Using Transient Search for Exploring Urban Activities

SUMMARY

This Master's Thesis is an investigation of the suitability of mobile transient search to facilitate exploration of urban attractions and activities. In Melbourne, Australia, five contextual interviews were conducted to better understand the needs for an event finding system. A working mobile application was designed, developed and subsequently evaluated in a laboratory setting. In Aalborg, Denmark the system was redesigned and developed into two variants for finding urban activities. The system was deployed and evaluated in a field study with ten participants. Follow-up field evaluations were conducted with seven participants after four weeks of use. 62 anonymous users downloaded the app online and 16 participated in an online-administered questionnaire. The results of the questionnaire are yet to be analysed.

This thesis sum up the findings of the two research projects and discusses the combined outcomes.

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“Exploration is what you do when you don’t know what you’re doing. That’s what scientists do every day. If a scientist already knew what they were doing, they wouldn’t be discovering anything, because they already knew what they were doing.”

- Neil deGrasse Tyson, Astrophysicist

Preface

This report documents the work of a Master's Thesis in Informatics, Department of Computer Science at Aalborg University. It is a continuation of a 9th semester project conducted at the Interaction Design Lab at The University of Melbourne in Melbourne, Australia. This report covers the work done between 02/02/2015 to 05/06/2015.

The report consists of three parts and is structured as follows: First an overall introduction will explain the background and motivation for this project and its stages. Then the main content is disclosed in a ACM CHI formatted research paper[ACM] followed by a combined discussion of the two projects. Lastly, the 9th semester paper can be found in the appendix alongside pictures, participant information, interview guides and preliminary work on the questionnaire. There are two reference lists, one included in the end of the disclosed paper and one in the end of the report.

The included CD contains this report, additional pictures, partial transcripts, source code etc.

A website has been set up as part for recruitment: www.exploration.dk

I would like to thank Dr. Jon Pearce, University of Melbourne for his foundational work on and invention of the iFish exploratory search platform that has inspired this work. Thanks to Troels Lund Laursen, VisitAalborg for providing data, promoting the system and giving input about tourism in Aalborg. Finally, I would like to thank Jeni Paay for her excellent support and guidance during this past year's ups and downs, home and abroad.

Enjoy

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Per Møller Nielsen

Introduction

Traditional search engines like Google, Bing etc. have become such an engrained part of our lives that using one has become a verb itself. We use these traditional text-querying search systems to answer all sorts of questions and to find information about a given topic, be it tomorrow's weather, movies running in the local cinema or the American Revolution. They have proven to be a strong tool in assisting our everyday lives and keep getting better and better at returning the most relevant results to a specific search query. Since they are such an integral part of our digital lives, we hardly consider how we use them and what limitations they have. The starting point of these traditional search engines is a text string composed by the searcher, where the correct formulation of the text string is essential to the results returned. But sometimes the searcher does not specifically know the goal of the search and thus do not know exactly what to put into a textual search field. Examples of these situations are plentiful, such as when searching for a small restaurant with a special atmosphere or looking for a book that is not too difficult to read, but not a children's book, preferably with illustrations scattered in the book. These situations require a way of searching, which is much more open-ended and explorative, making it difficult to formulate a proper text-string.

This thesis takes its starting point in the challenge of finding tourist attractions and activities in urban environments, where the searcher does not know what is available, and therefore what to search for. This calls for a system that allows flexibility in the search criteria and supports the exploration of activities with open ended goals. Triggered by this challenge this study investigates the suitability of mobile transient search for exploring tourist activities.

Research paper:

Using Transient Search for Exploring Urban Experiences

Using Transient Search for Exploring Urban Activities

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ABSTRACT
Searching for digital information about urban activities and events can be a difficult task when using traditional search engines, social networks or recommender systems. These systems often fall short in situations where the search in open-ended, non-deterministic, and explorative. This paper presents a mobile system based on the concept of *transient search*, where users explore urban activities using sliders. Two similar systems, Explore Aalborg and Discover Aalborg were designed to investigate how the ability to swap sliders, deactivate sliders and remove individual results influences the suitability of transient search for finding tourist activities in and around the city of Aalborg. The two systems were given to 10 participants and evaluated in the field. A follow-up field evaluation was held with 7 users after 4 weeks of use. It was found that sliders were perceived in many different ways influencing the participants' experience of the system. Swapping and deactivating sliders had a positive impact on their ability to tailor their search approach. The contribution of this paper is a better understanding of how people respond to transient search, and how the use of sliders influences their perceptions of the results.

INTRODUCTION
Think about a situation where you need to know a specific piece of information: the distance from work to home, the phone number to your favourite restaurant, or what is playing in the opera tonight. Chances are you would use a traditional search engine like Google to solve these tasks. These systems excel at looking up information based on a well-defined search query. They are so good at this task that they have almost become the de facto starting point for finding new information. This is all well and good if you know what you are looking for. However, in situations where you don't know exactly what you are looking for but only have a vague sense of what you want these systems fall short. Say you would like to do something that is not too physically active, maybe walking around, perhaps sitting, preferably somewhere among other people, close to the city centre. Many activities might fit such a description. It could be a walk in the park, shopping in the mall, sitting in a bar or café, visiting a gallery, watching an opera. All very different activities, yet they share some characteristics. This is a very difficult query to put into a traditional search engine. Often on tourist information sites, the user must rely on categorisations of events and tourist attractions, already narrowing their ways of thinking about them. A specific search for opera or galleries etc. in a traditional search engine already limits the results to event type. But, if the user does not know what to search for and don't know what is even possible, how can they be inspired and discover new things to do, without crawling through every webpage? Brochures, flyers and other print material may have limited utility in situations where you want to find something to do right now, since it is often not available based on the current time and place, and also can take quite a long time to browse through.

This calls for a more open-ended and exploratory search approach. An approach where it is easy to start the search with only a limited idea about what to search for, by comparing results and reformulating preferences until suitable results have been found.

In this study we have examined how a transient search system can facilitate such an exploratory search approach. The concept of *transitory search* is based on the existing concept of transitory information [3]. That is, it is temporary, transient and impermanent. The term transitory search is based on the term "transitory information", coined by Ayers and Youseff [3] in their research about the type of information contained in educational animations and how temporality impacts learning of the information content. When thinking about exploratory search [9] with large datasets of information about the world around us, investigation of that information, including discovery and transformation, becomes as equally important an outcome as learning, and can even become the focus, depending on the situation. *Transitory search* allows for a changing set of outcomes that can "bubble to the top" depending on the dynamic adjustment of a collection of search criteria. *Transitory search* can be seen as an interesting alternative to directed search when the domain is leisure, and the outcomes are happily ephemeral, serendipitous and fuzzy.

RELATED WORK
This paper builds upon research in recommender systems, exploratory search, mobile tourist recommender systems, and dynamic querying systems.

Recommender systems

Recommender systems (RS) gives users suggestions for all kinds of things such as books, movies, clothes and so on, by presenting information deemed particularly relevant for the user[1][15][6].

Ricci (2011) describes the constraint- and knowledge-based RSs as providing recommendations based on constraints and rules explicitly defined by the user [15]. This presents a challenge as users often construct their preferences only once a choice is presented to them [6]. Hence, it can be difficult for users to specify the input of preferences that will return the most relevant suggestions. This kind of RS must therefore allow easy adjustments of constraints and rules to provide relevant information and ease decision making.

In the context of mobile tourist recommender systems, limited screen space presents a challenge for visualizing recommendations [6] and the abundance of information in highly touristic areas can make it difficult to make informed decisions [17]. Several mobile systems have been proposed to help tourists in the task of searching for restaurants, shops, museums and public services, such as GUIDE[5], COMPASS[17], and Magitti[4]. Schaller, Harvey and Elsweiler(2012) created a mobile system for finding events during a festival in Munich, Germany. In their study they compared the use of four different discovery features, each used for different purposes by the participants. From loggings of user behaviour in the app they identified different patterns of use and found that when users wanted inspiration they would browse through lists of genres, locations and recommendations, and if user knew exactly what to look for they preferred a traditional text-input search bar[16]. This difference in preferences of search mechanisms relates well with Marchionini's (2006) distinction between two types of search activities: look-up search and exploratory search. He describes look-up search as an activity where the information seeker knows exactly what to query in a search, in order to yield *"precise results with minimal need for result set examination and item comparison".* In exploratory search on the other hand, the information seeker does not know what to query in a search, and must compare results and perform many query reformulations, in order to discover new results [9].

Ahlberg, Williamson and Schneiderman demonstrated one way of facilitating easy query reformulation and results comparison for finding elements in the periodic table. Dubbed Dynamic Querying (DQ), sliders were tightly coupled to the results, so that changes in slider setting would instantaneously change the results. In a comparative within-subjects study they found the DQ system performed better than a system based on text-input boxes and the DQ system got positive feedback of the participants' experience [2]. In another within-subjects study Williamson and Schneiderman compared two systems for finding real estate using a similar DQ system and a Natural Language system. They found the DQ system performed better and in general received positive feedback through a QUIS survey [18].

iFish

In a more recent attempt to facilitate exploratory search, Pearce et al. have developed a web based desktop system called iFish[10][11][12][13][14] for exploring large sets of data. In this system users formulate preferences using sliders and filters. Data is tagged on a continuum in which users use sliders to find various domain-specific information. Using filters, they can apply Boolean conditions that must be met, unlike the more fuzzy sliders. The filters and sliders directly manipulate the results, reformulating these results in an instant reordering, so that the best matching result on all parameters is on the top of the list. Animations of the results bubbling up and down the list are performed to visualize the re-ordering of items. Through a comparative within-subjects lab experiment, they studied students exploring university subjects outside their majoring field. They found that participants did not explore subjects more in-depth with the system compared with a printed handbook. This was credited to a delay in the re-ordering and wrongful categorization of sliders. They found that the participants did not alter their sliders once set, and were not satisfied by seeing only a subset of the subjects[14].

In another comparative within-subjects study they tested two restaurant finding systems, where one was using iFish sliders and another almost identical system using dropdown menus combined with a search button. The study showed that sliders were better for situations where the search parameters were ill-defined, while drop-down menus were better for well-defined search parameters. The system employing sliders also resulted in users spending more time reading about the restaurants and were more satisfied compared to the drop-down system[12].

A user's current location can also play a role in search. Smartphones today have location sensing capabilities meaning the user can be close to the recommended locations and be able to do decision making just-in-time when exploring a location. While there has been some work in creating mobile recommender systems for tourism [6], many of these systems do not enable users to easily and playfully explore events nearby to their current location. Schaller et al. showed that there indeed is a difference in how users use different search capabilities depending on how well their search is defined. But they do not provide suggestions on how to improve the explorative search. This acts as motivation for the study in examining

ways of facilitating mobile explorative search. Ahlberg et al. suggested how sliders can be useful for quantifiable data, but have not tried with more vague and difficult to quantify data such as vague characteristics of tourist activities. Pearce et al has done just that and shown how iFish can be useful for exploratory search. However they have not evaluated the system in the field or on a mobile device. They have strictly performed laboratory tests and therefore not evaluated the system with real users. This motivates a study conducting a field evaluation.

RESEARCH DESIGN

Using the iFish search slider concept, this study investigates the suitability and user's perceived experience of sliders as an interaction mechanism for transient search.

In a previous study in Melbourne, Australia, requirements for the systems was elicited through contextual inquiry of 5 participants looking for urban events while in the city. A design was suggested and a prototype developed. Lab-evaluations showed issues with the use of sliders as an interaction mechanism for transient search. One was a fear of missing out on potential events, and that the system did not assure the participants that no results were being hidden intentionally or unintentionally. Another issue was that the middle of a slider conveyed different meanings between participants.

Based on these findings, a redesign was made and two prototypes were developed called Explore Aalborg and Discover Aalborg. Explore Aalborg has the basic functionality of sorting a list of items based on the aggregate settings of four sliders. Discover Aalborg has the same functionality as Explore Aalborg, but gives the user the ability to deactivate sliders, swap sliders and remove irrelevant search results. The ability to deactivate sliders was implemented to investigate how the perception of the middle of a slider as a neutral setting and how the ability to swap sliders was designed to investigate how the choice of selecting your own set of sliders affects the use of the system. Lastly, the ability to remove individual search results was implemented to see if it would heighten the relevance of the results.

In a comparative between-subject study, the effects of using the additional abilities in Discover Aalborg were examined against the Explore Aalborg system, which did not employ these features. 10 participants were given one of the two versions of the system in a 4 week period. A field evaluation examined the participants' first use of the system, and follow-up evaluations were conducted 4 weeks later to study whether the participants change their perception and use of the systems over time.

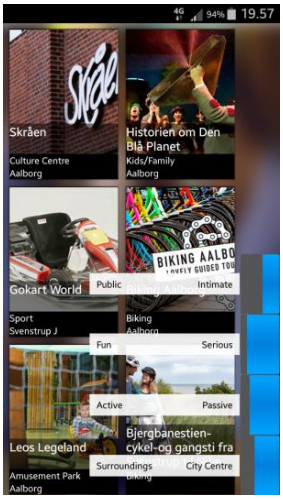

Figure 1a: Main screen

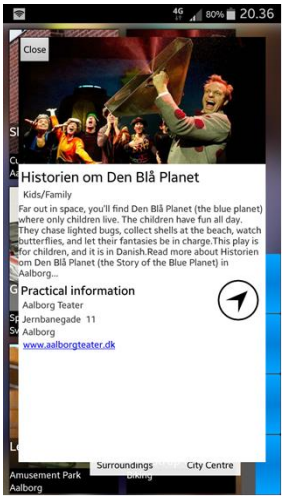

Figure 1b: Popup

DESIGN

The design of the system was elicited and developed in the previous study and refined for this study. The apps can be downloaded from the Google Play Store™, by searching for Aalborg Informatics. Each prototype shares the same graphical user interface design, and will be described as one system in the following. Photos are in Appendix B.

