaces How People Think About Space. *Environment and behavior*, 35(1), pp 66-80, 2003
- [23] Tversky, B., Narratives of space, time, and life. *Mind & Language*, 19(4), pp 380-392, 2004
- [24] Tversky, B., & Hard, B. M., Embodied and disembodied cognition: Spatial perspective-taking. *Cognition*, 110(1), pp 124-129, 2009
- [25] Taylor, H. A., & Tversky, B., Spatial mental models derived from survey and route descriptions. *Journal of Memory and language*, 31(2), pp 261-292, 1992