Module « Techniques d'Interaction et Multimodalité »

Monter une expérimentation sur votre projet TIM **et en rendre compte**

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http://atelierihm.unice.fr/enseignements/techniques-interaction/

2015-2016

Expérimentations TIM

- Menée le 12/11
- Par groupe (2 ou 3)
- Comparer pour une tâche
  - Comparaisons de modalités (= interactions) pour réaliser cette même tâche
    - Soit sur le même dispositif (e.g., téléphone, tablette, pc…),
    - Soit par adaptation de la modalité sur différents dispositifs
    - Soit par variation des données manipulées
  - Nb(modalités)+Nb(conditions) = Nb(membres du groupe)+2.
- Cela vous demande de préparer ces expérimentations en dehors des cours
- Un rapport sur ces tests (objectif, développement, déroulement, résultats) sera à rendre au plus tard le 19/11 (par courriel)
  - Taille indicative, hors mise en page, entre 5 et 8 pages
- Tâche et interactions
  - À vous de les proposer
  - Au plus tard lors de la 3ième séance (le 08/10)

Source : cours de Philippe Renevier

Projets Étudiants TIM 2015-2016 (A)

Projets	Modalités	Étudiants
Déplacer un personnage dans un labyrinthe **Affichage global de la carte**	Accéléromètre, onTouch, swipe Secousse, zoom de la voix ou simple bouton	Clément AUDRY, Edouard GERMAIN, Rémi POURTIER
Lancer de dés	Secouer, pencher, geste avec touch voire vuforia	Nabil ELMOUSSAID, Anaïs MARONGIU
Trouver une information dans un texte long	Scroll sur le texte entier, Changer de page, Scroll sur une partie de texte (cf. fil d'actualité Facebook)	Asma DHANE, Yoann BOUTIN
Déplacer un personnage dans un labyrinthe	Bouton, touch (drag), touch (point par point), accéléromètre	Guillaume BORG, Hong JIN, Yuqi WANG
Retrouver un mot-clef (le sélectionner) dans un graphe de « notions »	inclinaison pour se déplacer dans le graphe ou le touch ou un fisheye *(avec un graphe radial ou un graphe hiérarchique)*	Audric CHABERT, Jean-Philippe KHA
Retrouver un contact dans une liste (et le mettre en favori)	liste view / swipe	Raed CHAMMAM
Jeu type « Où est Charlie ? »	fisheye avec le doigt / fisheye en fonction de l'orientation (accéléromètre) /	Romain GUILLOT, Fernando GARRIGOS, Guillaume RAHBARI

Projets Étudiants TIM 2015-2016 (B)

Projets	Modalités	Étudiants
Mini jeu de sphères	touch (drag avec suivi des doigts), touch (va vers le doigt), inclinaison (accéléromètre)	Mathias COUSTE, Nicolas FORGET
Retrouver une commentaire dans une hiérarchie de commentaires	Afficher « dans l'ordre » (avec scrollbar) / Avec accordéon (cliquer pour déplier un rang) / ne montrer que quelques commentaires puis lien « voir plus » / navigation à la « prezi » » d'un commentaire à un sous-commentaire *(avec petit et grand graphe)*	Jean-Yves DELMOTTE, Fabien PINEL
Faire des calculs simples (additions) en binaire	reconnaissance vocale, touch (4 boutons : 1 0 + =), les chiffres sont des « boutons » à état *(avec 4, 8, 16 chiffres binaires)*	Marina DELERCE, Dan HE, Maxime DITO
Trier des aliments (l'un après l'autre)	drag, clic sur boite (« catégorie »), reconnaissance vocale *(avec 5 ou 30 ingrédients)*	Garance VALLAT, Sonia TUAL
Atteindre un « lieu » dans un jeu	Accéléromètre (pencher à gauche pour aller à gauche), un joystick virtuel, touch pour désigner où aller *(avec un véhicule et un personnage à pied)*	Hugo SIMOND, Franck DECHAVANNE

Projets Étudiants TIM 2015-2016 (C)

Projets	Modalités	Étudiants
Parcourir une liste d'images (compter une sorte d'images)	Scroll normal, inclinaison pour avancer ou reculer de X images (X = nb images à l'écran) , inclinaison pour avancer ou reculer de (X -1) images *(avec 4 ou 8 images sur l'écran)*	Ameni MERAI, Amal ZAYANI, Nizar BOUSSARSAR
Bubble, vider les bulles	Reconnaissance vocale (left / right / fire, par pas de 10°) / reconnaissance vocale pour couleur pour direction / touch	Falou SECK, Ying JIANG
Amener une bille dans un trou	Accéléromètre, Glisser le doigt sur l'écran en partant de la bille pour la propulser, Appuyer sur l'écran pour signaler la direction que la bille prendra, des boutons directionnelles	Salah BENNOUR, Amir BEN SLIMANE
Recherche dans une série de listes d'images de déchets pour trouver un déchet similaire	4 listes déroulantes + swipe pour passer d'une liste / + une autre technique d'interaction	Thibault PIKETTY
Recherche d'une photo dans une galerie	Fish-eye : avec accéléromètre (déplacement), avec one-touch (déplacement), avec multi-touch (zoom/dezoom)	Alexandre TISSIERE, Jean-Christophe ISOARD, Kevin JUSTAL

Expérimentations TIM

- Préparer votre expérimentation
- La réaliser (tests)
- En rendre compte (rapport)
  - Objectif
  - Développement
  - Déroulement
  - Résultats

Objectif du cours (1)

Acquérir – *via un* ***exemple*** – des **éléments de méthode** pour

- monter une **expérimentation** sur votre projet TIM
- et en rendre compte

Commencer à appliquer cette méthode sur votre projet TIM

Objectif du cours (2)

La méthode

- **Méthode expérimentale**
- *Référence :*
  - C. Appert. **Cours « Experimental Design »**
  - **Expérimentation (en laboratoire) :** méthode utilisée pour l'**évaluation** (de l'utilisabilité) **des systèmes interactifs**
  - En complément des méthodes :
    - Penser à voix haute (*Think aloud protocol*)
    - Etude de terrain

L'exemple d'expérience

- **Overview+Detail Visualization on Mobile Devices**
- *Référence :*
  - Stefano Burigat Luca Chittaro**. On the Effectiveness of Overview+Detail Visualization on Mobile Devices**. *Personal and Ubiquitous Computing* (2013) 17:371–385

Plan du cours ⇔ structure d'un rapport d'expérimentation (1)

- Le plan du cours reprend la **structure de l'article** où est rapporté l'expérience citée
- Cette structure servira à **introduire les éléments de la méthode expérimentale** (notions, procédures…) que vous appliquerez pour votre expérimentation
- Vous pourrez **utiliser cette structure pour rendre compte de votre expérimentation**

Plan du cours ⇔ structure d'un rapport d'expérimentation (2)