Main screen

The app has one main screen consisting of a 2-column grid of results and a vertical bar of four sliders. The grid contains tiles of all attractions, events and activities stored in the app. These tiles hold a descriptive picture of the item along with a title, category and suburb. (See figure 1a) The pictures take up most of the screen, so that it is easy to see clearly and assess the nature of the item. Naturally, the pictures could be fewer and larger, but by having 4-6 items at a time it is possible to perform comparisons between items. This configuration also allows users to see how the items rearrange in order when changing the slider values.

Popup

When tapping on one of the items in the result list a popup window appears containing a detailed description about the item, information about the location, a larger picture and a button for GPS –navigation to the location (See figure 1b).

Sliders

In the left hand side of the screen, four non-adjustable sliders are placed in a vertical layout. Each slider is facing horizontally, showing the current state of the slider. To the right of each slider a label describes the two extremes of the slider spectrum. These labels flow in front of the results and disappear when the user scrolls the list. When tapping

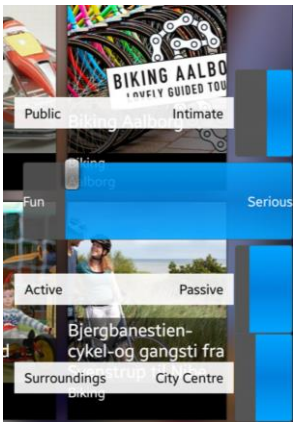

Figure 2a
Expanded slider

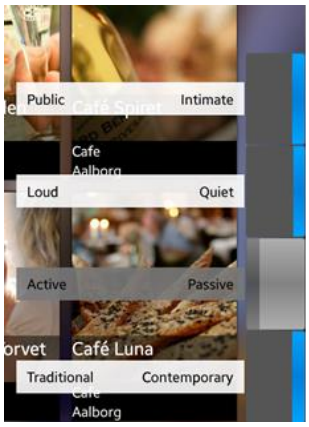

Figure 2a
Deactivated slider

one of the sliders, that slider expands into an adjustable slider covering half the width of the screen and the floating label (See figure 2a). Dragging the slider handle, or touching somewhere on the slider, results in an dynamic reordering of items according to the slider setting. As soon as the finger is released from the screen, the adjustable slider compresses back. Afterwards, the list scrolls to the top, showing the ordered list of items with the best match at the top. All of this happens instantaneously, making it possible to see the effect of changing sliders directly. The intention is to encourage the user to change the sliders often and explore the results.

Slider labels

A workshop held in Melbourne was used to elicit pairs of slider labels. 4 PhD students were given the task of selecting one or more urban events that they would consider going to, and write down their reasoning for that choice. This served as inspiration for a plenary discussion afterwards, where the participants discussed useful words to describe urban events. These descriptive words where written on a blackboard for validation and inspiration. Lastly, participants were asked to figure out pairs of descriptive words that could be used in the system. Together with user responses a list was compiled with 24 pairs of slider names and 52 words describing urban events. These were categorized into related groups by the author after the workshop. From this grouped list a set of 8 sliders were selected for the two systems:

Public ↔ Intimate: This slider pair categorizes events based on the size of the venue, amount of visitors and/or atmosphere. Events could range from monuments to massages.

Fun ↔ Serious: Differentiates the purpose of the event. E.g. an amusement park versus a theatre piece about the Iraqi war.

Active ↔ Passive: Indicates how much the user has to use their body and/or mind when participating. This could range from a paint-ball game to a movie in the cinema.

Surroundings ↔ City Centre: Indicates how far away from the city centre the item should be. The score is based on the distance from Nytorv, Aalborg as the crow flies. As most items are situated close to the city centre, the tags are manipulated, so it spreads out equally along the slider. Thus the slider is not to scale.

Fast ↔ Slow: An indicator of the tempo of the item, such as doing adrenaline filled speed boating or visiting a church.

Loud ↔ Quiet: A slider for the sound level of an item. Two extremes could be a concert and a walk in the park.

Traditional ↔ Contemporary: Indicates the style of the item such as seeing a classic art gallery or street art.

Big ↔ Small: Describes the physical size the area where the item is situated, such as a big park or a small café.

Additional features in the Discover Aalborg version B

To investigate if the perception of the middle of a slider can be changed the interaction mechanism that a slider can be deactivated by double tapping it was added to the design of this prototype. This interaction colours the slider grey and disables the option of adjusting it. That particular slider will no longer influence the order of the results (See figure 2b). Another double tap reactivates the slider again.

Another difference is the ability to swap a slider with a new one with a long press. An animation shows the label of a slider moving out of sight, and a new one replacing it on the main screen. 8 optional sliders are available in total, with 4 showing at a time.

The last alteration is the ability to remove individual items from the result list by long pressing that item. The removed result is only removed for the current session, and will reappear after the app has been restarted.

PROTOTYPE

Building upon a previously built system, the two redesigned prototype apps were developed during 8 weeks. Version A, called Explore Aalborg and Version B called Discover Aalborg.

Both versions enable playful interaction between sliders and the result list, but Discover Aalborg also has the ability to change slider labels, deactivate sliders and hide irrelevant search results. Each result has a details popup with further information and a button for GPS navigation.

Technical design

The prototype was developed for Android, targeted at API level 19 and compatible down to API 15, which covers 94% of all active Android devices [7].

In order to populate the prototype with realistic data, the local official tourist information centre, VisitAalborg provided a copy of the database for their website containing information about 514 tourist attractions, events and experiences, all in English. After removal of irrelevant and incomplete data, 282 entries remained, which was cleaned-up and subsequently tagged according to 8 slider continuums in an approximate uniformly manner. This was assessed and typed in manually by the author.

Data is stored in a SQLite database locally on each device, and each entry consists of slider values, practical information such as title, address, category and contact information alongside a picture and a detailed description.

Both apps calculate the best fit between all sliders and all events while the user is still moving the slider handle. When the user lifts the sliding finger from the screen, the data is sorted by the best fit, and the UI rearranges the tiles accordingly. This happens instantaneously within 50-100 ms. Whenever the app is launched from scratch, the sliders are set randomly, so the same set of results are not displayed every time.

EVALUATION

Two field evaluations were conducted in April and May 2015 in the streets of Aalborg with 10 individual participants. The purpose of the evaluations were to examine how users perceive, use and experience transient search when looking for tourist experiences both on their initial use of the system and over a period of time.

Participants

10 participants, 3 female, 7 male (Mean: 24,6 years, SD:2,34) were recruited through personal networks and using snow ball recruiting. All are residents in Aalborg and university students at various departments and levels. 7 participants were able to participate in the follow-up evaluation. Data about participants can be found in appendix A.

Method and Data Collection

The participants did the field evaluation in Aalborg city centre to put them in an urban situation where they could find things to do while on the go. Here they downloaded one of the two apps from the Google Play Store™, and received a brief explanation of the app and its prototype limitations. Participants were alternatingly assigned app versions as sessions were scheduled. Once downloaded, they were given the task to find something to do or see at that time using the app. After initial observation, participants were asked questions related to the understanding of sliders in respect to searching for information and the how satisfactorily the sliders' helped them to do this. Furthermore, users of the Discover Aalborg system were asked additional questions about how the ability to swap sliders, deactivate sliders and remove results from the result list impacted their search experience. Users of Explore Aalborg were instead asked about the hypothetical need for such abilities.

The field evaluations lasted 26 minutes on average per participant per evaluation, who in turn were compensated with a lunch voucher. The question guide can be found in appendix C.

Participants were asked to keep using the app after the evaluation and follow-up evaluations were conducted after 4-5 weeks, also in the city centre. Halfway through this period participants were reminded to use the app.

For both evaluations visual and audio data was collected with a camera. Apart from the installation part, the two evaluations followed the same method. The evaluations resulted in 7 hours and 24 minutes of raw material.

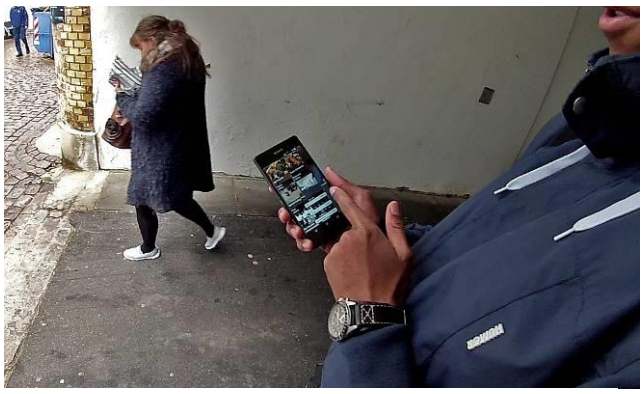

Figure 3: Participant using Explore Aalborg

ANALYSIS

All evaluations were selectively transcribed and coded in order to increase the speed of transcription and remove noise from transcript. This process was done purely by the author, which results in no inter-researcher reliability [8]. For the follow-up evaluation the findings from the first evaluation was used as an analytical lens to compare usage. In the following section only the most well supported and/or interesting findings from the two evaluations are presented.

FINDINGS FROM THE FIRST EVALUATION

The middle has different meanings

Depending on the participant and the individual slider, setting the slider to its middle point conveyed different

meanings. 8 participants expressed that the middle position of a slider meant that it would become deactivated or neutral, meaning results would not be influenced by that slider. But participants were not consistent in this way of thinking of the middle. In fact, when using other sliders, the middle would sometimes have a value of its own, just like the extremes. As an example, some participants perceived the middle of public-intimate as deactivating, while the middle of Active-Passive has a meaning of its own. One participant explained the middle of the slider as:

"It means we don't go mountain biking, but we don't have to sit still either. So it could be like a walk."

Minutes after, she goes on and describes the middle of public-intimate as:

"Something that is a bit of both. You are kind of saying it doesn't matter if it is intimate or public."

Only two participants consistently described the middle as having a value of its own. Three others changed their perception of the middle as having a unique value of its own only when asked to put the slider in the middle and reflect upon the results. This indicates the users were able to understand the sliders as continuums, but that it is not intuitive. In general, is seems to be that the understanding of the middle is highly changeable.

Sliders are inconsistently described as binary and continuous.

Users mental models of the sliders differ between thinking of sliders as continuums and as binary choices. Thinking in continuums, the different results have a value in a spectrum with the labels as two extremes. Thinking in binary, the results either belong or do not belong to a set of categories named after the labels. Four participants were not consistent in their way of thinking about the different sliders, and only two were consistent. Some participants expressed that the more extreme a slider was set, the more likely the results would stem from that category. This way of thinking, can be compared to deciding the ratios of coloured marbles in a bowl. Two participants preferred using the sliders as binary even though they understood the concept of continuums. More often than not, users tended to choose values at either extreme of the spectrum and only used the middle if they had a clear idea of what they expected to match that position.

"I don't know if it is necessary to have a slider choosing how public it should be and how serious it should be. Because, if I want something serious I will just press serious and active. Boom".

The version of the system that they were using did not seem to influence the understanding of the sliders.

It seems that even though some participants do not understand sliders as continuums, the participants can benefit from the system anyway. The slider end points are still valid, but participants will miss out on the results that are situated in the middle of the continuum. Thus misunderstanding of the sliders, does not necessarily make the system useless, but maybe only limit its usefulness.

Deactivating sliders eases understanding of results

Three participants using the Discover Aalborg prototype expressed satisfaction with the ability to actively deactivate sliders. They found it easier to understand how an individual slider operated once the other sliders were deactivated. This way only one slider influences the algorithm, returning results matching that particular slider very well. Participants found the results to be more useful in narrowing their search down like one participant states: *"It gives me more clarity, as to how I can prioritize and find specific things".* And another states:

"I like that it gets more precise. I prefer that I have few choices, so I don't have to consider too many. So it is great that I can eliminate some of them so I don't have to relate to them too much."

This may indicate that the sliders themselves can be useful enough on their own. However this finding may suggest that the combination of sliders complicate the understanding of the results.

Perhaps starting with a few activated sliders, and gradually building on top of that can be a good way to introduce the user to the meaning of sliders.

Swapping sliders made it easier to tailor the search:

Five out of six participants using Discover Aalborg were happy with the ability to replace a slider with a new one. When looking for something to do, participants mixed the sliders as they wanted and were able to explain their choices. For example, when participant 1 was asked to find something to do alone, the following sliders were chosen: Surroundings-City, Fun-serious, Public-intimate and Loud-quiet. But when asked to find something to do with a partner, participant 1 would select Big-Small instead of Loud-Quiet because the partner had a fear of large spaces and many people. When asked about the usefulness of this ability a participant said: *"I actually find that nice. For example some [slider] don't matter, and then it is better to get some other [sliders] which can be spot on."*

Additionally, two participants considered some of the sliders as overlapping, making one of them obsolete. One found fun-serious and fast-slow as overlapping, while the other found big-small and public-intimate as overlapping.

