The In-Context Slider: A Fluid Interface Component for Visualization and Adjustment of Values while Authoring

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ABSTRACT

As information environments grow in complexity, we yearn for simple interfaces that streamline human cognition and effort. Users need to perform complex operations on thousands of objects. Human attention and available screen real estate are constrained. We develop a new fluid interface component for the visualization and adjustment of values while authoring, the *In-Context Slider*, which reduces physical effort and demand on attention by using fluid mouse gestures and in-context interaction. We hypothesize that such an interface will make adjusting values easier for the user. We evaluated the In-Context Slider as an affordance for adjusting values of interest in text and images, compared with a more typical interface. Participants performed faster with the In-Context Slider. They found the new interface easier to use and more natural for expressing interest. We then integrated the In-Context Slider in the information composition platform, combinFormation. Participants experienced the In-Context Slider as easier to use while developing collections to answer open-ended information discovery questions. This research is relevant for many applications in which users provide ratings, such as recommender systems, as well as for others in which users' adjustment of values on concurrently displayed objects is integrated with extensive interactive functionality.

Categories and Subject Descriptors

H5.2 [Information interfaces and presentation]: User Interfaces. - Graphical user interfaces.

General Terms

Design, Human Factors, Experimentation

Keywords

In-Context Slider, interest expression, in-context interface, fluid gestures, interaction design

1. INTRODUCTION

As information environments grow in complexity, we yearn for simple interfaces that streamline human cognition and effort. Interactive spaces contain thousands of objects. Users need to perform complex operations on individual objects and subsets. The limits of human attention and available screen real estate constrain the design solution space. We need to discover new interface components, which recognize and take into account the context of the user's situated task. In-context interfaces address these design issues by providing affordances in-place. Activation is *transitory*, that is, they only appear when necessary and requested. Clear mappings are based on fluid gestures. Activation rules are based on the user's context.

The present research is concerned with contextualized visualization and adjustment of a one-dimensional value. The task context integrates authoring and getting recommendations. It is conducted either in a space of many graphical objects, or in a text editor. With each graphical object or word, a value is associated. The set of these values constitutes the profile of user interests. Eliciting the user's input on ratings is sufficiently difficult that it proves to be a barrier of participation in many recommender systems [3, 11].

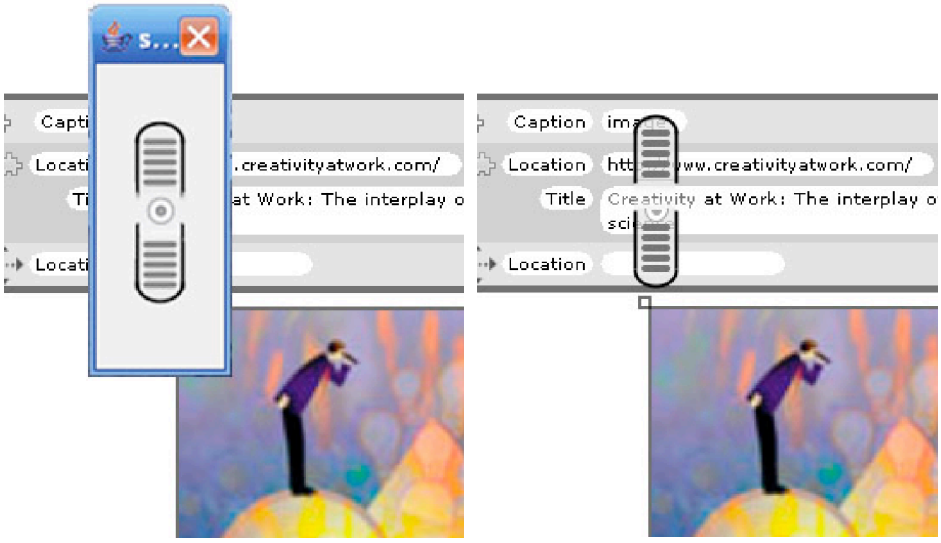
We redefine providing ratings in a human-centered way, as "expressing interest." We develop a fluid in-context interface for interest expression, which can be tightly integrated into other user tasks, such as authoring and editing of textual and visual information. Our hypothesis is that expressive interaction will be increased by reducing user effort and increasing feedback.

A typical interface design for adjusting a value associated with a graphic object or word is to display an input interface (e.g. slider or text field) inside a pop-up window that is often activated by selecting from a menu or sidebar. The pop-up can occlude the user's context (see Figure 1) or appear outside the current point of focus. Some alternative interface design methods dedicate real estate. Others require the user to press hot keys that lack visibility.

We develop the In-Context Slider, a fluid transitory affordance for visualization and adjustment of values. We describe the role of the In-Context Slider in the integration of interest expression with authoring. We present an evaluation based on text-editing and image ranking tasks. We introduce the combinFormation mixed-initiative information composition platform [9], and how the In-Context Slider fulfills interest expression needs within that platform. The platform plays a key role in information discovery tasks performed by 1000 undergraduate students annually. The student users are novices, with no particular computing background. We present user experiences of expressing interest to represent collections with composition. We then review related work and conclude by deriving implications of this research.

2. THE IN-CONTEXT SLIDER

The In-Context Slider is a user interface component that recognizes aspects of the user's situated task to provide transitory affordances in proximity to the focus object to support the adjustment of a value through fluid movements. We arrived at this solution through a human-centered iterative design process. The goal of the design process was to create a better interface for interest expression in combinFormation while not disrupting the user's experience of authoring compositions.