- **Introduction** (le problème abordé et son contexte)
- **Hypothèses**
- **Interfaces** (techniques d'interaction)
- **Méthode**
  - Participants à l'expérience
  - Matériel
  - Tâches
  - Plan d'expérience
  - Procédure expérimentale
- **Résultats**
- **Discussion**
- **Conclusion**

Plan du cours ⇔ structure d'un rapport d'expérimentation (3)

Projet cité (O+D Visualization)	Votre projet
• **Introduction** (le problème abordé et son contexte) • **Hypothèses** • **Interfaces** (techniques d'interaction) • **Méthode** – Participants à l'expérience – Matériel – Tâches – Plan d'expérience – Procédure expérimentale • **Résultats** • **Discussion** • **Conclusion**	• Quelles techniques vont être testées ? • Quelles hypothèses ? – Quelles V.I. et quelles V.D. ? • Quels participants ? • Quelle tâche ? • Quelle procédure ? • …

Pauses aménagées pour commencer à répondre à ces questions

INTRODUCTION (PROBLEM AND CONTEXT)

Problem and Context

- **Visualizing information effectively on mobile devices**
- Limitations of mobile devices (compared to desktop computers)
  - smaller displays
  - less powerful hardware
  - different input mechanisms

Source: Bashar Altakrouri

Problem and Context (1)

- **The presentation problem:** laying out the information on the available screen space
- When the information to accommodate is larger than the available viewing area,
  - users need access to fine-grained details
  - as well as coarse-grained context information to effectively explore the visualization
- **How to provide details as well as context information when screen space is at premium**

Problem and Context (2)

- **Typical approach to the presentation problem:**
  - to provide users with **pan and zoom** mechanisms, thus introducing a <u>temporal separation</u> between detail and context information
- **However:**
  - <u>temporal separation</u> makes it difficult for users to focus on the details of a visualization while keeping track of the global context

Problem and Context (3)

- Researchers have investigated **four classes of solutions** to solve or at least mitigate the presentation problem on mobile devices:
  - Overview+Detail [O+D]
  - Focus+Context [F+C]
  - Contextual Cues
  - Custom Pan and Zoom mechanisms

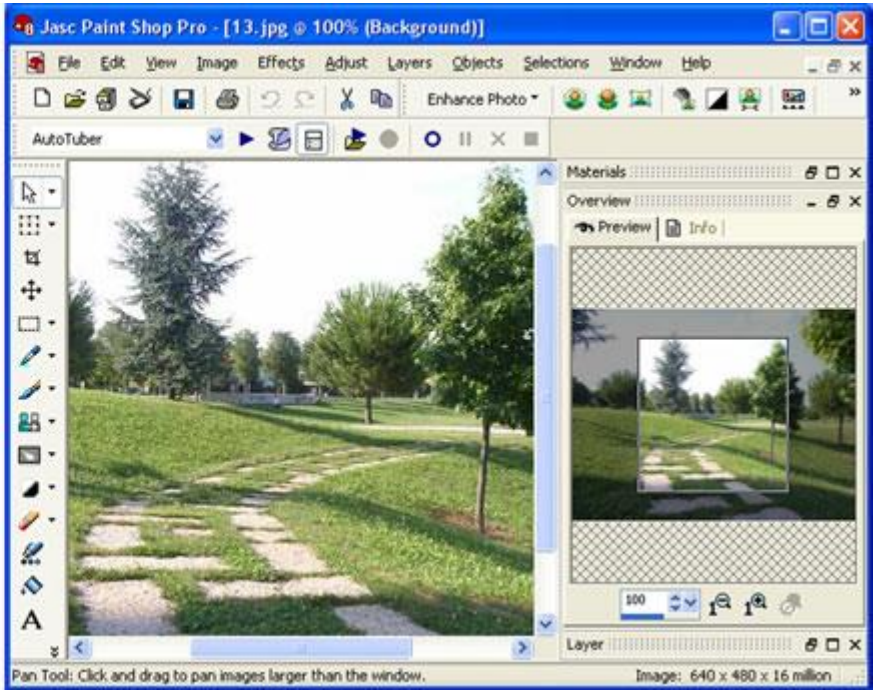
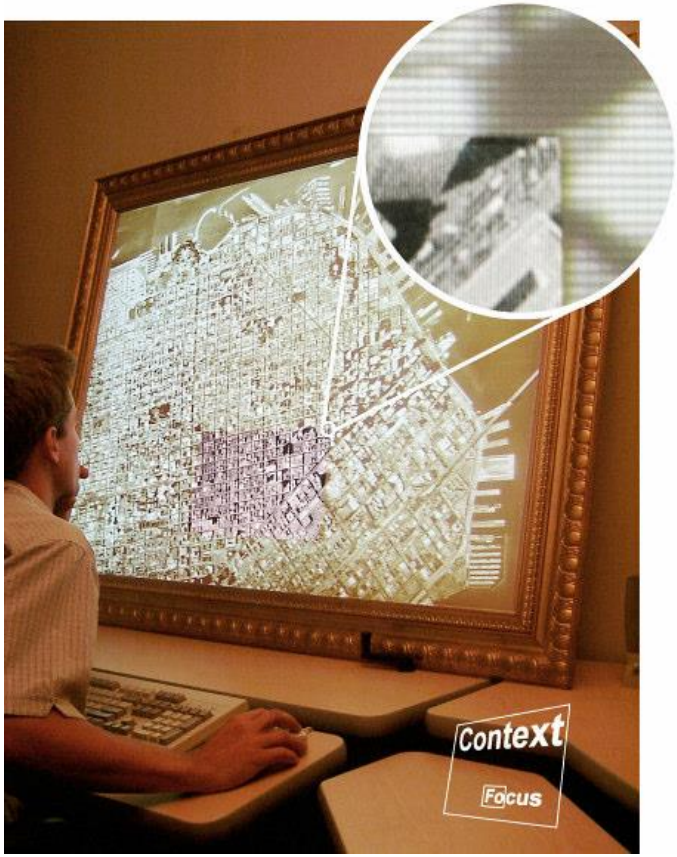


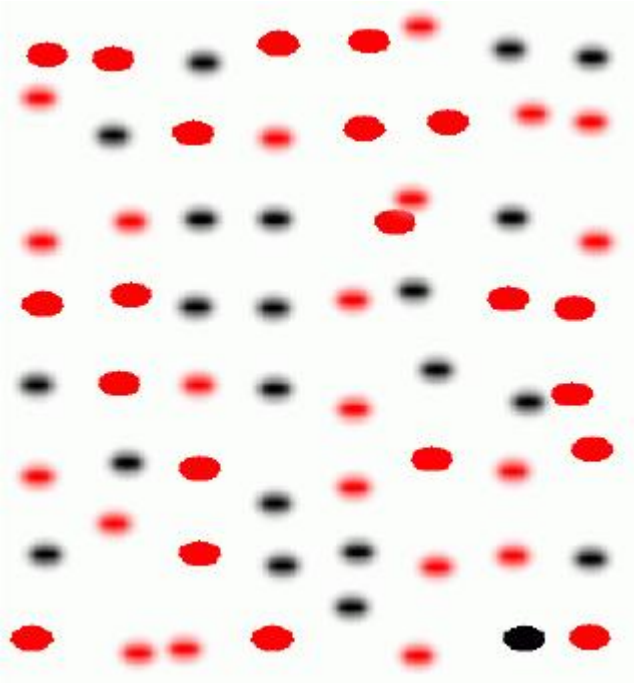
Fig. 1 Two examples of Overview+Detail visualization in desktop applications.