When this happened they swapped one of the sliders with a new one that best encapsulated what they were looking for, further highlighting the importance of having multiple sliders available, despite potential overlaps.

Participants' understanding of slider ends corresponds well to tagging.

When asked to describe their understanding of each end of the sliders, most participants described them in a way similar to how the data was tagged in the system. This was especially true for Public-intimate, Surroundings-City Centre and Fun- serious. Despite describing the labels in a fashion consistent with the way the data was tagged, not all participants understood the slider as a continuum. Half of the participants understood the slider ends as the data was tagged, yet still perceived the middle as deactivating the slider. As such, clear understanding of labels did not influence the understanding of the slider as a continuum.

Removing results from list does not seem important

Being able to remove individual items in the result list was deemed relevant for 5 participants, albeit not an important feature. In fact the main concern was not so much about removing irrelevant results, but how to restore them (as this was not part of the prototype). The results removed may not be irrelevant in every search sessions, and thus it is important to easily get the removed items back. As a participant states:

"For me it would be relevant [to remove results], but if I am looking for some entertainment for my nephew I would make the same search [like when he was finding activities for his friend]. I could actually do that. And then suddenly it is relevant [a children's play centre]"

Thus, results not relevant one day, might be relevant another day, suggesting the ability to remove results should be designed with functional clarity in order to be useful in transient search. Two participants suggested filtering specific categories instead, which is an ability already implemented in the system in [12]. The effects of such filters have yet to be studied in this context.

System facilitates serendipitous discoveries

5 participants explicitly stated that they found something they would consider doing, which they did not know existed before using the system. This is perhaps the most important part of the system as a product, since failure to provide new information would render the system useless. Interestingly, users found new and useful information regardless their understanding of the sliders. This suggests that there might be some leeway in terms of misunderstanding the sliders and still getting interesting results.

FINDINGS FROM FOLLOW-UP EVALUATION

7 people were able to participate in the follow-up evaluation. As the remaining 3 participants were unavailable, a short e-mail was sent to them with short and easy questions about the system in hope of getting at least some kind of response. None responded.

The following section reports on the findings from the follow-up evaluation conducted 4-5 weeks after the first evaluation.

Participants' understanding of slider ends does not change

When asked to describe the ends of each slider, the participants agreed on the meaning of each end, with the same few exceptions as in the first evaluation. One participant mistook Contemporary for "temporary", likely because of a language gap. This changed the meaning of Traditional-Contemporary to mean how permanent an activity was. From the first evaluation 2 participants interpreted Fast-Slow as the duration of an activity while the remaining participants perceived it as meaning the tempo of the activity. As in the first evaluation there are still overlaps in the meaning between Public-Intimate and Big-Small, and now also Active-Passive and Fast-Slow. In each case, only one of those sliders would be chosen.

Removing results from list is still not important

The ability the remove individual results in Discover Aalborg had not been used once by any participant, and was still deemed irrelevant. Instead, the ability to remove a complete category such as music, sports and kids was suggested as a relevant alternative by 4 participants.

Inconsistent understanding of sliders is consistent

Participants still had inconsistent ways of understanding the sliders. Those who perceived sliders as continuums still maintained this perception. The same applied to participants perceiving the sliders as binary. Even the same kind of inconsistency arose, in that some sliders would be operated and described as binary, whilst other sliders as a continuum. Especially the Surroundings-City Centre was operated as a continuum by all but one. Participant 7 illustrates the difference between surroundings-city centre and other sliders well:

This one differs from the others somehow, because the way I understand it, it has a clear definition: This [left side of slider] is the Centre of the city and then you move it longer, and long outwards. The other sliders are neither or. Either it is passive or it is active."

As in the first evaluation, the middle of a slider is still found to have different properties for different sliders, systems and participants. The middle can mean

deactivating the slider. That is, the slider no longer influences the results, which is not the case. Interestingly, they did not find the results to conflict with this way of thought. It can also mean it has a value of its own. Additionally it can mean the system returns results containing activities from either set of binary categories.

One participant had another interesting way of understanding the sliders, adding to the complexity of sliders:

Q: "What does the middle of Public-Intimate mean?"
A: "The middle means I can't decide. It's either or. That I don't care[...]"
Q: "How does this differ from moving it just a little to the side?"
A:"If everything is 100% and the middle is 50% and I put it on 52/48.. That would mean that... Even a small move can actually mean a lot for my mood"
Q: "Is that different?"
A: "Yes, it is very different compared to putting it in the middle!"

A graphical explanation of the slider understandings can be seen in figure 4 below.

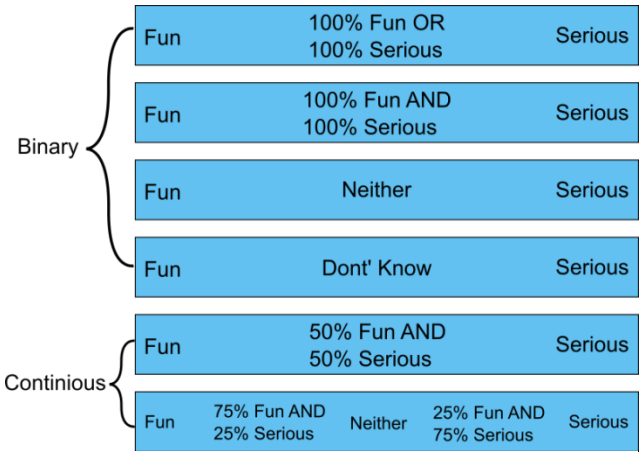

Figure 4: Overview of slider understandings

Users of Discover Aalborg would most often swap sliders instead of deactivating sliders. Only one participant had used the deactivate function and chose to rely on 3 sliders instead of 4. This behaviour is described by participant 3 reflecting on a use experience with her friend:

"We changed them [the sliders], but in the end, we chose the same. Because, I still don't understand this one [Big-Small]. I still question it. So we just deactivated it and kept the rest." And, *"It's just one less thing to consider. It made it easier"*

The remaining 3 participants of Discover Aalborg were satisfied with the ability to swap sliders. Participant 9 says *"I think it is fine, because it gives me more options"*, while participant 6 states: *"Right now, I have made a good combination. So I think I will keep this [combination] and use the same [sliders]."*

The above statement is also testimony of how Discover Aalborg participants use a set-and-forget behaviour of picking sliders and don't feel a need to change the selected sliders from time to time. Directly asked about this, participant 9 says:

"Obviously, I have tried to change them [sliders] in order to test the app. But if I were to use it myself, I would use the same ones. But it is because those 4 I have now are the ones that I can relate the categories to. That's more difficult with some of the other sliders I haven't selected.

When probed about the ability to deactivate sliders, users of Explore Aalborg had a positive attitude and would find it useful. Conversely, they had difficulty imagining the ability to swap sliders.

More tools for look-up search requested

Multiple features were suggested such as the ability to filter by categories like music and sports, and also set the time, date, duration and price of an event. Being able to see an overview of all sliders was requested as well. Two participants had experienced difficulties with looking up specific kinds of results such as a list of restaurants and concerts, and thus wished to be able to make direct searches in the app.

DISCUSSION

The purpose of this investigation was twofold. First, to investigate the suitability of transient search for finding tourist activities in an urban environment. Second, to investigate how the ability to swap and deactivate sliders, and to remove irrelevant individual results influences the use of transient search.

The findings of this study indicate that there is a need for a combination of tools to perform more directed look-up search in conjunction with transient search. This was shown by participants requesting an ability to pick certain categories (e.g. music) or trying to use the sliders with a specific result in mind. This supports the findings of [14] who found users would narrow down their search when performing structured search tasks. [9] also mentions the need for look-up searches to be embedded to bringer the searcher into the correct neighbourhood for exploratory browsing.

One of the reasons for conducting the follow-up field evaluation after 4-5 weeks was to see if the participants would change their use of sliders over time. The first field

study and the follow-up field study both clearly showed how the different sliders were being operated differently by different participants. The fact that the participants mostly agreed on the meaning of the slider ends, which also matched the way the data was tagged, tells us that the individual labels were understandable. However, despite having a good understanding of the ends, users did not always know the implications of setting the sliders part way between the two end points. This may perhaps be attributed to how the labels were paired together. After all, our vocabulary does not have a single well-known word for things between for example active and passive, or public and intimate. The graduations of meaning between slider ends may just be too abstract to grasp while using the system, and may explain why participants don't use the middle much. This indicates that participants do not reflect much upon their query, which is also supported by the finding that participants don't change the slider setting once inputted. This was also the case in [14] who found participants would not alter the sliders after setting them according to their preferences. One of the key features of an exploratory search system is the ease with which users are able to reflect upon their query and reformulate it. Apparently, this system has not facilitated this property enough, which is problematic as it limits exploratory behaviour.

Perhaps separating two-dimensional slider pairs into individual one-dimensional sliders would be a solution to the differing understandings of the slider middle. In the studies by [2][18] the sliders were one- dimensional and they found them to be a useful and effective mechanism for dynamically querying data. However, their system only contained quantifiable data, thus they did not study the effect of using more qualitative, ambiguous and vague slider labels, e.g. passive. One of the most interesting findings in this study is the way users understand different sliders differently and often inconsistently. The fact that participants seem to consistently understand the slider Surroundings-City Centre quite well compared to the other sliders suggests that the ability to quantify a slider setting, for example, giving a certain position on the Surroundings-City Centre slider an approximated meaning of say "within 2kms of the city centre", has an impact on the understanding of sliders. However, this did not appear to be a deterrent to the use of non-quantifiable sliders, as participants in fact did enjoy playing with the sliders, and some had no problem understanding the continuous nature of the sliders and using them accordingly. We should therefore not rule out the use of sliders with qualitative data just yet, but investigate how to improve the design. Perhaps giving the middle of the slider a label alongside the two ends would provide guidance on what to expect. Maybe using the same one-dimensional sliders as [2], might also make it more clear how the sliders are to be used. Just slightly adjusting the graphical design of the slider could be the key to convey a consistent understanding of the slider. The suggestions for a new slider design are illustrated in Figure 5. Alternatively, we could embrace the ambiguity of the meaning of the sliders and leave it up to users to form their own meaning that match the returned results.

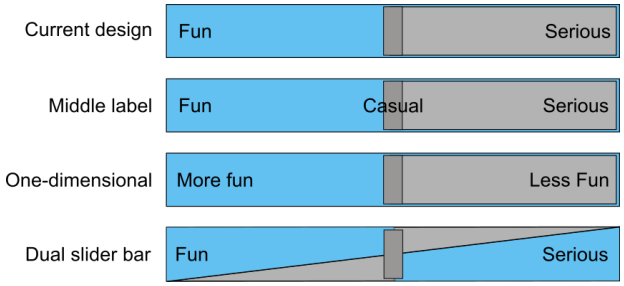

Figure 5: Suggestions for redesigning sliders

Participants expressed satisfaction with the tight coupling of the sliders and results, and were especially happy with the speed at which the results were updated. Participants were happy to think of tourist activities in a more vague and non-traditional way, but did not quite utilize the breadth of the slider spectrum due to difficulties understanding sliders. This however, does not necessarily mean that the system is not suitable for exploration, as participants did indeed make some serendipitous discoveries, which counts in favour of using transient search.

CONCLUSION

This study reports on the findings of two field evaluations of two prototype systems using sliders as a mechanism for finding urban tourist activities with transient search. The contribution of this paper is a better understanding of how people respond to transient search, and how the use of sliders influences their perceptions of the results. The study found transient search to be useful for discovering urban tourist activities, especially when their intentions were explorative rather than trying to find a specific type of activity. Interestingly, participants had varied perceptions of how individual, yet similar sliders operated. The sliders were both perceived as being continuous and binary regardless of the system version, experience with that system and the individual user. This resulted in personalized experiences of the connection between sliders settings and results, influencing the participant's use of the system. This may call for a more flexible approach in designing sliders. The ability to swap sliders and deactivate sliders was received well and used by participants as a way of tailoring their search to cover those

aspects of tourist activities that mattered the most to them. This was seen as a useful feature that improved their search experience. Participants happily used the two features in a mutually exclusive manner, in that users who deactivated sliders would not swap sliders, and users swapping sliders did not deactivate sliders.

FUTURE WORK

While this study has emphasized the use of continuous sliders, it is clear that this approach cannot stand alone. Sometimes users want binary search tools, other times continuous search tools. Therefore, future research should strive to incorporate different variations of interaction mechanisms to give the user more control of the search approach. Perhaps we need three-state switches for binary filtering with a disjunctive or conjunctive middle state. Perhaps we need sliders to describe degrees of various continuous characteristics while also having sliders to adjust the ratio of two binary properties. The design and configuration of these interaction mechanisms needs more exploration.

ACKNOWLEDGEMENTS

Thanks go to the 10 participants taking part in the field evaluations and to the local tourist information centre, VisitAalborg, for providing data about tourist activities in Aalborg.

