The Importance of Conveying Inter-Facet Relationships for Making Sense of Unfamiliar Domains

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ABSTRACT
The design of online retail environments has improved significantly by including features such as faceted navigation, which provide meta-data to users as a means to apply constraints over the available products. The position held in this paper, and supported by a growing body of evidence, is that the specific implementation of such faceted experiences can increase the support for more exploratory searches and sensemaking in unfamiliar domains of information. The challenge remains, however, to understand exactly what aspects of the browsers support sensemaking and how. We conclude that the powerful models of information seeking used in recent research can be combined with sensemaking models to understand more about what interface elements support users as they progress in their knowledge acquisition during sensemaking and more exploratory tasks.

INTRODUCTION
Online stores focus heavily on guiding users into quickly and effectively making decisions that lead to sales. By providing facets of metadata, such as price, brand, and quality, for example, users can intuitively apply constraints that will help narrow down the results to the items they are looking for. This technique has shown advantages over simply providing keyword search boxes, especially in particular domains of information. This scenario is fine, if not very effective, for users who are already clear about their needs, and how their choices will affect the results. Many users, however, may not know exactly what they need or much about the domain of information. For these users, the consequences of their actions need to be lightweight and easily reversible, as they will depend on the interface for supporting their decisions.

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Considering an example where a user is shopping for a new digital SLR (Single-Lens Reflex) camera, the user may be presented with facets such as price, brand and pixel-quality. Despite being given these options, the user may not know which price bracket, or brand, will give them their desired quality, or if the quality they desire is in their budget. The user can only discover such relationships between facets by trial and error, and by considering the different results that are returned, which may take some time given the relatively few results usually viewed [5]. The problem is further confounded when the user has made a couple of decisions such as a brand and a price bracket, but is not sure which constraint to then remove or if doing so will find better results.

In faceted browsers like iTunes, mSpace, and RB++, more information is provided about a domain of information, by both conveying relationships across facets and previewing the effect of decisions before they are made. They each share a similar spatial column layout, which studies have shown to better support information seeking tasks in unfamiliar domains.

Part of our position in this paper is that conveying inter-facet relationships, that is how facets of meta-data relate to each other, as well as how facets relate to results, provides useful and key information while making sense of a new domain. Two major questions, however, remain: 1) How exactly do these interface elements, and their combination, support sensemaking? And 2) to what extent can we extend the functionality of faceted browsers so that they continue to enhance sensemaking rather than impede it? The second part of our position, therefore, is that we need better models to understand the incremental effects of design variations in terms of sensemaking, knowledge acquisition, and cognitive load.

RELATED WORK

Exploratory Search is a research area that has primarily focused on alternative scenarios of search to the typical keyword search box made familiar to most users by online search [11]. The main criteria of such alternate scenarios are when the user may not know much about a) the domain, b) the information service (or website), or c) their own goals. A user who is thinking of buying a digital SLR camera for the first time, to continue the example, may not know more than simply that they would like to buy one, may know little about what makes a good one, and may have never used the online camera store before. In such a scenario, a user would likely find it hard to type anything into a keyword search box.

Marchionini [7] presented a diagram of exploratory search, shown in Figure 1 that highlights, although not exhaustively, many of the tactics that are involved more exploratory searches, such as comparison, synthesis of results, and evaluation. Tactics such as discovery are also related to information seeking strategies such as information scent [2], where the user follows what appears to be a valuable lead in order to try and better understand the information they have found.

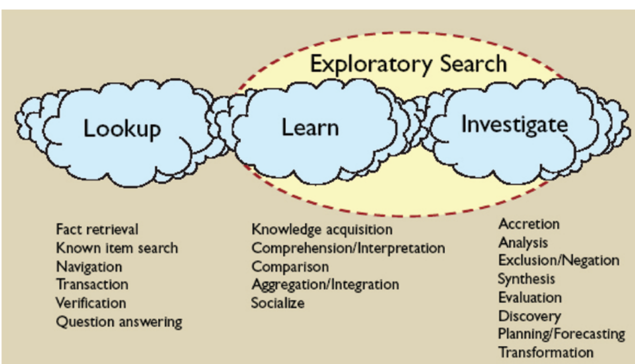

Figure 1: Strategies and Search Types involved in exploratory forms of search [7].

Russell *et al* present four main cognitive stages that are involved in sensemaking [8], where being able to effectively use facets to define a specific camera requires being in the fourth stage, where the user has constructed a schema to understand the domain of digital SLR cameras. Many of Marchionini's tactics may be used in the previous three stages, such as analysis, comprehension, and comparison, before the user has a strong schema about the domain.