- In the map example (Google Maps), **<u>the overview overlaps the detail view</u>** at the bottom right corner of the screen.
- In the photo-editing example (Paint Shop Pro), **<u>the overview is displayed at the right of the detail view</u>**.

The Mac Os X Dock icon-panel



(Baudisch et al. 2002)



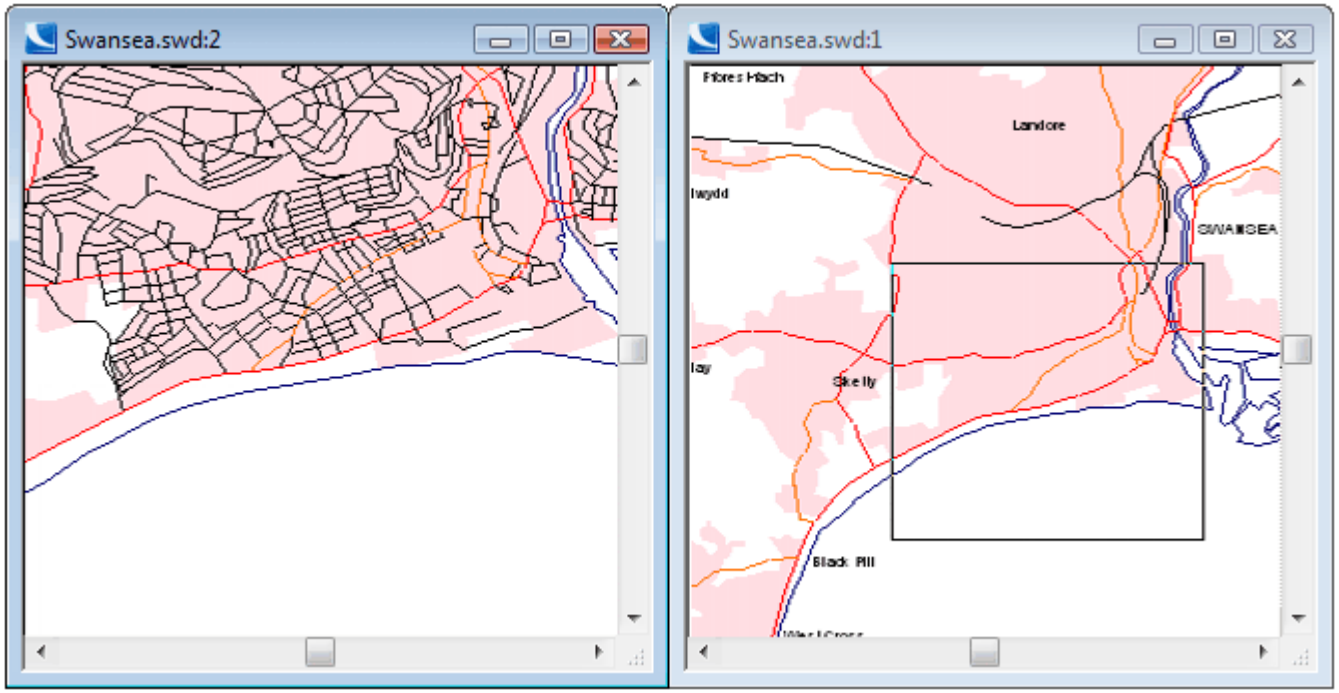
Depth of focus ‘blurring’ (Kosara, Miksch and Hauser 2002)

Halo depicts items beyond the window edge (Baudisch and Rosenholtz 2003)

Panning : “the process of changing the position at which the view is displayed, *without modifying the scale*” (*)

Zooming : “the process of *magnifying or reducing the scale* of a map or image displayed on the monitor” (*)

(*) European Commission (1998, p. 76)



Panning and zooming in multiple windows

(Cadcorp, 2000-2011)

Problem and Context (4)

- **Overview+Detail visualization:** its feasibility on mobile devices has been scarcely investigated
- An experiment that **studies unexplored aspects of the design space for mobile interfaces based on the Overview+Detail approach**
  - investigating the effect of letting users manipulate the overview to navigate maps
  - and the effect of highlighting possible objects of interest in the overview to support search tasks

Problème et Contexte

- **Commencer à définir le <u>problème</u> et le <u>contexte</u> de votre expérimentation**

HYPOTHESES AND INTERFACES

General hypothesis

- Both **highlighting objects of interest** in the overview
- and supporting navigation through **direct manipulation of the overview**
- would have a positive effect on <u>user performance</u>