REFERENCES

1. Adomavicius, G. and Tuzhilin, A. Toward the next generation of recommender systems: a survey of the state-of-the-art and possible extensions, *Knowledge and Data Engineerin*g, 17 (2005), 734-749.
2. Ahlberg, C., Williamson, C., Schneiderman, B. Dynamic queries for information exploration: an implementation and evaluation. *Proc. CHI 1992*, ACM(1992), 619-626.
3. Ayers, P. and Youssef, A. Investigating the influence of transitory information and motivation during instructional animations. *Proc. ICLS 2008*, ISLS (2008), 68-75.
4. Bellotti, V., Begole, B., Chi, E. H., Ducheneaut, N., Fang, J., Isaacs, E., et al. Activity-based serendipitous recommendations with the Magitti mobile leisure guide, *Proc. CHI 2008*, ACM (2008), 1157-1166.
5. Cheverst, K., Davies, N., Mitchell, K., Friday, A. and Efstratiou, C. Developing a context-aware electronic tourist guide: some issues and experiences. *Proc. CHI 2000*, ACM (2000), 17-24.
6. Gavalas, D., Konstantopoulos, C., Mastakas, K. and Pantziou, G., Mobile recommender systems in tourism, *Journal of Network and Computer Applications*, 39 (2014), 319-333.
7. Google. Google Play Store Installation Statistics. developer.android.com/about/dashboards/ (10/05/2015)
8. Lazar, J., Feng, H.J., Hochheiser, H. *Research Methods in Human-Computer Interaction.*Wiley, West Sussex, UK, 2010
9. Marchionini, G. Exploratory search: from finding to understanding. *Communications of ACM, 49*, 4 (2006), 41-46.
10. Pearce, J. iFish webpage. Available: people.eng.unimelb.edu.au/jonmp/projects/iFISH/ (10/05/2015)
11. Pearce, J., Chang, S., Alzougool, B., Kennedy,G., Ainley, M. and Rodrigues,S. Search or explore: do you know what you're looking for? *Proc. OzCHI 2011*, ACM (2011), 253-256.
12. Pearce, J., Chang, S., Kennedy,G., Ely, R. B. W. and Ainley, M. Search and explore: more than one way to find what you want. *Proc. OzCHI 2012*, ACM (2012), 469-478.
13. Pearce, J. and Pardo, S. To search or to explore -- that is the question: a study in mindful engagement. *Proc. OzCHI 2008*, ACM (2008), 251-254.
14. Pearce, J. and Pardo, S. So now you're ready to play: but with what? a system to encourage playful exploration. *Proc. HCIEd 2009*, ACM (2009), 2-2.
15. Ricci, F., Rokach, L., Shapira, B. and Kantor, P.B. Recommender Systems Handbook, Springer, 2011.
16. Schaller, R., Harvey, M. and Elsweiler, D. Entertainment on the go: finding things to do and see while visiting distributed events. *Proc. IIiX 2012*, ACM (2012), 90-99.
17. van Setten, M., Pokraev, S. and Koolwaaij. J. Context-Aware Recommendations in the Mobile Tourist Application COMPASS. *Proc. AH 2004*, Springer (2004), 235-244.
18. Williamson, C., Schneiderman B. (1992). The dynamic HomeFinder: evaluating dynamic queries in a real-estate information exploration system. *Proc. SIGIR '92*. 338-34

Discussion about the process

Having done two related research projects during the past two semesters, it is worth discussing the process of the two projects. The following will cover the actions taken in the projects, the reasons for those actions, their consequences and what could have been done differently. An illustration of the process can be seen in figure A.

In the second semester of 2014 I visited the Interaction Design Lab at The University of Melbourne as a visiting Master's student. Under local supervision of Dr. Jon Pearce, Assoc. Prof. Frank Vetere and later Dr. John Downs, we discussed several project ideas before settling on the final project. With the personal experience of trying to find something to do during a weekend, an idea arose about facilitating discovery of events in the city while being in the city. To get an understanding of the difficulties of finding events I conducted contextual interviews in the city centre, where most urban activities happen. The purpose was to inform the design of a mobile application for discovering urban events, and thus the interviews were combined with small tasks of finding something to do using whatever tools the participant found appropriate. Contrary to my own preferences, the participants were not particularly interested in the locality or price of an event, as long as it was something worth going to. It was clear, that the task of designing such an application was less about figuring out the practicalities of an event, and more about the potential experience of an event. With inspiration from iFish a design was created and discussed over several weeks, culminating with a seminar where I presented my designs for the Interaction Design Lab, and received plentiful feedback. Afterwards, the development of a working prototype began, and a workshop with 4 PhD students was later held to figure out the slider labels. Once the prototype was finished, laboratory evaluations were conducted with the participants from the contextual interviews and soon after, I returned back to Denmark. Here, I wanted to continue the work from Melbourne, but had to broaden the domain in order to make the project fit an Aalborg context. Based on the findings from the laboratory evaluation in Melbourne the system was redesigned and two prototypes developed. Development took much longer than anticipated and therefore pushed everything from the two field evaluations, launch of public test and questionnaire approximately one month later than planned.

The design of the study evolved based on the knowledge obtained from previous activities, meaning in hindsight, the study could have been executed completely different. In an alternative study design, I could have relied on the iFish software and saved time on developing a new system and used that time for further evaluations. However, the iFish software is not yet ready for mobile devices, meaning the system would have to be a desktop-system. As the contextual interviews in Melbourne showed, decisions about what to do are not always planned ahead, and the preferred tool for finding information about the events on offer was a smartphone. To cover this use scenario, the iFish software would not have been sufficient. However the results of

this study are not necessarily unique for a mobile system, and could perhaps also have been found using iFish software. Considering the number of participants for the field evaluations, a within-subjects study would perhaps have been a better choice than the between-subject to improve the reliability of the data sources. The choice of conducting field evaluations is also worth a discussion, as this was a very time consuming activity. When designing the study, it was expected that the added contextual information obtained from a field evaluation would have been of huge value, as in-situ studies are good at capturing how systems are used in their intended setting [7][2]. However, based on the results from the field evaluations, the extra contextual information did not provide a much richer understanding of the intended use, than what would have been expected in a lab setting.

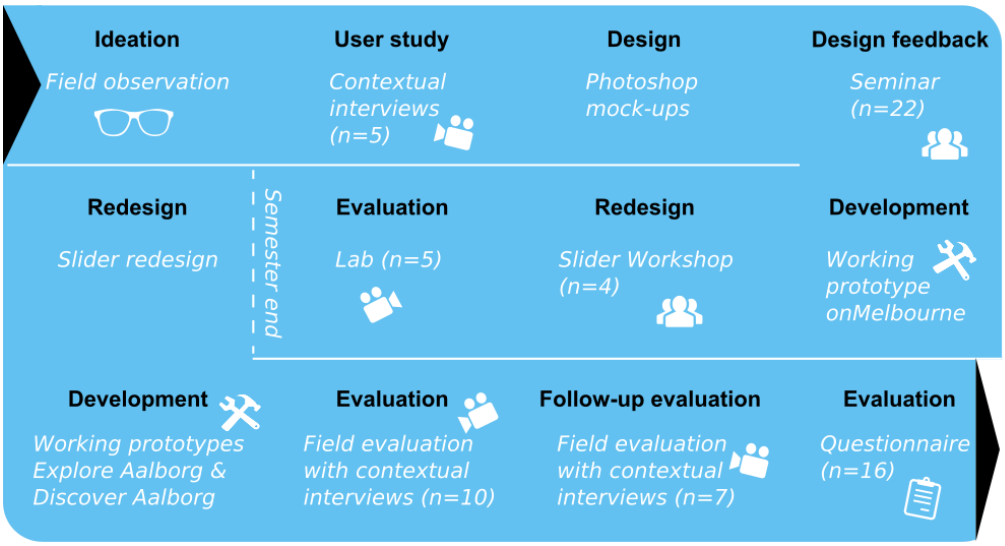

Figure A: Steps taken in the 2 projects

Discussion of findings across projects

Besides discussing the process of the two projects, it is also worth discussing the results of the two projects as a whole, and not just this last research project. Each project discovered their own unique findings, but also findings that are shared by both projects. The following will discuss the most interesting shared and unique findings.

Fear of missing out

In the Melbourne study, it was discovered that participants were afraid of missing out on potential events, and would thus scroll to the bottom of the result list every time they changed the slider. This was because they felt that the system was hiding information either due to disagreement in the tagging of data, or due to the system only showing a subset of results. While this was observed for all five participants in the Melbourne study, this was not the case in the Aalborg study despite explicitly asking participants about the issue. The reason for this difference is unknown, but it is reasonable to think that the temporality of the data stored in the system influences this feeling. Events like concerts or street performances are not recurring much and are bound to a particular time, making the consequence of not discovering that event in the system much worse compared to activities that are available most of the time. Since the Aalborg systems contain significantly fewer one-time events than the Melbourne system, the question about temporality might explain why the fear of missing out was not shared between the systems. The fear of missing out may also be attributed to a lack of trust in the tagging of the data, mentioned by many in the Melbourne study, and few in the Aalborg study. This calls into doubt the appropriateness of having a single person (or a group) deciding how items in the database are tagged in the first place. What is slightly active for a 20 year old is probably extremely active for a 70-year old, and what is very fun for one person, might not be fun for another. This discrepancy would probably have been more visible had the sampling of participants been more demographically representative. A possible solution could be profiling, where recommendations are based on user behaviour and similar users' behaviour [1]. Pearce and Chang implemented a feature where users do the tagging in an iFish variant called BookFish. Here, users decide what tagging database to use; the one defined by librarians or by the "crowd". The effect of this feature has yet to be studied [5]. This approach however, assumes that the average opinion of the crowd fits everyone, which might not be the case.

Slider understanding

One of the most interesting findings from both studies was how the sliders were being perceived differently. In the Melbourne study it was discovered that there were different understandings of how to interpret the middle of the slider, which could either be understood as deactivated or that it had its own value in between the slider

extremes. The explanation was found to be a lack of understanding of the slider labels and difficulty understanding the continuous nature of the slider. While this was also the case of the Aalborg Study, more details of the reasoning behind this behaviour have been found. The different understandings may now be attributed to differences in how people view the logic structures in the system and whether the slider use a binary AND, OR, or XOR logic to filter the results or filter in a continuous manner. In future designs, we must therefore be aware of how this logic structure is perceived if we are to better support users in performing query reformulations. It is hard to tell if the uncertainty of the sliders promote more exploration compared to sliders that are easy to understand, but users in both studies still made serendipitous discoveries despite the uncertainty of the slider logics. Exploratory search is already uncertain in terms of undefined goals and search approaches and uncertainty of even finding relevant information [8]. In that sense, uncertainty in the understanding of sliders may not necessarily pose a problem in exploratory search, but invite the user to explore the slider itself.

Serendipity

The key aspect of search is the ability to find a result. In exploratory search neither the result nor the means to find the result is given. Thus, the event of serendipity, "the encountering coincidental events or unanticipated circumstances, which can produce positive outcomes such as new insights or discoveries" [3] becomes very useful. While it is easy to find a result that you have never heard about in a huge catalogue, finding something new that you actually like is more tricky. In both studies, participants experienced finding something unknown, but more importantly made serendipitous discoveries, as they were pleasantly surprised by some of the results. This may indicate that transitory search is capable of facilitating serendipitous discoveries when performing explorative search.

Mix of search approaches

Both studies found that there is a need for combining look-up search activities with exploratory search activities. In the Melbourne study participants requested the ability to search by category or specific keywords, but it was not clear if it was only a matter of learning the system. The two studies in Aalborg showed that it was not a question of learning, but a persistent request. Thus, the two studies support the recommendations from [6] and [4], that exploratory search tools should facilitate look-up and exploratory search activities.

Transient search as a tool for exploring urban activities

Despite different understandings in the way the system work, both studies showed that participants were able to use the sliders and find new surprising results. Participants in both studies enjoyed playing with the slider and immediately see how

the results change. This indicates that transient search can facilitate explorative search of urban events, despite uncertainties in the understanding of the individual sliders.

References

1. Adomavicius, G. and Tuzhilin, A. Toward the next generation of recommender systems: a survey of the state-of-the-art and possible extensions, Knowledge and Data Engineering, 17 (2005), 734-749.
2. Kjeldskov, J., Skov, M.B., Als, B.S., Høegh, R.T. Is It Worth the Hassle? Exploring the Added Value of Evaluating the Usability of Context-Aware Mobile Systems in the Field. MobileHCI 2004, 61-73
3. Leong, T. W., Vetere, F., and Howard, S. 2012. Experiencing coincidence during digital music listening. ACM Trans. Comput.-Hum. Interact. 19, 1, Article 6 (March 2012), 19 pages.
4. Marchionini, G. Exploratory search: from finding to understanding. *Communications of ACM, 49,* 4 (2006), 41-46.
5. Pearce, J., Chang S. Exploration without keywords: the bookfish case. Proc. OzCHI '14, ACM 2014, 176-179
6. Pearce, J. and Pardo, S. So now you're ready to play: but with what? a system to encourage playful exploration. *Proc. HCIEd 2009*, ACM (2009), 2-2.
7. Rogers, Y., Connelly, K., Tedesco, L., Hazlewood, W., Kurtz, A., Hall, B., Hursey, J., and Toscos, T. 2007. Why it's worth the hassle: The value of in-situ studies when designing UbiComp. In UbiComp 2007, J. Krumm et al. Eds., Lecturer Notes in Computer Science, vol. 4717, Springer-Verlag, Berlin, 336–353.
8. White, R.W., Roth, R.A. Exploratory Search – Beyond the Query-Response Paradigm, Morgan & Claypool, 2009

Appendix

Designing Mobile Applications for Exploration of Urban Events within Physical and Temporal Proximity.