FACETED BROWSERS

In previous work [16] we have begun to analyse how different approaches to implementing faceted browsers have appeared on the web and in popular software. All implementations, however, share the same aim of presenting facets of metadata to users so that they can use them to make decisions that narrow the scope of their search [4]. Flamenco was one of the first implementations of this idea [3], shown in Figure 2. This implementation is similar to that of many online faceted experiences, including those provided by eBay, Walmart, Borders Bookshop, Amazon, B&Q, Epicurious and many more. The main idea is that the user selects an item, such as a particular price range from the facet of Price, and the results and all remaining facets are filtered to show information that is related to that price bracket. The selected price range, in most implementations, is then placed in a separate breadcrumb space, listing all of the selections made by the user. The user continues by making another selection in the Brand facet, which is added to the list of selections breadcrumb, and the results and remaining facets show related information to the price range and brand selected.

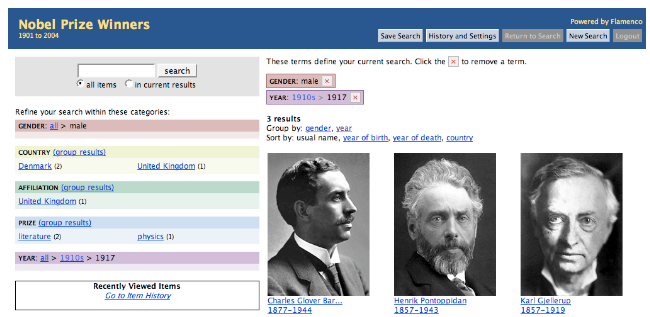

Figure 2: The Flamenco faceted browser, presenting a Nobel Prize Winners dataset.

There are some notable instances of faceted browsers that do not take this same approach. The iTunes music browser, shown in Figure 3, for example, presents three facets in three columns: Genre, Artist, and Album. A selection in any of these facets will only filter the facets to the right of the selection. Selecting an Artist, for example, only filters the Album column. There are good reasons for this different approach, as described further by Wilson and schraefel [16], which include rapid comparison, and that the user can, unlike in most faceted implementations, see: a) all the genres, b) all the artists in a selected genre, and c) all the albums from a selected artist in that genre. In terms of comparison, Lunzer *et al* discuss the benefits of subjunctive browsing, where a user can quickly compare two options [6]. If, like in iTunes, the list of Artists maintains a presence in the interface, despite the user having chosen one, then it is very quick and simple for the user to switch between multiple Artists before making a decision on one.

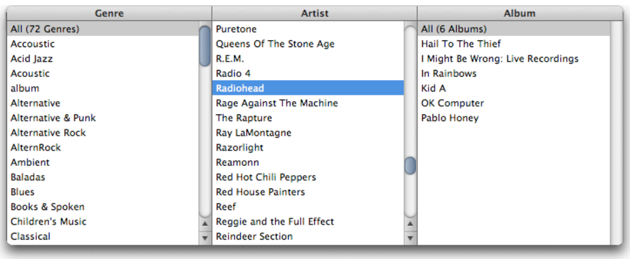

Figure 3: The music faceted browser available in iTunes, showing that Album is filtered by the selection of Radiohead, but Genre is not.

This column-based approach has been the focus of the mSpace project, which has produced a number of user studies into the mSpace browser [10], shown in Figure 4. Like iTunes, facets are shown in columns across the top of the interface and a selection causes filters in the columns to the right. In extension to the iTunes browser, the user has many optional column-facets and can add, remove, and re-arrange them as necessary. Further, mSpace provides Backward Highlighting [13], which would, if implemented in iTunes, highlight the Genres that Radiohead have worked in (see Figure 3).

Figure 4: mSpace column-faceted browser, showing a archive dataset of News Footage.

In terms of the position held in this paper, the faceted approach provided by iTunes, and our own investigation into the mSpace browser, appear to support users to more quickly discover information about their domain, as well as finding relevant results. In the next section we discuss the growing evidence found within our own research, which supports the notion that conveying inter-facet relationships is important when making sense of unfamiliar domains.

USER STUDIES INTO COLUMN-FACETED BROWSERS

Early work on mSpace, which led to the decision to have facets in columns, investigated two effects on finding information in an unfamiliar domain: multi-modal feedback and spatial versus temporal layouts [9]. Typical faceted browsers are often experienced as temporal, as after users make a selection, the screen reloads and is presented with new facets and/or filtered contents of the existing facets, as well as a subset of the results. To see the state before their selection, users have to press the ‘Back’ button and the action is undone. In spatial column layouts, like iTunes and mSpace, each user selection simply filters columns to the right, maintaining both the layout and their previous actions in doing so.

As noted above, a user can see a) all of the genres, b) all of the artists in one Genre (after the user has made a first selection) and c) all of the Albums from one Artist (after a user makes their second selection). In the early user study, it was clearly shown that spatial layouts had a number of advantages, and was usually preferred by participants. One advantage found was that spatial, unlike temporal, did not see a drop in performance with age of participant. In support of the position of this paper, clearly seeing the users path across the facets improved user performance on the information seeking tasks in the unfamiliar (to the participants) domain of classical music.