Interfaces

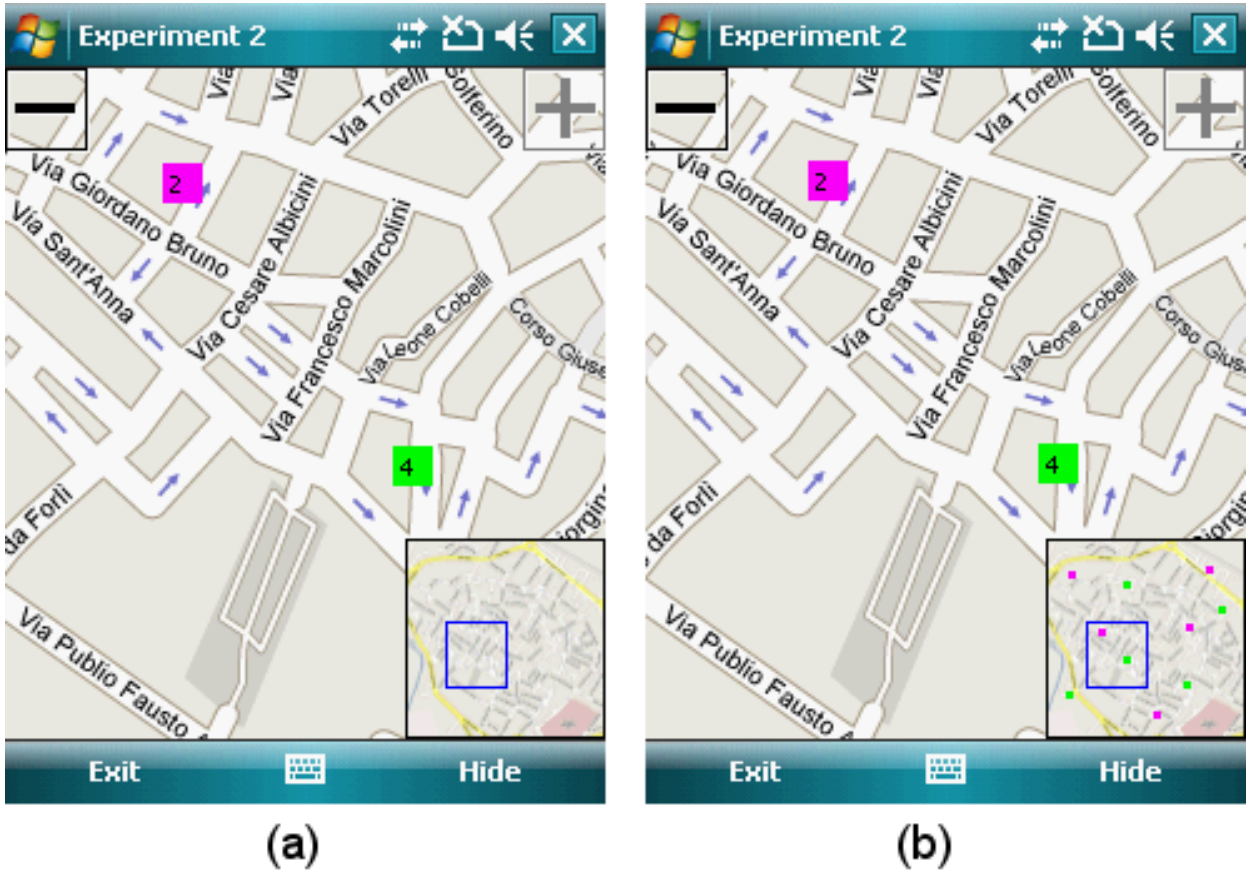


Fig. 4 O+D visualization without (a) and with (b) highlighted objects of interest in the overview.

Specific hypotheses (1)

- Users should be **faster** in searching for targets when objects of interest are highlighted in the overview.
  - Highlighting, together with the additional orientation cues provided by viewfinder size and position, should enable users to directly navigate towards possible targets, thus **reducing search time** by avoiding a blind search in the considered information space

Specific hypotheses (2)

- Users should be **faster** in carrying out search tasks when they can **manipulate the viewfinder** in the overview to pan the detail view.
  - Moving the viewfinder towards the desired destination should allow users to be faster with respect to the traditional panning technique based on dragging the portion of information space displayed in the detail view.

Specific hypotheses (3)

- Users should be more **accurate in remembering target location** when objects of interest are highlighted in the overview
  - With visible objects of interest, users can see the global configuration of possible targets in the overview, which should simplify construction of an accurate mental map of the information space

Hypothèses et Interfaces

- **Commencez à préciser vos <u>hypothèses</u> et <u>techniques d'interaction</u>**

METHOD

Method: Participants

- **Twenty-eight subjects** (11 female, 17 male)
  - Undergraduate or graduate students from the Computer Science and Engineering courses
  - Age ranged from 21 to 28, averaging at 25
  - All mobile phone users
  - Frequency of use of map-based applications on their devices (mobile phone or PDA)
    - Often: 2
    - Occasionally: 13
    - Never: 13

Method: Materials (1)

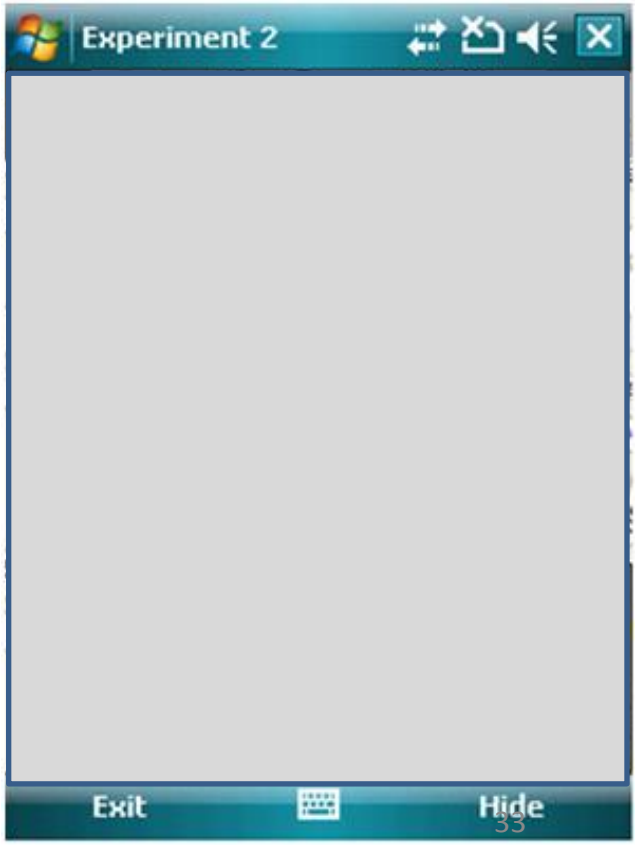
- **Asus P535 Windows Mobile 5 phone**
- **City maps (Interfaces)**
- **Paper Sheet**
- **Printed sheet**

Method: Materials (2)

- **Asus P535 Windows Mobile 5 phone**
  - Used for the **MapNavigation task**
  - Features a 520 MHz processor and a 2.8-inch touchscreen with 240 x 320 resolution
  - The detail view covered a 240 x 268 area in the middle of the screen ❶
  - The rest of the screen displayed two standard Windows Mobile menu bars at the top (❷) and bottom (❸)