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ABSTRACT

Large urban cities can accommodate numerous events at the same time within a limited geographic area. With a variety of events on offer, and with a plethora of associated information available, it can be a difficult task to choose which event to go to. Though multiple mobile recommender systems have been developed to help people make such choices, these systems do not account for users adapting their preferences as a direct response to the recommendations that the systems give, thus restricting people's explorative nature and the serendipity of discovering events.

This paper investigates how to facilitate users exploring urban events while mobile in the city. Based on contextual interviews and a design workshop, a smartphone app was designed, and a working prototype developed. The app uses a set of sliders to allow people to explore information rather than submitting traditional search queries or applying filters. A user evaluation of this prototype suggests that selecting values on continuums of event characteristics to reformulate preferences, supports exploration of events with respect to qualities of an event rather than genre or location.

This paper contributes understanding on the user experience of sliders as an interactive exploration mechanism that enable just-in-time and just-in-place exploration of events to attend, on a mobile device while people are moving around the city.

Author Keywords
Exploration; Event finding; Continuums; mobile user interface design;

INTRODUCTION

Like many other large cities, Melbourne, Australia, hosts many events and festivals during the year. This year Melbourne hosts at least 50 festivals and between 70 and 110 events every single day [1]. With that many events on offer, figuring out what event to go to can be a difficult decision making task. This is especially true, if this decision is to be made just-in-time and just-in-place[2] only with access to the cues of the environment and/or a mobile phone. Print material may have limited utility in such situations, since it can take quite a long time to browse through all events, which might not even be available at the current time and place.

Using search engines have become a common way of looking up information online. In look-up search activities, the person seeking information knows exactly what to query in a search, to yield "*precise results with minimal need for result set examination and item comparison*"[3].

This approach is helpful when searching for a specific event. For finding out what event to go to among many other events available, a more open and exploratory search is required in order to compare events and reformulate preferences until a decision is made. Many smartphones apps have been developed to help facilitate this task of finding events. Though, in a preliminary examination of 20 event finding apps for Android, it was discovered that they require the user to filter events, by having a predefined idea about the category, time or location of the events to consider. This approach inhibits reformulation of preferences, thus limiting exploration.

Previous work by Pearce et al. has investigated how a system called iFish can facilitate exploration of large unknown dataset within different domains using continuums as a search mechanism directly manipulating the ordering of results. With iFish, they have investigated how students may explore university subjects[4], how to explore restaurants[5, 6] and a range of other domains such as books, people, conference papers and more[7]. iFish has shown its usefulness in exploration of different datasets on a desktop computer. However, this setting has plenty of screen space to properly show enough information to compare items and manipulate queries simultaneously, while situated in a static use environment unbounded by time and space. Smartphones do not have these luxuries, and it is not known how such an explorative system would work on a smartphone used in context and for data as volatile as urban events.

Building upon the idea of iFish, this project investigates how the concept of exploring data using continuums as a tool for rapid preference reformulation is suitable for

finding events on a smartphone just-in-time and just-in-place.

The structure of this paper is as follow. First, related work in the areas of event-finding and mobile recommendation systems is presented. Then, the process of developing a design for a mobile event finding system will be presented, followed by a presentation of the implementation and evaluation of a working prototype. Finally, the findings from this evaluation will be discussed.

RELATED WORK

Forsblom, Nurmi, Åman and Liikkanen [8] developed the mobile app "Sounds of Helsinki" to support serendipitous discovery of events by notifying users about new recommendations based on either geographic proximity to the event or random location. In a questionnaire the participants did not find the individual recommendations particularly relevant, but were satisfied with the app as a whole. Using in-app rating-statistics the authors found that recommendations of events based on location were not rated more relevant than recommendations based on a random location. This was attributed to a maximum possible travelling distance of 15 minutes for all recommendations[8].

Schaller, Harvey and Elsweiler[9] created and tested a system for finding events during a festival in Munich, Germany. Contrary to Forsblom et al., they found travel time to be important, though the events were distributed amongst different cities resulting in longer distances. The system contained four different discovery mechanisms, each used for different purposes by the participants. When users knew exactly what they wanted they used a search bar, and when they wanted inspiration they browsed through lists of genres and locations[9]. This behaviour connects well with Marchionini [3] who distinguishes between two types of search activities, look-up search and exploratory search. In look-up search activities, the person seeking information knows exactly what to query in a search, to yield *"precise results with minimal need for result set examination and item comparison"*. Conversely, if the information seeker does not know what to query in a search, engaging in an explorative search is a more suitable approach. This kind of search requires comparison of results and reformulation of queries in order to discover new results[3].

iFish:

Pearce et al. [4-6, 10] have worked with exploration of large sets of data using the iFish web application. iFish is a desktop system, where the user formulates his/her preferences using sliders and filters. When reformulating these filters and sliders the list of results is instantly reordered, so that the items matching all the sliders and filters the best is on the top of the list. When the re-ordering occurs animations of items bubbling up and down are

Figure 1 iFish for restaurants

performed to visualize the re-ordering of items. In a lab study, they investigated how students explore university subjects outside the field the students were majoring in. They found that participants did not explore subjects more deeply than with a printed handbook, which was attributed to a delay in the re-ordering and wrongful categorization of sliders. Once set, the participants did not alter their sliders afterwards and they were not satisfied by seeing a subset of the subjects[10]. In a later study they conducted a comparative study of a two restaurant finding systems. One system used sliders to indicate preferences, while another used menus to indicate preferences and a "search" button to start searching. They found the system with sliders was better when the search parameters were ill-defined and the system with menus was better for well-defined search parameters. Users spent more time reading about the restaurants using the slider system and were more satisfied[6].

Other Android apps:

Several apps have been developed to help people find different kinds of events. In a preliminary examination of 20 event finding apps for Android (See Appendix A) it was discovered that these apps require the user to have a predefined idea about the type of event to attend. Applying a hierarchical/sequential way of finding events the user must apply different filters that exclude events that do not adhere to these filters. Two types of filters were observed; Category and Temporal.

Category filters, divides events into categories such as Music, Theatre, Art, Performances and so on. Each category may contain sub-categories. In order to explore events the user must pick a category on one screen and browse through the list of events on another.

Temporal filters are often combined with the category filter and work in a similar matter, in that the user picks a time and/or date to browse through events. Whilst the temporal filter is a practical tool for excluding events not optional to

see now, the category filter is not. This is because in order to find inspiration for an event to go to, the user must navigate the application like a folder-structure, going back and forth between choosing different categories and browsing events. This approach seems ineffective and unsatisfying, as the user must have a clear idea of what to look for in order to choose the appropriate filters. If not, relevant events may remain undiscovered.

Besides filters, another common feature is to sort events by distance to the venue or by alphabetical order. Apart from the alphabetical sort, sorting by distance may be a practical tool if the means of travel are constrained and events physically distributed, but it does not describe anything about the event itself, and thereby help find the right event. This same problem applies for map representations. These apps seem to come short in letting the user explore events and in delivering serendipitous discoveries.

Recommender systems

To address the issue of discovering new things, recommender systems (RS) have been used for several years to prevent information overload by matching information from the user(s) with different characteristics resulting in a recommendation for specific items, such as movies, books, news etc. [11-13]. Ricci et al. (2011) describe six types of RSs, based on which information they recommend. One of these is the constraint- and knowledge-based RS, which recommends items based on constraints and rules explicitly defined by the user [13]. Gavalas et al. (2014) identifies a challenge with this approach, since people often don't know what their preferences are until they are presented with a choice [12]. This makes it difficult for users to give the right input to this kind of RSs, resulting in the RS returning non-optimal recommendations. To address this issue, the choice of rules and constraints needs to be dynamic and enable the user to easily explore the results of different constraints and rules to ease decision making.

With smartphones sales surpassing feature phones[14], recommender systems can be used in many mobile devices. This presents a challenge for visualizing recommendations, due to the limited screen space [12]. Smartphones have also facilitated access to online services while on-the-go which can be useful for people, who are visiting places they have never been to before. Tourists, who visit new unknown locations, can now use their mobile phones to search for restaurants, museums, shops, public services, and so on in systems like the GUIDE[15], COMPASS[16], and Magitti[17]. In highly touristic areas the number of search results can be very high, making it difficult to make an informed decision [16]. This may also be an issue for residents in these tourist areas.

Having a smartphone with location sensing capabilities means the user can be close to the recommended locations and be able to do decision making just-in-time when exploring a location. While there has been some work in creating mobile recommender systems for tourism [12], many of these systems do not enable users to easily and playfully explore events at their location.

In summary multiple mobile recommender systems and event finding systems have been developed to suggest various attractions, but without letting the user easily change his/her indicated preferences, and does not account for situations where the search parameters are ill-defined. iFish has proposed an interesting approach to exploration, which this project will extend.

RESEARCH DESIGN

This study reports how searching with continuums can be used in a mobile app designed to facilitate users' exploration of urban events. Through contextual interviews with 5 participants in Melbourne City Centre, it was investigated how people explored data about events happening just-in-time and just-in-place. Combined with a design workshop with PhD-students from University of Melbourne's Interaction Design Lab and previous work by Pearce at al. [4-6,10], inspiration for a design emerged. Over the course of 7 weeks a working mobile prototype was developed, called onMelbourne. This was later evaluated in a laboratory setting with the same participants from the contextual interviews. The focus of the evaluation was to investigate the appropriateness of sliders as a tool for exploration of city-wide festival events.

USER STUDY

In order to get an understanding of how people currently look for events, contextual interviews[18] were conducted with 5 participants in Melbourne city centre in September 2014.

Before embarking on a walk around the city with contextual interviews, an informal field trip was conducted during Open Day at The University of Melbourne to capture the ambiance of 60,000 visitors attending multiple events of both an academic and entertaining nature [Appendix B].

Based on the impressions from University of Melbourne Open Day, Federation Square, Melbourne, was then chosen as location for the contextual interviews as it is a public space in Melbourne, which acts as a forum for various performances, cafés, exhibition spaces and a visitor centre. Many people pass through this area, which often means there is something going on, creating the same kind of ambiance experienced at Open Day. This place was used for the first interview, but due to poor weather conditions, not much was happening there. A more sheltered location at Bourke Street, a busy shopping pedestrian street, was chosen for the remaining interviews, which also had an ambiance similar to Melbourne University Open Day.

Participants

The participants were recruited through personal contacts and the snowball recruiting effect, and consisted of three female and two males, all in their twenties who owned a smartphone. Two were students, while three were working.

Method and data collection

Each participant was introduced to a scenario involving the task of finding an event during Melbourne Festival like for example, a music performance, art, theatre or similar. They were allowed to use whatever tools they wished including asking staff at the nearby visitor centre, using their phone or a booklet about Melbourne Festival events[1] circulated by the Melbourne Festival organizers, made available by the interviewer. To get an understanding of what influenced their decisions participants were to think aloud while looking for an event to attend and were probed when failing to do so. Semi-structured interview questions prepared beforehand were asked when appropriate. This included questions about the participant's prioritization of event characteristics such as time, location, price, event type, genre and so on.

Visual and audio data was collected with a handheld camcorder, which was operated by the interviewer.

Analysis

Due to difficulty simultaneously operating the camera and conducting the interviews, the audio data was the main source for analysis accompanied with video when applicable. From the data 119 unique codes were identified and through affinity diagraming [18] 8 categories were identified which will be discussed in the next section.

Findings from user study

From the analysis of the user study, it was clear that people chose events based on how attractive each participant finds the events. Attributes like the price of the event, distance to the event, time of event, and the duration of an event are all negotiable criteria that are first considered after an event has been deemed interesting. The main priority is therefore to find the right event, and then afterwards consider if the price/time/event trade-off is acceptable.

Distance trade-off

The distance itself does not matter. Instead, the distance is an indicator of the effort required to get to the event, both in terms of monetary, temporal and physical efforts of transportation. Since events take place at different locations throughout the city, it is necessary to consider the means of transportation when considering going to an event. This finding is also supported by Forsblom et al. (2012). It was discovered that choosing events based solely on distance is not suitable, as the notion of "close-by" is influenced by the perceived attractiveness of the events, the price and timing. If the price is perceived low compared to the event, "close by" is considered as approximately 1-5 blocks (100m-500m). If the price is perceived high, the notion of "close by" changes to 1-10 blocks (100m-1000m).

Personal recommendations matter

When judging whether an event was worth going to, participants stated that they find trustworthy recommendations important. To be trustworthy, the recommendations should originate from e.g. friends, an employee at the visitor centre, or connections on Facebook or Instagram.

Price trade-off

As with distance, the amount of money participants were willing to pay for an event depended on the kind of event. The participants would be more willing to experiment with a non-recommended event if the price is low (0-10 $ was suggested) compared to events with higher price tags. The same trade-off was noted between events further away and a lower price. If an event was recommended by another trustworthy person they would be willing to spend more money.

Time trade-off

Likewise, the duration of the event must correspond to the temporal and financial cost of getting to the event. If an event takes two hours, and it takes one hour to get there, the benefit does not outweigh the cost. Unless it is an event the participant expect to be satisfying.

The fuzzy relationship between price, distance, time and event desirability makes it difficult to create a decision model for recommender systems.

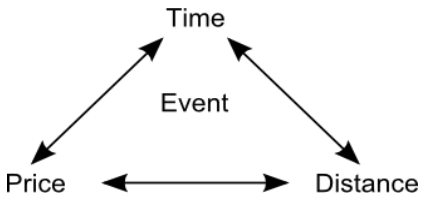

Figure 2 Relationships between event, time, price and distance.