The use of multi-modal cues, within the facets (as opposed to for each result), was shown to help users make more educated decisions in finding enjoyable classical music pieces. Audio previews were played without the user having to make a selection, by hovering over items in the facets. Similarly, the RB++ browser has also shown that providing preview cues as to the effect of making a selection supports information seeking tasks [17]. In RB++, changes in the number of results associated with each item in each facet were previewed using bar-chart style representations behind each item. This allows users to see if making a selection will exclude important categories from their search, and thus allowing users to make a more informed decision.

In some of our most recent research into using highlights to enhance the inter-facet relationships conveyed by an iTunes style column-faceted browser, we again saw that consistent layouts with highlighted relationships encouraged deeper exploration and discovery of facts in unfamiliar domains of information [13]. One perceived problem of the iTunes approach is that if a user starts by selecting an Artist, then the left-to-right filtering model means that, although they see the Artists' Albums, they do not see any information about the associated Genres in the column to the left, as shown in Figure 3. Instead, the user is forced to scan the meta-data in the results to see which Genre's are associated with the selected Artist. The solution included in mSpace, is to provide 'Backward Highlighting' which would, put simply, highlight the Genres associated with the selected Artist. Combined with the benefits of the column-faceted layout, the highlights convey a greater number of inter-facet relationships.

A study of Backward Highlighting [14], clearly showed that a significant number of extra meta-data facts were discovered and remembered during information seeking tasks and recall tasks, respectively. An additional variable of the study was to see if there were benefits in grouping highlights together. The benefits of grouping were shown to be conditional, particularly when highlights were embedded in long lists. Conversely, however, when highlights were left in place, rather than being grouped, users were seen to explore deeper into the facets, finding significantly more secondary facts, such as how multiple items within one facet are related according to other facets. This result further supports our position that consistently organised spatial layouts, which convey inter-facet relationships, support sensemaking in unfamiliar domains of information.

DISCUSSION

Naturally, part of the aim of understanding the strengths of spatial column layouts, has been to compare them to the more predominant temporal faceted browsers. Comparing them, however, is quite a challenge, as reported by Capra *et al* [1]. In their study, they compared RB++ with a temporal faceted browser and a custom made website, and surprisingly did not find significant performance differences under that variable. Instead, more intricate differences were found, and they report that manually constructed experiences were, in the end, favoured.

In a bid to overcome these challenges and understand the differences between such browsers in more detail, the doctoral work of this paper's primary author has focused on using models and theories of information seeking to estimate their strengths and weaknesses [15]. The evaluation framework cam analyse search interfaces according to three aspects: strength of separate interface features, support for different seeking tactics, and support for different user types. For this position paper, the latter is most interesting, as the types of users included vary from clearly being able to articulate their needs (user type 16) to having to explore and make sense of a domain (user type 1).

While using this framework to evaluate the interfaces in the study by Capra *et al* [12], we saw that the user-types created by the tasks given match the user-types that were most equally supported by the three interfaces. It is not surprising, therefore, that the performance differences were not particularly significant. The analysis also showed where the more significant differences may have been. RB++ scored particularly high for the users who are learning about the domain, by recognizing information, and by working with the metadata (the content of the facets), rather than the actual information. Broadly, the support provided by the spatial layout and the preview cues increased towards the more exploratory and sensemaking user-types, whereas the temporally designed browser had a relatively flat level of support for all types of users. Part of the strength of the analysis, however, was that the individual aspects of the interfaces could be individually analysed to confirm the findings.

FUTURE WORK

While there is growing evidence that faceted browsers can support more exploratory forms of search, two questions remain. 1) how can we understand exactly how these interface elements affect, or indeed improve, sensemaking. 2), how far can we extend the functionality of such interfaces without overwhelming users and impeding their search. So far the research using models of information seeking strategies and user-types has allowed us to understand the additional support these changes are providing, and in a recent position paper we have proposed how we might further integrate models of cognitive load that might help us tell when users will be overwhelmed [16]. We aim to answer both questions presented here in future work by considering how sensemaking models might be further included to help how users progress in more exploratory tasks.

CONCLUSIONS

In this paper we have presented our position that, while faceted interfaces have, in general, made significant improvements in online retail environments, different implementations and interactions can further enhance the experience for more exploratory users who will be making sense of unfamiliar domains of information. We have reviewed a series of related user studies that contribute to the growing evidence of such a position, but we conclude with two further open questions: 1) how exactly do these advantages support sensemaking? and 2) how far can the functionality of faceted interfaces be extended before they become overwhelming and impede sensemaking? We aim to continue our research into theories and models in order to better understand how users progress in their sensemaking of unfamiliar domains during more exploratory tasks.

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