❷

❸

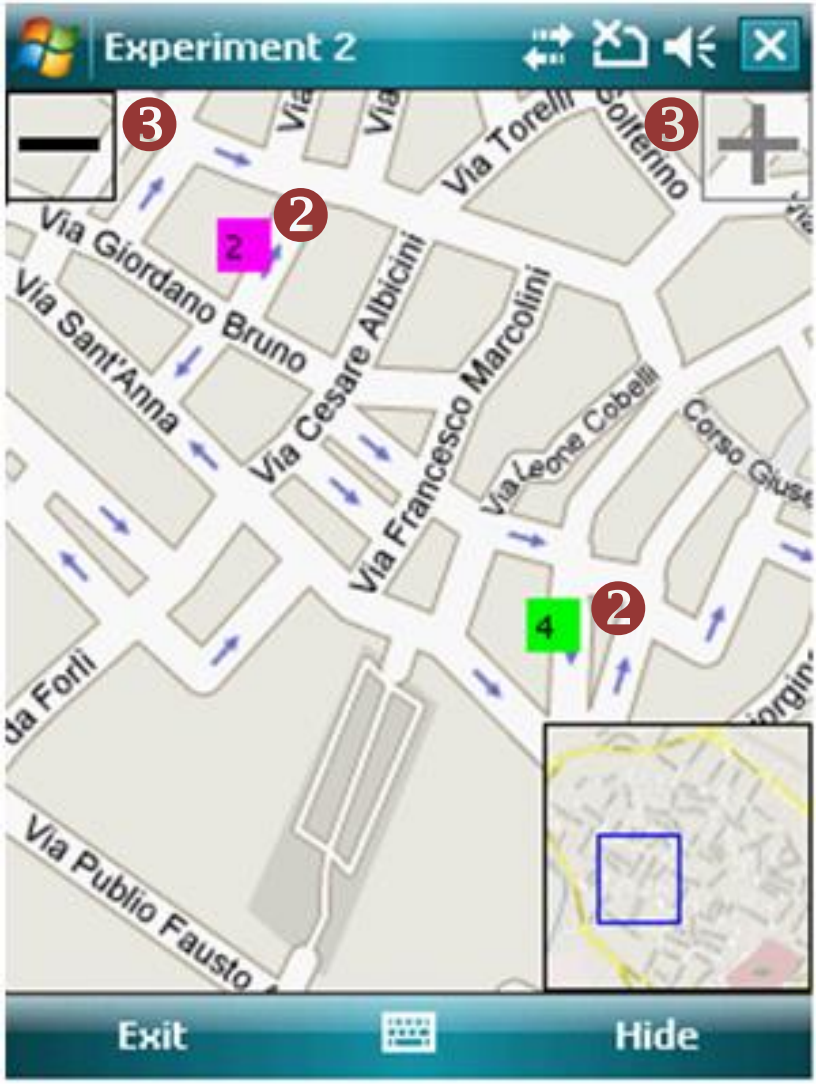


❸

Method: Materials (3)

- **City maps ❶ (2 Interfaces : A, B)**
  - Cities *unfamiliar* to users
  - *4 maps* for the experimental tasks and *1 map* for training
  - Each map includes 10 possible targets depicted as *numbered color icons* ❷
  - Targets *placed randomly* on maps
  - *Four zoom levels* available to users
  - Maps initially displayed at the *coarsest level* of detail
  - *Zoom icons are semi-transparent* to minimize occlusion on the detail view ❸
  - When highlighting of objects of interest was active, *hotels* were *displayed in the overview as small color dots* ❹

A



❶

B

Method: Materials (4)

- **Paper sheet**
  - Used for the **SpatialMemory task** (performed without the mobile device)
  - The paper sheet that reproduced the considered map at the coarsest level of detail
- **Printed sheet**
  - Used for both tasks
  - The printed sheet provides clear <u>instructions</u> for each task

Participants et Matériel

- **Commencez à préciser qui seront les <u>participants</u> à votre expérimentation et quel <u>matériel</u> vous utiliserez**

Method: Tasks (1)

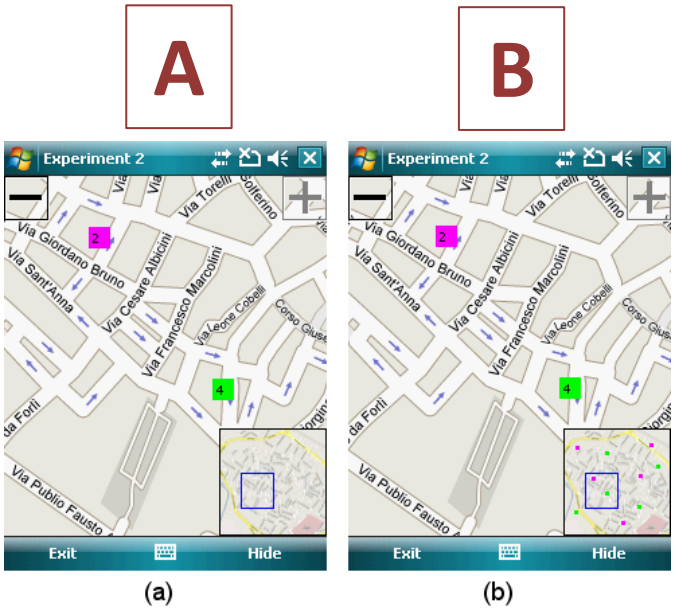
- **MapNavigation task**
- **SpatialMemory task** (without the mobile phone)

Each participant carried out

– one MapNavigation task and

– one SpatialMemory task

for each interface (8 tasks in total)



4 maps

Method: Tasks (2)

- **MapNavigation task**
  - *Goal:* to navigate a city map to find the location of two specific hotels and tap on their icons on the detail view
  - *Example: ‘‘Find out hotels 2 and 5 on the map and tap on their icons as soon as you locate them’’*
  - The two hotels were always located in different areas of the map

    to prevent users to find both in a single screen (at the maximum zoom factor)

Method: Tasks (3)

- **SpatialMemory task**
  - *Goal:* **to mark the location of the targets** searched for in the MapNavigation task **on the paper sheet** reproducing the considered map
  - **Users** could not use the mobile device and **had to rely only on the spatial knowledge** they had previously acquired during the MapNavigation task

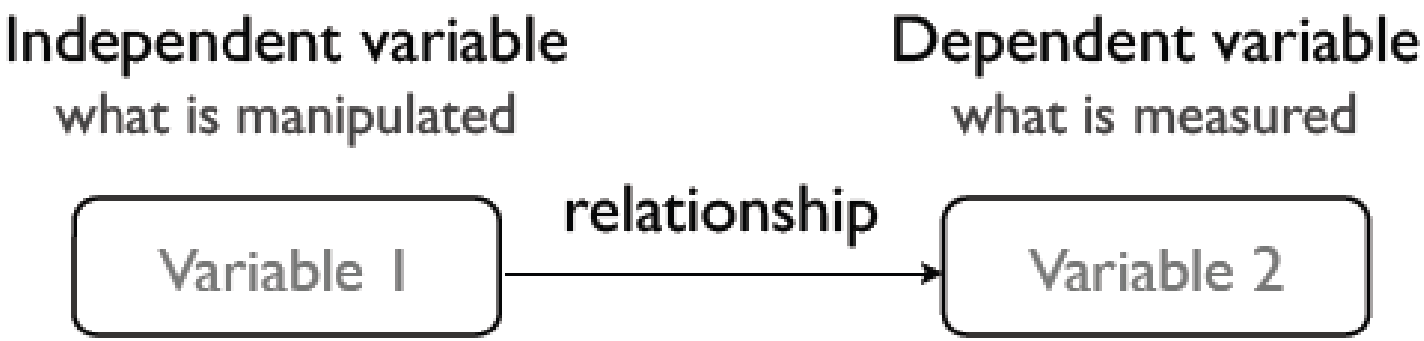
Tâches

- **Commencez à préciser les tâches que réaliseront les participants avec votre dispositif**

Method: Experimental design (1)

Testing a hypothesis

- The experimenter manipulates **independent variable(s)** and measures **dependent variable(s)**



(Source : C. Appert)

Method: Experimental design (2)

- **Within-subjects** design
  - Each participant takes the same experimental conditions

Method: Experimental design (3)

Independant variables	Modalities	
Manipulatibility of the overview	• Manipulable overview **(MAN)**	
	• Non-manipulable overview **(NMAN)**	
Highlighting of the objects of interest in the overview	• Highlighting enabled **(HIGH)**	
	• Highlighting disabled **(NHIGH)**	