Browsing events

When browsing through the Melbourne Festival booklet, participants emphasize the importance of the event picture. Pictures are very important as concise way to describe/illustrate the event so that people could gain a quick impression of what the event was likely to be about thus easing the browsing experience. Combined with the title of the event, participants quickly judged whether an event was interesting to them and worth reading about.

[1]https://www.melbournefestival.com.au/media/79160/4p_planner_joomag.pdf

Planning

A small amount of intermediary planning before and after an event was also an issue for some participants as there might be a time gap between now and the starting time of the event. Ideas for things to do in the meantime were necessary. This could be handled by meeting friends for a drink, by eating at a restaurant or going shopping. Though, a couple of participants would not be content with receiving (sponsored) ads for these intermediary activities.

Filters

When looking for events in both the booklet and on their smartphones, participants started by filtering out those events that they were not able to attend that day. In the booklet this was done be browsing through the register in the back to make a shortlist of those events that was on offer that day. On the smartphones filtering by day was also observed, but also filtering by category or genre.

Preferences depends on day

Most of the participants mentioned the day of the week, and time of the day as important for which events they would consider. Going to a concert late Tuesday night, would not be an option as this would disturb the participants' sleep and make it harder to get up the next morning.

CONCEPTUAL DESIGN

Based on the information gathered from the user study and extending the works of Pearce et al., a design was created (See figure 3). For larger images see Appendix C.

Grid view

From the user study it was clear, that pictures of the events played a huge role in determining the nature and attractiveness of an event. Meanwhile, being able to perform comparisons of events was important as well. To cater for this, a large emphasis has been put on displaying big pictures of the events (see figure 2). These pictures are placed on cards in a scrollable grid structure. Each picture has a 1:1 aspect ratio, with a width taking up roughly half of the screen width, resulting in approximately 4-6 cards on display depending on screen resolution. This way the pictures are so big, it's easy to see what it is, yet small enough to be amongst others for comparison. By displaying multiple events on the screen at the same time, it is also possible to see the rearranged order of events when indicated preferences are changed.

Since the participants also rapidly assessed the events by their names in conjunction to the pictures, the title of an event is layered on top of the picture making it easy to spot and read. By layering the title on top of the picture, valuable screen space is saved. From the analysis it was found that information about the starting time and ending time was more important than the price and location of the event. Hence, information about starting and ending times is shown below the picture and title. Likewise, knowing the category of an event was found important, so information about the category is also displayed. Recommendations were important for some of the participants in order to judge the attractiveness of events. Therefore, the number of other users who have decided to shortlist a particular event is shown, to illustrate the popularity of the event. Alternatively this number could be replaced by the number of *likes* from social connections, illustrating the popularity of the event amongst more trusted people. Though, in the case that no connections *like* any events, this approach would not be very useful.

Shortlist timeline

Because the participants found multiple candidate events worth to consider, and afterwards made a decision from these candidates, the app enables shortlisting. This way the user can change the sliders to explore more events, without "loosing" an event or having to set the sliders again to find that event. As a suggestion to further facilitate exploration

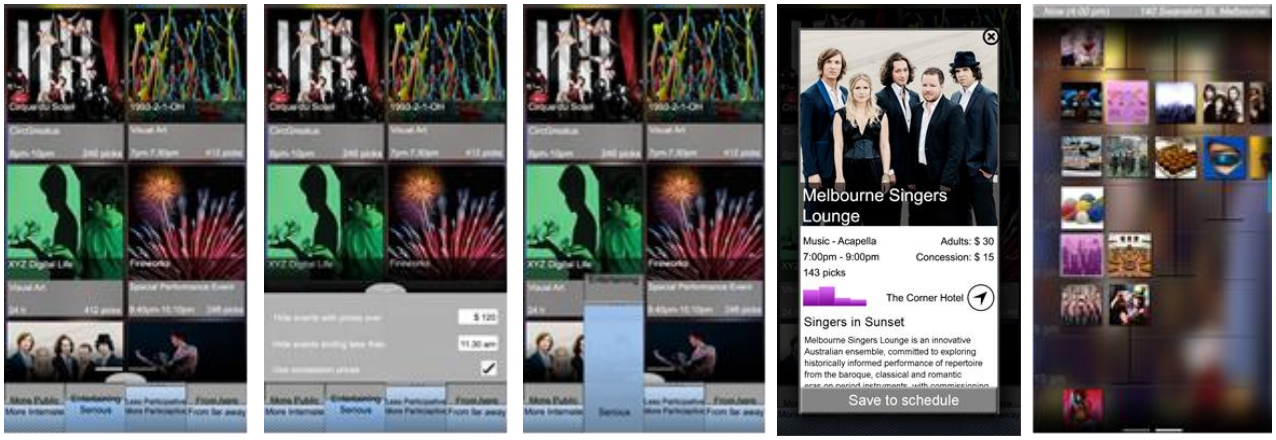

Figure 3 - From left: Idle exploration screen, filters slide-up menu, slider activated, popup window, shortlist timeline screen

this shortlist is combined with a timeline interface where preceding and subsequent events are suggested to the user (see figure 2). Hopefully this will let the user explore additional events that may fill the time leading up to the beginning of the shortlisted event, or in between several shortlisted events. The time line consists of thumbnails placed in scrollable horizontal rows according to the starting time of the event with horizontal bars indicating the duration and thereby ending time of the event. By scrolling vertically events starting at other times appear. The events shortlisted are highlighted to ease navigation and distinguish selected events from suggested events.

Popup

If the user wishes to know more about a particular event, it is possible to tap on that event, after which a popup window appears with additional information not displayed on the list, such as a description, price, and location of the venue, which can also be viewed on a map.

Sliders

Inspired by ideas from the iFish applications, sliders are used to indicate preferences. A bar of four sliders are located at the bottom of the grid view screen indicating the current position of the sliders. Upon tapping one of the sliders, the selected slider stretches beyond the bar, enabling manipulation of the slider setting. Screen space is saved by only showing the stretched slider, when it is to be manipulated. Upon dragging the slider handle or touching somewhere on the slider, the events are instantaneously reordered according to slider setting. When releasing the finger from the screen, the seek bar disappears and the list scrolls to the top, showing the events that match all the sliders best. By instantaneously reordering the list it is possible to directly see the effect of changing sliders. This is to invite the user to explore the data, by regularly adjusting the sliders based on the results.

WORKSHOP

During development of the prototype a workshop was held to elicit names for the slider tags. The participants were 2 male and 2 female PhD students from the Interaction Design Lab, The University of Melbourne. Prior to the workshop, all participants had attended a seminar about the project, and therefore knew the context of the project. To facilitate the ideation of words, each participant received a booklet from Melbourne Festival, and was asked to pick one or two events to go to. To give the participants time to think, they were to write down their thoughts about the events they chose to read about, and ultimately write their reasoning for choosing a certain event. Next, each participant presented their decision and why they found it interesting. Finally, participants were showed the current design of the app and encouraged to give input to new slider labels in a group discussion. Whilst this discussion was unfolding, descriptive words and suggestions for continuums were written on a large white board to facilitate the discussion and validate the participants' suggestions.

Choice of slider names

After the workshop, a list of slider labels was compiled from the participants' notes from the first task and words from the whiteboard. Combined with words describing events extracted from the video recordings of the workshop and video recordings from the first user study, the compiled list featured 24 pairs of slider names and 52 words describing events.

Afterwards, each item on the list was categorized into related groups and four pairs of slider names were chosen. The basis for tag selection is described below.

Since the purpose of the app is to let the user explore different kinds of events, the tags have to fit all types of events, not just music or art events etc. To avoid narrowing the users' choice of slider setting and to encourage an explorative behavior, the tags have to be non-quantifiable. That way, the user must engage in a continuous interaction between the slider and the results in order to learn the slider tags and arrive at a preferable slider setting. Due to the limited number of sliders, the tags have to be comprehensive by conveying various meanings connected to each other. For instance *Public* versus *Intimate* can mean the size of the venue, the crowd size or atmosphere of the event. Meanwhile, in order for the sliders to be understandable for all users, the words must have a relatively universal connotative meaning for the users. This is to avoid words like *Interesting* and *Provocative* which are highly defined by individual perceptions. Lastly the values are to describe the content, and not the practicalities of the event, such as price, duration, accessibility. Since these practical topics are secondary in the process of exploring events, they are more useful as filters which may be applied afterwards if necessary.

Based on the compiled word list and the above criteria the following slider tags were chosen.

Public ↔ Intimate: This slider pair categorizes events based on the size of the venue, amount of visitors and/or atmosphere. Events could range from street art to cooking classes.

Entertaining ↔ Serious: A slider to differentiate the purpose of the event. E.g. comedy shows vs environmental talks.

More participative ↔ Less participative: Distinguishes events based on how much the visitor is able to participate in the event by using their body and/or mind. This could range from a photography workshop to a movie in the cinema.

From far away ↔ From close by: This slider pair indicates what part of the world the event comes from. They are

thought as both a proxy for how exotic an event is, and a proxy for the chance of it reoccurring, and thus the quality of the event.

PROTOTYPE

Over a period of 7 weeks, a prototype was developed, focusing on supporting the participants' exploration of events by enabling playful interaction between sliders and result list. Thus, designs regarding shortlist timeline, filters and maps were omitted from the prototype.

Technical design

The prototype was developed for Android, targeted at API level 18. This platform was selected due to the author's technical skillset, ensuring immediate responsiveness when rapid updates of the UI occur. A web app might be more useful in a final app due to cross platform compatibility, but this was not necessary for the prototype.

Using a web crawler, data about 485 events in Melbourne were mined from The City of Melbourne's official tourism site, ThatsMelbourne.com.au. To reduce the workload of tagging each event, the tag-values were initially randomly assigned, but as the tag-values and the events clearly did not match, a need for a manual assignment of tag values was deemed necessary. As this required a substantial amount of manual work, the dataset was reduced to 87 events, in order to have enough data to test, while limiting the time consumption of tagging. To decide which events to keep, a principal of diversity was applied in terms of price, starting time and ending time, while the distribution of categories remained representatively. While tagging, the distribution of these values was continuously monitored to ensure approximate uniformity.

The event data is stored in a local SQLite database, and the best fit between all sliders and all events are calculated while the user is moving the slider. When the best fit is calculated, the data is sorted by the best fit, and the UI rearranges the tiles accordingly. This happens instantaneously. Every time the app is restarted, the sliders are set randomly, so the same results are not displayed every time.

The app itself consists of a minimum of hardcode, thus making it easy to maintain and update. By ensuring pictures does not take up more memory than available on the device, the app is also stable.

DESIGN EVALUATION

To investigate how useful sliders are for exploring urban events, an evaluation of the prototype was conducted in November 2014. The focus of the evaluation was on the participants' experience of thinking in continuums when looking for events and their overall experience with using the app for finding events. This includes investigation of the participants' satisfaction with the results returned by the slider setting and the participants' enjoyment when using the app.

Method and data collection

Learning from the difficulties of simultaneously recording and moderating in the contextual user study, this evaluation was conducted in a laboratory setting to give the researcher more control. A camcorder on a tripod was placed in front of the participant, facing down on the smartphone to record the participant's interactions with the app. Additional cameras and audio recording equipment were already mounted in the ceiling and was used simultaneously as backup in case problems occurred with the camcorder.

The participants were the same as from the contextual user study making it possible to refer to the situation from the contextual user study. They were introduced to a scenario much like the first user study, and afterwards shown a video created for Melbourne Festival[2] to help the participant's imagination and further set the context.

After viewing the video, the participants were given the task of finding a comedy event, to see how they interpret and adjust the sliders to find a specific kind of event. Afterwards, they were to find an event that fit an outing with their colleagues and would suitable for the work crowd.

Lastly, they were asked to find an event they would like to go to themselves, adjusting the slide.

Analysis

Video recordings of the participants' interaction with the app and audio recordings of their comments were used as data source for analysis of the design evaluation. While going through the data, only the most significant observations were coded, as time was limited. With that in mind, further findings may remain undiscovered.

Findings

Through a design evaluation of the prototype, it was investigated how users responds to the use of continuums as a tool for describing and exploring events.

Fear of missing out

All participants mentioned a fear of missing out on events. This fear is articulated in two situations. The first is if the user thinks the sliders works as filters, thereby only returns a subset of events. One participant said:

"But I can't really figure out if all the events are here (on the list) all the time or it sorts something out. Like, I'm always very afraid of missing out on anything"

[2] https://www.youtube.com/watch?v=aGu868nIHI0

The second is if the user suspects that the events may not be tagged correctly, so relevant events may hide somewhere in the result list. One user said:

"I always go through the (entire) list" [...] "I want to be sure I'm not missing an important event", while another said: *"There could be a cool event down at the bottom, because one of the sliders are wrong"*

This indicates a lack of trust in the system, as participants fear it does not show them all relevant events.

Sliders middle has different meanings

Putting a slider handle in the middle of the continuum conveyed different meanings depending on the users' Understanding of the sliders names. If they don't understand what the slider means (fx *From far away/From close by*) or the sliders does not matter, putting the handle in the middle of the continuum, neutralizes the slider. If they do have a clear understanding of what events might fit in the middle of the slider, they use more of the continuum. One participant put the slider for entertaining/serious in the middle and said:

"I'll take something where I can get a bit inspired. That could be good. So I am taking a middle thing between entertaining and serious stuff. I don't want to hear about heart deceases in Australia, but still I don't want to see a circus"

Afterwards the same participant considered the *From far away/from close by* slider. *"I'm not sure that matters"* and proceeded by setting the slider in the middle. As this behavior was exhibited by all participants, it was clear that the *From far away/From close by* slider was a bad choice of slider, underlining the importance of choosing understandable slider names.