Plan d’expérience et variables indépendantes

- **Commencez à préciser vos variables indépendantes et votre plan d’expérience**

Method: Experimental procedure

- **Steps**
  - ***Briefing*** about the nature of the study and ***Introduction and demonstration*** of the interfaces
  - ***Training tasks*** to let the users familiarize with the interfaces and clarify possible doubts concerning interfaces or tasks
  - ***Experimental tasks:*** users carried out the 4 pairs of experimental tasks (8 tasks total), each pair including one MapNavigation task and the corresponding SpatialMemory task
    - *To start the MapNavigation task*, users tap on a ‘‘Start Task’’ button initially displayed on the screen
    - *To end each MapNavigation task*, users tap on the last target
    - To end the SpatialMemory task, users ended when users mark the last target on the paper reproduction of the considered map
  - ***Preference task:*** users order the 4 interfaces from the best to the worst according to their preference (draws were allowed)
  - ***Interview:*** users are briefly interviewed to collect their comments

Method: Dependent Variables

- **The time users spent to complete a MapNavigation task**, from the instant they tapped on the ‘‘Start Task’’ button to the instant they tapped on the last target.
- **The number of distinct pan, zoom, and target selection actions** during each MapNavigation task. A pan action was counted each time users dragged the stylus on the information space, a zoom action each time users tapped on zoom buttons, and a target selection action each time users tapped on any object of interest on the detail view.
- **The duration of each pan action**, from the instant users began dragging the stylus on the map to the instant they lifted the stylus from the screen.
- **The distance between actual target location and the location indicated by the user** in the SpatialMemory task.

Method: Confounding Variables

Confounding variable = *Variable parasite*

- "Any variable other than the independent variable that can possibly explain the change in measures"

$\Rightarrow$ **Controlled variables**

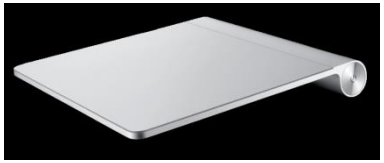
- Order of presentation of experimental conditions
- Target configurations on the maps

Variables dépendantes et contrôlées

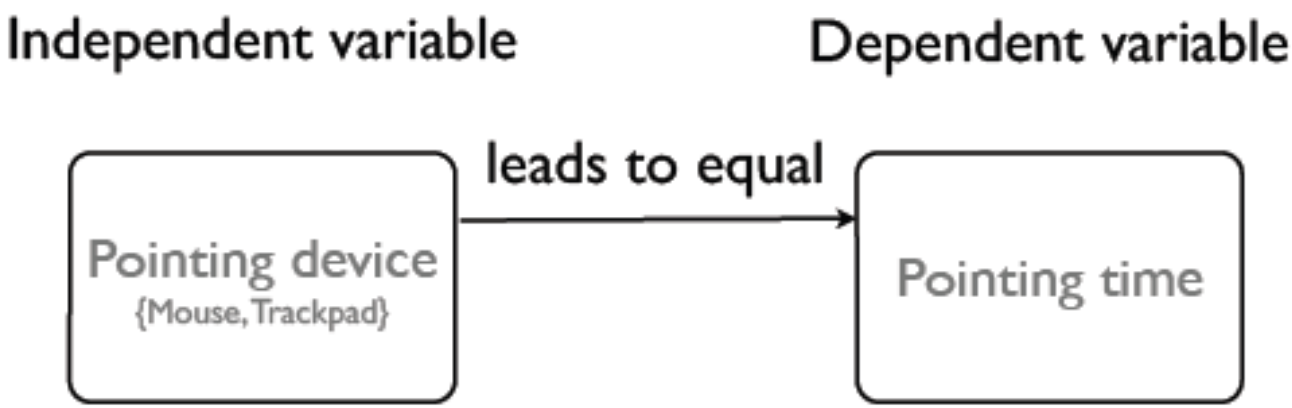
- **Commencez à préciser vos <u>variables dépendantes</u> et les variables parasites que vous controlerez (<u>variables contrôlées</u>)**

Method: Data analysis (1)

Testing a hypothesis

- **research hypothesis:** Users point faster with a <u>mouse</u> than with a <u>trackpad</u>
- **null hypothesis:** Users point as fast with a mouse as they point with a trackpad



(Source : C. Appert)

Method: Data analysis (2)

Independant variables	Modalities
Manipulatibility of the overview	• Manipulable overview
	• Non-manipulable overview
Highlighting of the objects of interest in the overview	• Highlighting enabled
	• Highlighting disabled

Dependant variables
Time to perform the task
Number of zoom actions
Number of pan actions
Duration of each pan action
Memory: The distance between actual target location and the location indicated by the user

Method: Data analysis (3)

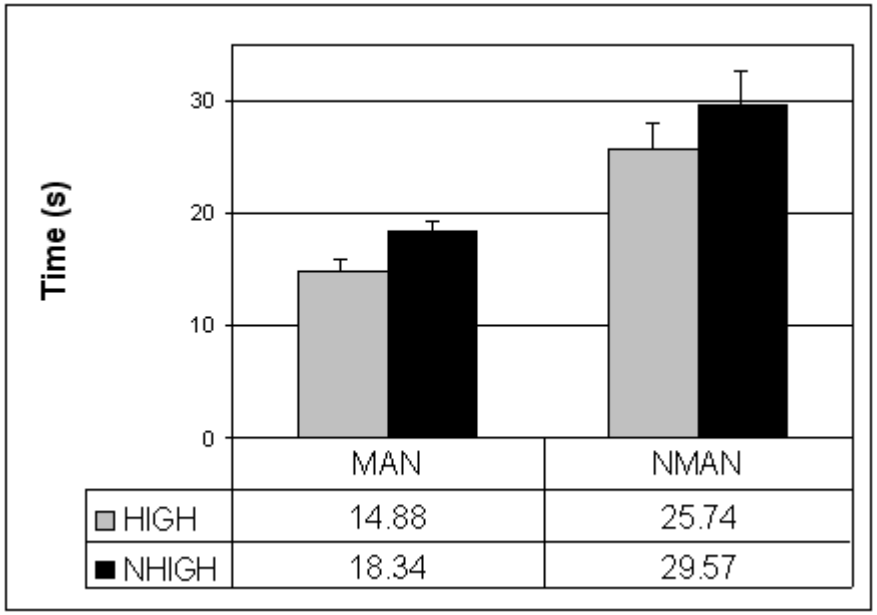
- Test statistique des hypothèses en fonction de la distribution des données
  - Test de la normalité de la distribution (Shapiro-Wilk test of normality)
  - Si normalité constatée: test paramétrique ANOVA (ANalysis Of Variance): F
  - Sinon normalisation (via roots, logarithm, inverse)
  - Si normalité obtenue, test paramétrique ANOVA
  - Sinon test non paramétrique (ATS statistic: *ATS*)

RESULTS

Results: Task completion times

Fig. 5 Mean completion times for the search task.

- MAN = manipulable overview
- NMAN = non-manipulable overview
- HIGH = highlighting enabled
- NHIGH = highlighting disabled

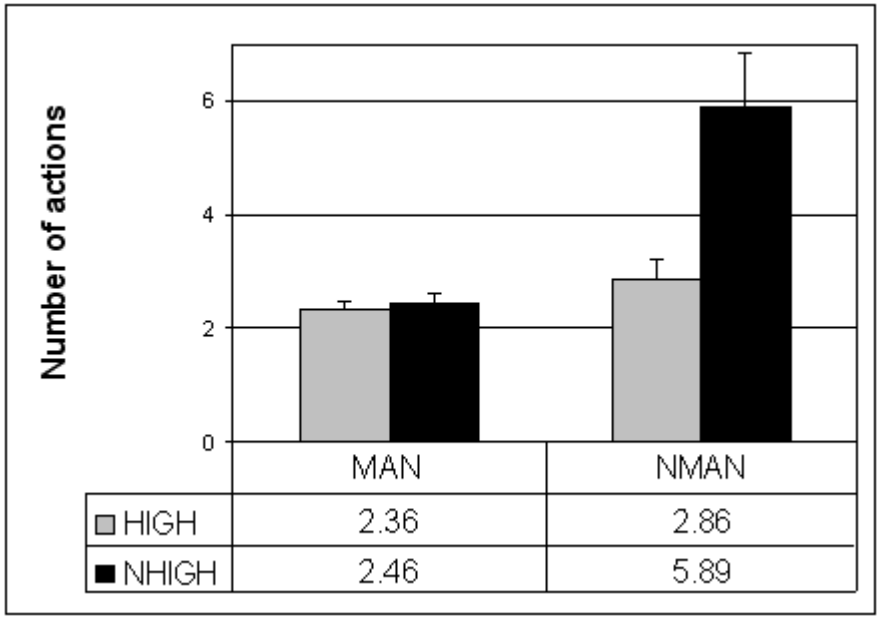


Variable	Effect
Manipulability (M)	**Significant effect :** less time to complete the task with the manipulable overview
Highlighting (H)	**Significant effect :** less time when objets of interests are highlighted
M x H Interaction	**No effect**

Results: User interface actions

(zoom & pan)

Fig. 6 Mean number of zoom actions.

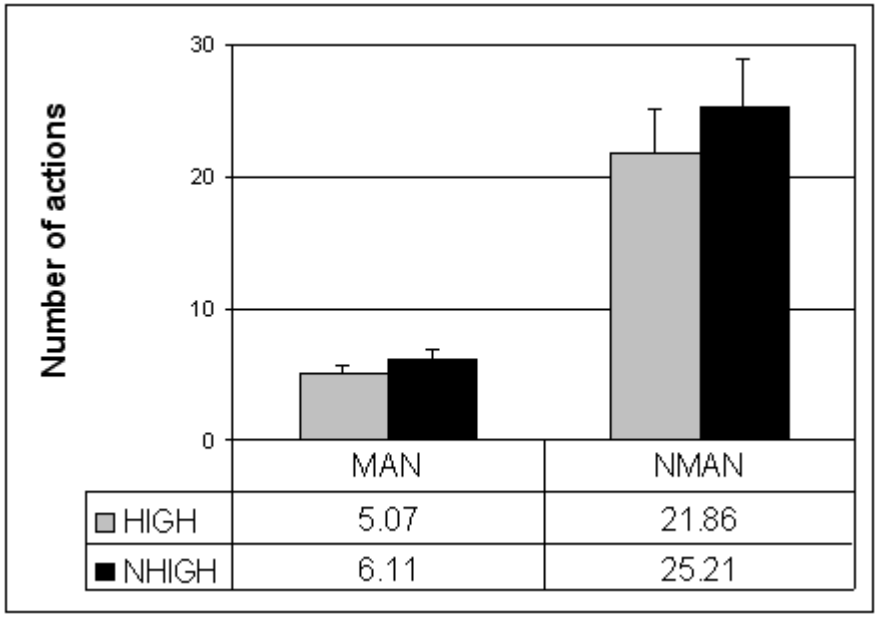


Variable	Effect
Manipulability (M)	**Significant effect :** less zoom actions with the manipulable overview
Highlighting (H)	**Significant effect :** less zoom actionswhen objets of interests are highlighted
M x H Interaction	**Significant effect** for the non-manipulable overview: more zoom actions when the objects of interest are not highlighted

Results: User interface actions

(zoom & pan)

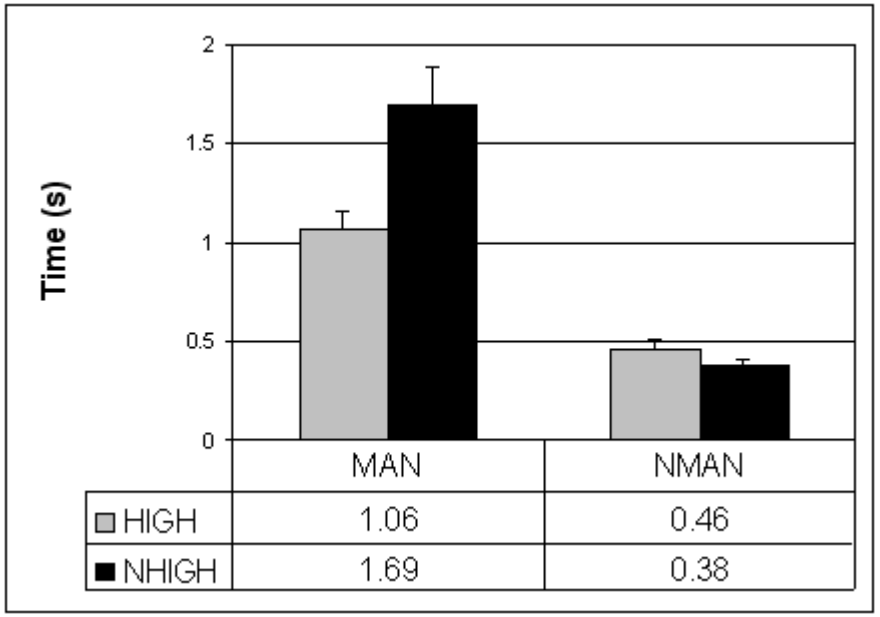
Fig. 7 Mean number of pan actions



Variable	Effect
Manipulability (M)	**Significant effect :** less pan actions with the manipulable overview
Highlighting (H)	**No effect**
M x H Interaction	**No effect**

Results: Pan time

Fig. 8 Mean pan times.