Learning to use sliders

During the course of the evaluation the participants learned how the sliders worked. In the beginning most user were a little confused about what happened when using the sliders and misunderstood how the list of events behaved. After using the app they got a better understanding of the app.

Using sliders to describe events

All participants found the sliders to be helpful in describing events, and when asked if the sliders are helpful in describing event, a participant stated:

"I think, yeah, in general. I think they are much more helpful than I'm used to with apps. That's exactly what I am asking when I am looking for an event. So yeah, they are really handy"

Using sliders to find events

Overall participants found the sliders useful, as a way of finding new events. Participants were fond of using sliders in general. One user said:

"I think it was useful. Like, I like this idea of the sliders. When I don't know what I am looking for.[…] "And this is easy, it's right there. So I like that".

And another participant stated: "*When I am looking for an event I want to know for example something that it is entertaining. It's important for me. [...] It's useful"*

Serendipitous discoveries

Several participants mentioned that they had discovered a type of event that they had not considered looking for to begin with. When trying to find an event for colleagues, one participant carefully adjusted the sliders and said:

"Yeah, I didn't think about a dining event, but now that I see it, it comes up to mind that it could be a really nice instance to get to know each other. Yeah, maybe tastings too…"

It should be noted that several usability problems were observed, which may have influenced the users experience with the prototype. These can be attributed to the fact, that the prototype was not fully developed, and will not be discussed in this paper.

DISCUSSION

Inter-researcher bias

When carrying out interpretations of qualitative data, one must be aware of the validity of the analysis if the goal is to make a general claim [19]. In this study all activities, including analysis has been carried out by one researcher, resulting in a low measure of inter-rater reliability. However, this study does not seek to make a general claim. Rather, the purpose was to understand user requirements to inform a design, which was later evaluated by the same participants. Even though the analysis itself was not validated by the participants, the outcome of the analysis, the design, was validated through a design evaluation.

Participants

Since this study consisted of only five participants in the initial user study and design evaluation, the results cannot be considered conclusive or generalizable in any way. However, the purpose of this project was to inform a design and build a working prototype, which will serve as a vehicle of investigation in the follow-up project.

Thinking in categories

From the design evaluation the participants articulated a need for more specific search options, such as dividing results into categories or searching for keywords. This supports the finding of Pearce (2004). It is not known if these requests will disappear after long term use of the app or not, but it may be worth considering implementing these features, as it cannot be assumed users are always clueless about what kind of event they want to go. Implementing

these features could further facilitate the task of figuring out what event to go to, despite limiting the explorative nature of the app. In that case it may be useful to enable different sets of sliders to match the chosen category of events, to facilitate exploration within that category.

Fear of missing out

From the design evaluation it was found that participants were concerned about not seeing the entire list of events when using the app. This concern was also identified by Pearce et al.[10]. To avoid this issue the UI must clearly tell the user that no results are removed from the list and make it clear that the most relevant results are at the top. This may be achieved by adding animations to show the users that the list is merely reordered. Alternatively, a brief introduction to the app could suffice. The fear of missing out on events could also be mitigated as user gain trust in the tagging of the events. To improve tagging, it might be useful to let the users contribute to the tagging, creating a more democratic classification of events.

Choosing the right slider names

As the slider "From far away / From close by" was relatively unused, the space that slider occupied was waste, and a better slider name would have been preferred. Figuring out the names of the sliders was a tricky task and easy to get wrong, which was the case for "From far away / From close by". The challenge is twofold as the slider must represent a useful characteristic of the events and also named in an understandable fashion. Nevertheless, some sliders may sometimes be less important than others for some users, thus calling for the feature of weighting sliders.

The system does not work well if the user wants to explore events within a particular category. It may therefore be relevant to enable filtering by categories. A simple filtering was discouraged by Pearce et al.[10], but it would be interesting to have different sets of sliders to match the characteristics of different categories. as comedy events can be described much richer than using sliders fitting all events.

Sliders as search tool

From the design evaluation it was clear that sliders were mostly useful when the participants were not trying to find any specific events, or specific category of events. When performing look-up search activities, the sliders were not so useful in returning satisfying results. In contrast, the sliders were useful for explorative search activities. This supports the findings of Pearce et al.

Determining the appropriateness of using sliders for exploration is highly dependent on the choice of slider names and assignment of slider-values to items. As this is a tricky and subjective task it is a challenge to implement sliders properly.

CONCLUSIONS

This paper has investigated the user experience of a mobile app designed to support users in exploring urban events in their vicinity. Through a contextual user study challenges of finding events within close temporal proximity were identified. A design to accommodate these challenges was created based on this user study and work by Pearce and colleagues. A workshop explored how to describe events in terms of continuums between two words. Subsequently, 4 pairs of slider tags were chosen to be used in a working prototype, which was later evaluated in a lab setting with previous participants. Having in mind that both user studies consisted of just 5 participants each, the results suggests that exploration of events by direct manipulation of data ordering through sliders is a useful and enjoyable way of discovering new events on a smartphone.

FUTURE WORK

A redesign based on the feedback from the evaluation user study, has yet to be developed and more insight about mobile exploration of events may yet be discovered. While this study has focused on developing a working prototype, a follow up study will investigate how exploration of urban events can be further facilitated based on the initial results from this study. In late February, Melbourne hosts a large festival called WhiteNight, which in 2014 consisted of 100 events during 24 hours and attracted over 500.000 guests all gathered in Melbourne City Centre[20]. With that many people filling the streets within such a limited amount of time, getting from A to B can be difficult. With many events distributed across the city centre picking the right event is important. In the next study, a large scale evaluation of the app will be conducted during Melbourne WhiteNight 2015. With 500.000 visitors, the number of potential participants is quite big. Combining app usage logging and interviews with participants after their use of the app during WhiteNight, the use of continuums as a tool for adapting preferences in response to the returned result list will be further examined.

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REFERENCES

[1] (20-11-2014). *Events*. Available: http://thatsmelbourne.com.au/Whatson/Pages/Whatson.aspx

[2] J. Kjeldskov, "“Just-in-Place” Information for Mobile Device Interfaces," in *Human Computer Interaction with Mobile Devices*. vol. 2411, F. Paternò, Ed., ed: Springer Berlin Heidelberg, 2002, pp. 271-275.

[3] G. Marchionini, "Exploratory search: from finding to understanding," *Commun. ACM*, vol. 49, pp. 41-46, 2006.

[4] J. Pearce and S. Pardo, "To search or to explore -- that is the question: a study in mindful engagement," presented at the Proceedings of the 20th Australasian Conference on Computer-Human Interaction: Designing for Habitus and Habitat, Cairns, Australia, 2008.

[5] J. Pearce, S. Chang, B. Alzougool, G. Kennedy, M. Ainley, and S. Rodrigues, "Search or explore: do you know what you're looking for?," presented at the Proceedings of the 23rd Australian Computer-Human Interaction Conference, Canberra, Australia, 2011.

[6] J. Pearce, S. Chang, G. Kennedy, R. B. W. Ely, and M. Ainley, "Search and explore: more than one way to find what you want," presented at the Proceedings of the 24th Australian Computer-Human Interaction Conference, Melbourne, Australia, 2012.

[7] J. Pearce. (10/10/2014). *iFish webpage*. Available: http://people.eng.unimelb.edu.au/jonmp/projects/iFISH/

[8] A. Forsblom, P. Nurmi, Pirkka, #197, man, and L. Liikkanen, "Out of the bubble: serendipitous even recommendations at an urban music festival," presented at the Proceedings of the 2012 ACM international conference on Intelligent User Interfaces, Lisbon, Portugal, 2012.

[9] R. Schaller, M. Harvey, and D. Elsweiler, "Entertainment on the go: finding things to do and see while visiting distributed events," presented at the Proceedings of the 4th Information Interaction in Context Symposium, Nijmegen, The Netherlands, 2012.

[10] J. M. Pearce and S. Pardo, "So now you're ready to play: but with what? a system to encourage playful exploration," presented at the Proceedings of the 2009 international conference on HCI Educators: playing with our Education, Dundee, UK, 2009.

[11] G. Adomavicius and A. Tuzhilin, "Toward the next generation of recommender systems: a survey of the state-of-the-art and possible extensions," *Knowledge and Data Engineering, IEEE Transactions on*, vol. 17, pp. 734-749, 2005.

[12] D. Gavalas, C. Konstantopoulos, K. Mastakas, and G. Pantziou, "Mobile recommender systems in tourism," *Journal of Network and Computer Applications*, vol. 39, pp. 319-333, 3// 2014.

[13] F. R. Ricci, L.; Shapira, B.; Kantor, P.B, , *Recommender Systems Handbook*, 1st Edition ed.: Springer, 2011.

[14] Gartner. (2014). *Smartphone Sales Surpassed Sales of Feature Phones for the First Time in 2013*. Available: http://www.gartner.com/newsroom/id/2665715

[15] K. Cheverst, N. Davies, K. Mitchell, A. Friday, and C. Efstratiou, "Developing a context-aware electronic tourist guide: some issues and experiences," presented at the Proceedings of the SIGCHI conference on Human Factors in Computing Systems, The Hague, The Netherlands, 2000.

[16] M. van Setten, S. Pokraev, and J. Koolwaaij, "Context-Aware Recommendations in the Mobile Tourist Application COMPASS," in *Adaptive Hypermedia and Adaptive Web-Based Systems*. vol. 3137, P. E. De Bra and W. Nejdl, Eds., ed: Springer Berlin Heidelberg, 2004, pp. 235-244.

[17] V. Bellotti, B. Begole, E. H. Chi, N. Ducheneaut, J. Fang, E. Isaacs, *et al.*, "Activity-based serendipitous recommendations with the Magitti mobile leisure guide," presented at the Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Florence, Italy, 2008.

[18] H. Beyer and K. Holtzblatt, *Contextual Design: Defining Customer-Centered Systems*: Elsevier Science, 1997.

[19] J. Lazar, J. H. Feng, and H. Hochheiser, *Research Methods in Human-Computer Interaction*: Wiley Publishing, 2010.

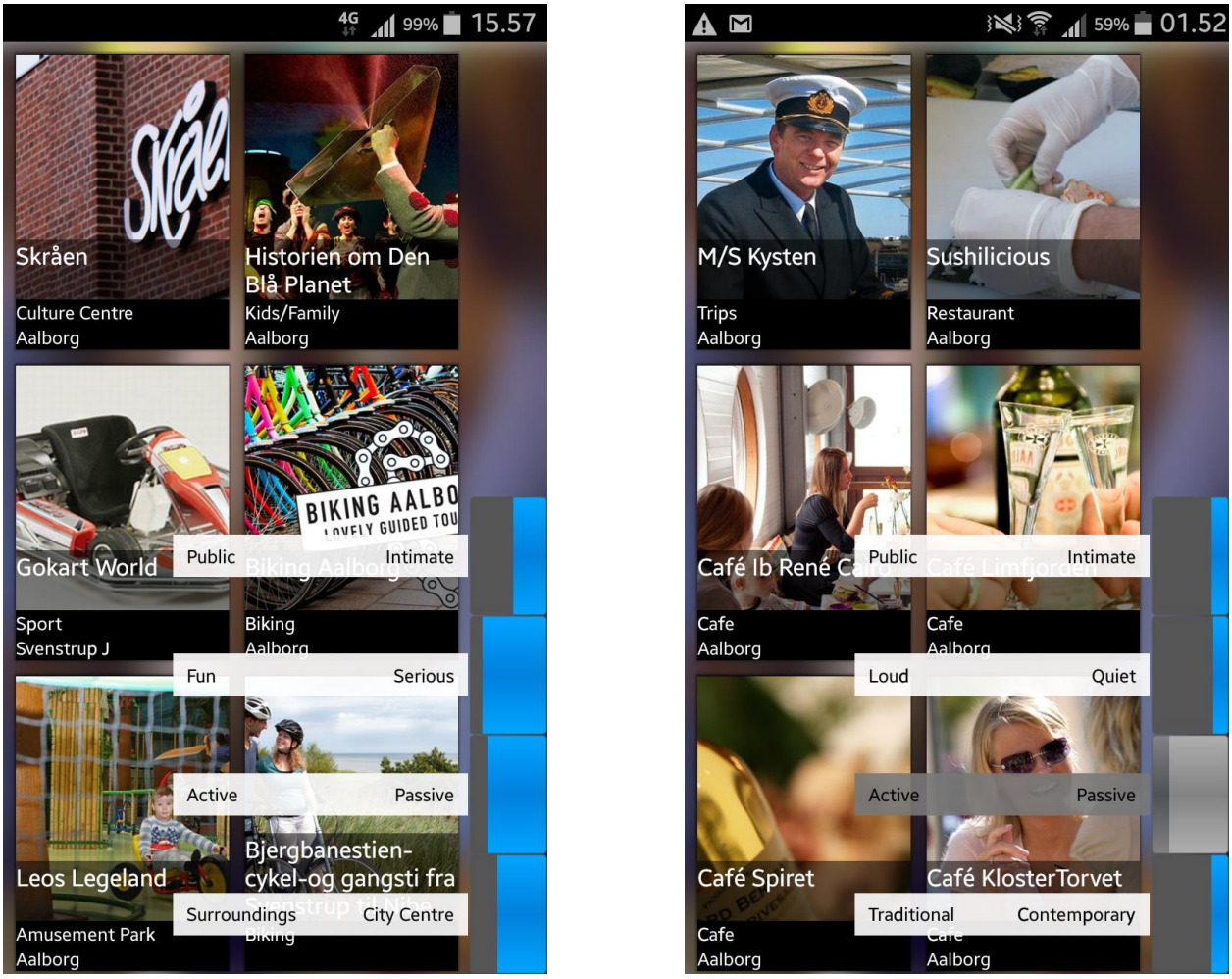
[20] "White Night Melbourne set to dazzle again in 2015," ed. http://www.premier.vic.gov.au/images/140909_Asher_-_White_Night_Melbourne_set_to_dazzle_again_in_2015.pdf: State of Victoria, 2014.