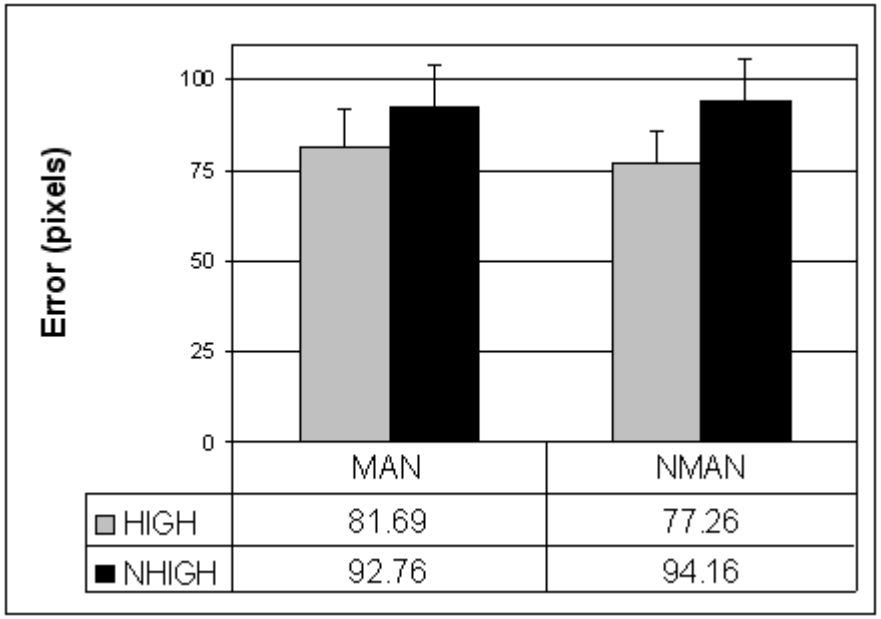


Variable	Effect
Manipulability (M)	**Significant effect :** pan actions are longer with the manipulable overview
Highlighting (H)	**No effect**
M x H Interaction	**Significant effect** for the non-manipulable overview: pan actions are longer when the objects of are highlighted

Results: Error

Fig. 9 Error in the SpatialMemory task

Amount of error = the average of the distance (in pixels) between the location indicated by users and the correct location for the two considered targets

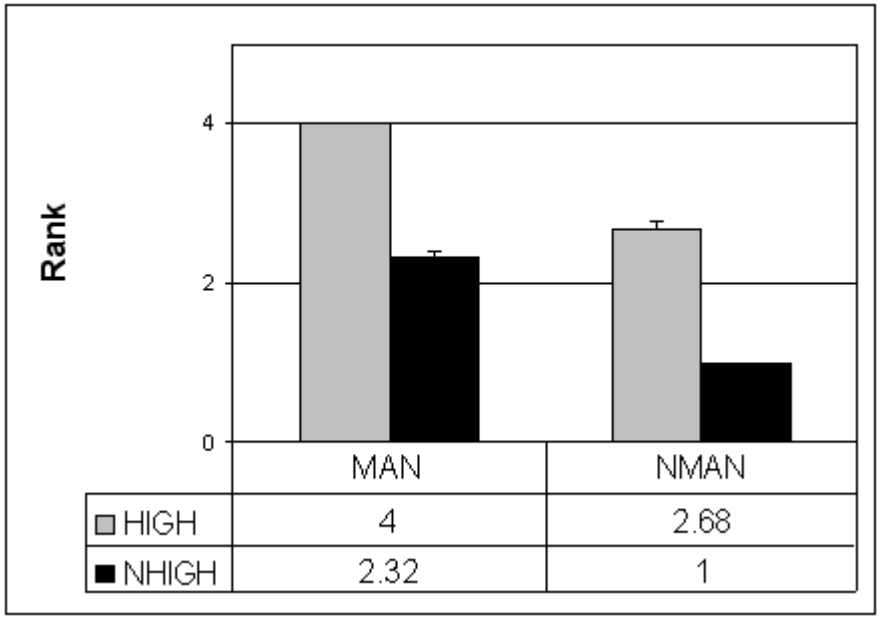


Variable	Effect
Manipulability (M)	**No effect**
Highlighting (H)	**No effect**
M x H Interaction	**No effect**

Results: Subjective preference

Fig. 10 Mean preference for each interface

Higher numbers correspond to better scores



Variable	Effect
Manipulability (M)	**Significant effect :** the manipulable overview is preferred
Highlighting (H)	**Significant effect :** highlighting is preferred
M x H Interaction	**No effect**

DISCUSSION AND CONCLUSION

Discussion (1)

- *General hypothesis (reminder):* Both **highlighting objects** of interest in the overview and supporting navigation through **direct manipulation** of the overview would have a positive effect on user performance

- *Results* suggest that **both direct manipulation of the overview and highlighting objects of interest in the overview have a positive effect on user performance**
  - in terms of the time to complete search tasks on mobile devices
  - but do not provide specific advantages in terms of recall of the spatial configuration of targets

Discussion (2)

- *Results* suggest that **both direct manipulation of the overview and highlighting objects of interest in the overview have a positive effect on user performance**
  - in terms of the time to complete search tasks on mobile devices
  - but **do not provide specific advantages in terms of recall of the spatial configuration of targets**
- This **might be due to the small size of the overview**
  - which could have made it more difficult for users to easily discriminate the relative position of targets and support their memorization
- However, **possibility that** it is not the visualization of targets but **the position and size of the viewfinder** that **play a major role** in helping users construct a mental map of the configuration of targets.

Conclusion (1)

- This paper investigated **Overview+Detail visualization**, focusing on its applicability to mobile devices
- The experiment
  - explored the role played by two specific features of O+D interfaces, manipulability of the overview and highlighting of objects of interest in the overview,
  - and revealed that both features are beneficial to users in search tasks, with manipulability providing the highest performance improvement

Conclusion (2)

- However, **knowledge of the strengths and weaknesses of the O+D approach** on mobile devices **is still limited**
- **Further empirical analyses are needed**,
  - for example, to obtain general guidelines on the impact of different overview designs on different kinds of task or to understand the relative effectiveness of O+D visualization compared to the other approaches to the presentation problem on mobile devices
- **Important questions for devices with limited screen space**, e.g., the effect of overview size on user performance, **need also answers**

Expérimentation (mise au point, réalisation et compte rendu)

- Introduction (le problème abordé et son contexte)
- Hypothèses
- Interfaces (techniques d'interaction)
- Méthode
  - Participants à l'expérience
  - Matériel
  - Tâches
  - Plan d'expérience
  - Procédure expérimentale
- Résultats
- Discussion
- Conclusion

Supports

- Ce cours
- Stefano Burigat Luca Chittaro**. On the Effectiveness of Overview+Detail Visualization on Mobile Devices**. *Personal and Ubiquitous Computing* (2013) 17:371–385

- Cours **« Monter une expérimentation permettant de tester l'utilisabilité des techniques d'interaction »** (adaption au module TIM du cours « Experimental Design » de C. Appert)
- E. Pietriga, C. Appert, & M. Beaudouin-Lafon. **Pointing and Beyond: an Operationalization and Preliminary Evaluation of Multi-scale Searching**. *CHI '07: Proceedings of the 25th SIGCHI Conference on Human Factors in Computing Systems*, pages 1215-1224, April 2007, San Jose, CA, USA.