Appendix A: Information Schemes

Information about participants from field evaluation:

Participant #	Age	Occupation	Gender	System	Start-up evaluation date	Follow-up evaluation date
1	27	Grad student	M	V3	06/04/2015	Drop-out
2	23	Undergrad student	M	V3	06/04/2015	Drop-out
3	25	Undergrad student	F	V3	09/04/2015	25/05
4	21	Undergrad student	M	V2	08/04/2015	18/05
5	24	Grad student	M	V3	13/04/2015	15/05
6	26	Grad student	M	V3	08/04/2015	15/05
7	26	Grad student	M	V2	13/05/2015	12/05
8	25	Grad student	F	V2	09/04/2015	Drop-out
9	28	PhD student	F	V3	07/05/2015	18/05
10	21	Undergrad student	M	V2	08/04/2015	18/05
			M:7,F:3	V2:4,V3:6		

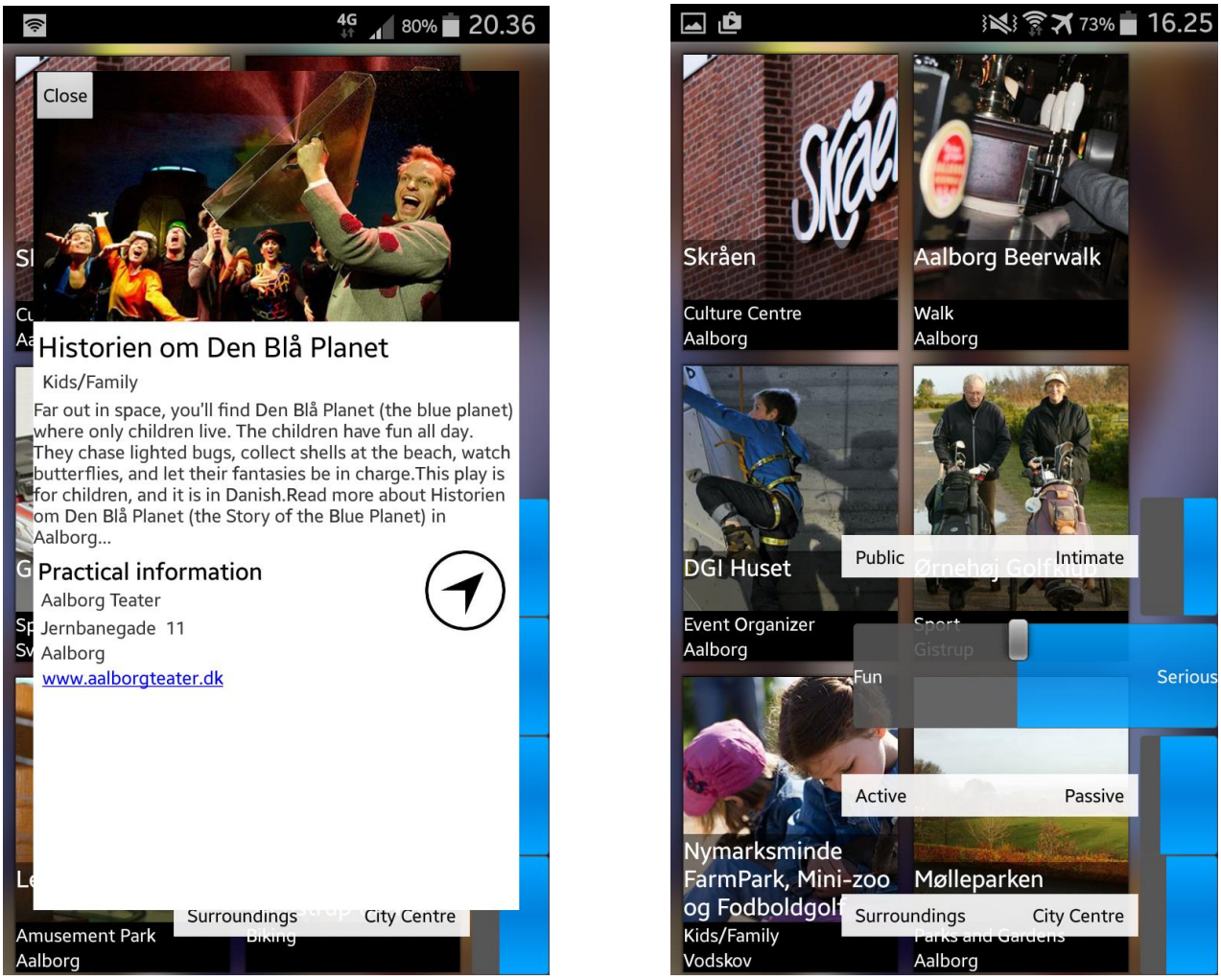
Appendix B: Pictures of system



Left: Explore Aalborg

Right: Discover Aalborg, with Active-Passive deactivated

Appendix B: Pictures of system



Left: Popup

Right: Slider expanded

Appendix C: Question guide

Common questions for Explore Aalborg and Discover Aalborg:

- What do the individual sliders mean?
- Is every slider relevant for describing an attraction or activity?
- What happens when you put the slider in the middle?
- What is the difference between putting the slider all the way to the side and putting it almost to the side?
- Did you find something relevant?
- Did you find something that surprises you?
- What do you think about the connection between your slider setting and the results you get?
- Would you prefer doing this on the phone or at a computer?
- Do you feel that you are not being shown all the results?

Specific questions for Discover Aalborg:

- What do you think about the ability to swap the sliders with a new on
  - What does it mean to you?
- What do you think about the ability to mix the configuration of sliders?
- What do you think about the ability to deactivate slider?
  - Does it change your perception of the middle?
- What do you think about the ability to remove an attraction or activity?

Appendix D: Quantitative evaluation of the system

The two systems were released to the broad public in Aalborg, May 27. Posters were put up at university locations in the city centre and on campus, along with posters at public libraries, and apartment complexes. Flyers were distributed at the tourist information centre, promotional pictures were displayed on their digital advertising screens and a banner featured the front page of their mobile website. Promotional material was also posted on the Aalborg subpage on reddit.com and on Aalborg related Facebook groups.

In order to download the app, people had to visit the website Exploration.dk, created for the purpose of the study. Here, every second visitor was assigned one of the apps and directed to a corresponding sign-up pages asking them to provide their email address. Once provided, they were redirected to the download page on the Google Play Store™. 43 users signed up in total, with 19 users assigned Explore Aalborg, and 24 users assigned the Discover Aalborg app. The unequal distribution is due to users aborting before submitting their e-mail address and thus "taking up" that spot. 4 weeks after launch a link to a questionnaire was sent to all the submitted e-mail addresses. This meant participants had different amounts time to try the system. A reminder was sent out 3 days after.

As of 30/05/2015 Discover Aalborg had been downloaded by 35 unique users and Explore Aalborg had been downloaded by 26 unique users. Of those, 10 originates from the field evaluations and 43 from the website, provided people actually downloaded the app after sign-up. This means at least 7 people had downloaded the app without visiting the website, suggesting the app had been recommended by some users or installed on multiple devices belonging to the same user.

Demographics

15 questionnaires had been administered for Discover Aalborg, and 11 for Explore Aalborg. Empty, or almost empty responses has been ignored along with and responses consisting purely of answers "Neither agree nor disagree".

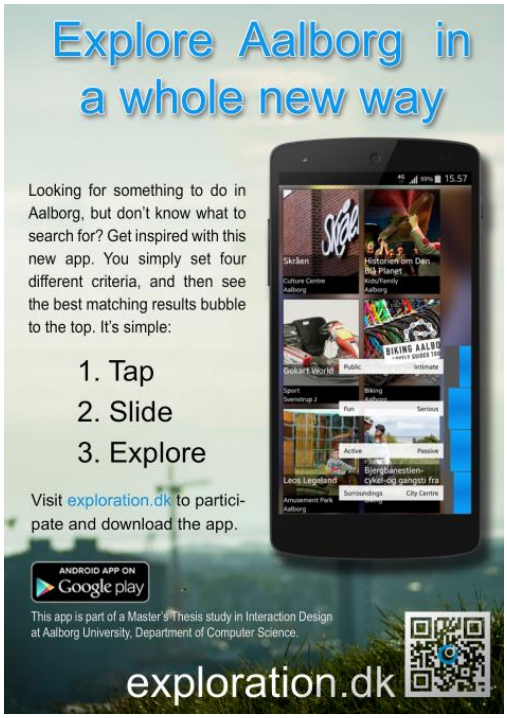
In the Discover Aalborg survey, 4 male (Mean age: 24.3; SD: 1.71) and 5 female (Mean age: 23.6; SD: 4.04) participants had proceeded further than page 1 and 6 of those participants had completed the whole survey. All were living or working in Aalborg.

In the Explore Aalborg survey 6 males (Mean age: 22.5; SD: 2.88) and 1 female (Age 24) participants had proceeded further than page 1 and 6 of those participants had completed the whole survey. 6 were living or working in Aalborg, 1 did not.

In total, 16 participants proceeded further than the first page about demographics.

Appendix D: Recruitment

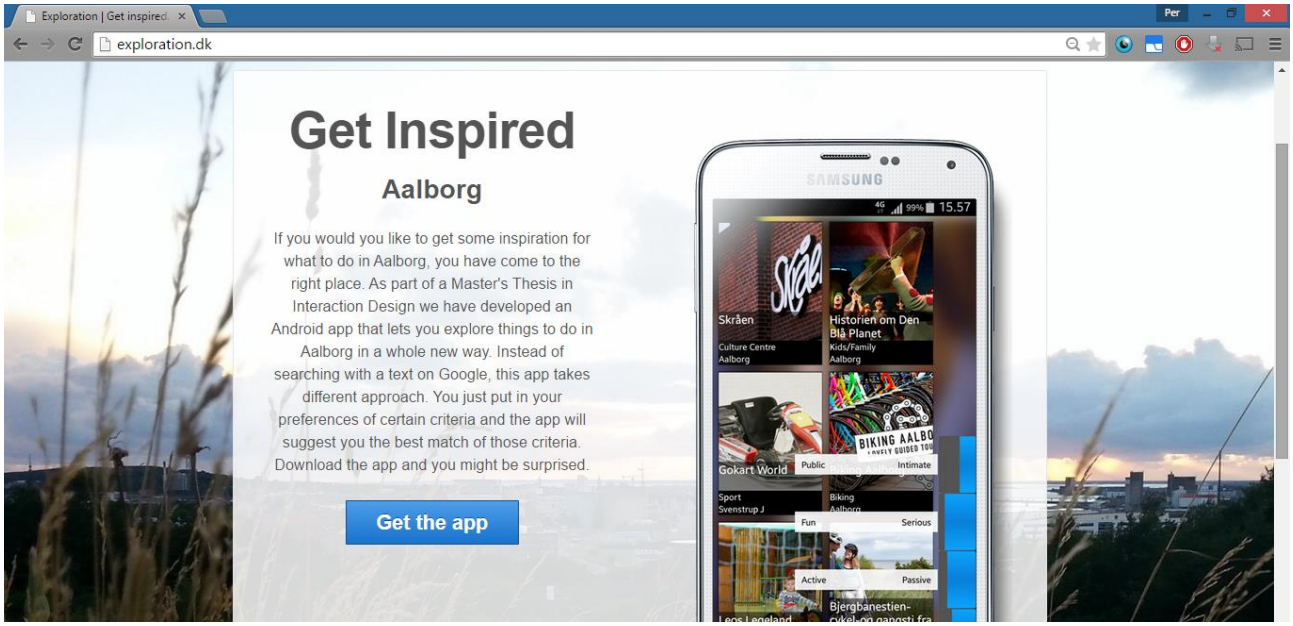
Type	Location	Period	Amount
Posters	University locations in the city centre, libraries and apartment complexes	6 weeks	110 pcs.
Flyers	Tourist information centre desk	6 weeks	100 pcs.
Information screens	Tourist information centre	5 weeks	4
Featured banner	Tourist information centre's mobile website	5 weeks	
Social media	Facebook groups in Aalborg and Reddit Aalborg	5 weeks	
Word-of-mouth		6 weeks	



Left: Flyer located at local tourist information centre

Rigth: Poster

Appendix D: Recruitment



Top: Website for signing up to the study. www.exploration.dk

Bottom: Mobile website of local tourist information centre. www.visisaalborg.dk