(a) **(b)**

Figure 1: Popup vs. In-context Interfaces

2.1 Layered Activation

What makes an in-context interface fluid is the ability to activate layers of the interface at the point of focus, in the midst of an interactive space, through simple gestures. Clear affordances are required to cue the user about how to trigger each successive layer. We call these affordances *activators*. An activator provides fluid transitions between the layers of interaction. Activation affordances must be designed so that their presence minimally disrupts other constituent functionalities of the context. Through layered activation, the affordance's capability and screen presence grow gradually, with the user's attention. The possibilities for interaction are always visually clear. The affordance for each successive layer of activation is positioned in-context, relative to the positions of the preceding activators. In order to prevent unwanted activations, a delay may be necessary before visualizing each layered activator.

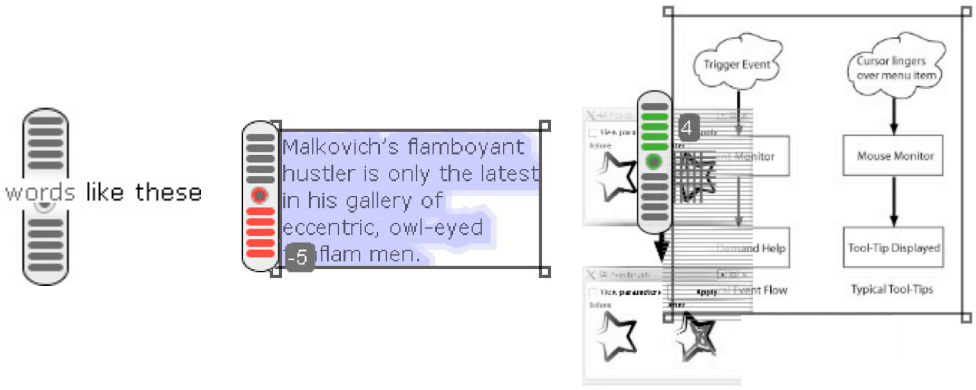
An In-Context Slider has three layers of activation. Each layer is activated by the mouse-over gesture. The activator in the initial layer, layer 0, is an object already in the interactive space, whose functionality is augmented by the In-Context Slider. As an activator, this object receives new functionality as an affordance for accessing the next layer of activation. In the present research, a layer 0 activator is an image, a word in a passage of text, or a whole passage of text (see Figure 3). While a value is visualized, disruption of context is minimized. Thus, editable text remains editable, while each word is augmented to enable interest expression. Since a layer 0 activator has other pre-existing functionality, mousing over it does not necessarily mean the user desires to activate an In-Context Slider. The user could be simply passing over the activator to interact with something else. To confirm the user's intention to interact, a small adjustable delay (defaulted to 550ms) is applied before visualizing the layer 1 activator. Interaction with the pre-existing functionality of a layer 0 activator, such as clicking to type a character amidst text, or click and drag to highlight, results in the immediate removal of the activator. Pulling the mouse off the layer 0 activator, away from the layer 1 activator, also removes both activators.

In the In-Context Slider, the layer 1 activator is an affordance called the *navel*. The navel is a small circular object that is designed to be differentiable from, yet not disruptive of its surroundings (see Figure 2b), and to form the center of the subsequent layer 2 In-Context Slider body (see Figure 2c). The location for the navel places it in close proximity to layer 0, while avoiding occlusion of visual features that are otherwise necessary for legibility and usability of the context. The navel comes in two distinct visual forms to accommodate different layer 0 activators. For images and passages of text, the navel is a full circle (see Figure 3b,c). For text, the navel is the bottom half of the full circle version (see Figure 3a). The horizontal edge forming the top of the half circle navel fits visually with the base line of text. As well, text is normally formed by a horizontal sequence of words across vertical arrangements of lines. The gap between the lines provides an appropriate unused space to place the navel. To avoid interference between text editing and activation of navels for text passages, the navel for a text passage is placed directly to the left side of the text (see Figure 3b).

Layer 2 is visualized by the body of the In-Context Slider, which expands vertically outward from the navel. The slider body contains a set of vertically stacked horizontal bars representing the possible values for the slider. The horizontal bars are split across the navel, so that bars representing positive values appear above the navel and bars representing negative values appear below the navel (see Figure 2c). As few as 3 pixels can be used for each bar and in between space. The total number of bars can be adjusted. The default number is ten, five positive and five negative. A slight

(a) **(b)** **(c)**

Figure 2: Example of Activation Layers, (a) layer 0, (b) layer 0 and 1, (c) all layers



(a) (b) (c)

Figure 3: Examples with all three layers of activation: (a) single word, (b) passage of text, (c) image.

translucence is applied to the slider body in the area surrounding the bars. This translucence allows visual objects occluded by the slider body to remain partially visible. As an in-context interface designed to minimize the cognitive effort on the user, keeping the focal point of the interactive space optimally visible is an important task. The translucence also gives the slider body a lighter than air quality, which is representative of its transitory nature as a layer of activation. Mousing off the slider body but onto the layer 0 activator removes the slider body and leaves the navel. Mousing off the slider body and off the layer 0 activator in the process removes both the slider body and the navel.

2.2 Visualizing Values

The present research applies Norman's prescription, to "make things visible" [13]. The current value of an In-Context Slider is visualized by highlighting, with hue, the navel and the bars in the slider body that represent the value (see Figure 4b, c). Color is a pre-attentive visual feature [12]. In our vision, hue is processed early and in parallel requiring no attention. This cognitive property of color makes it well-suited for visualizing value in an In-Context Slider. With the In-Context Slider body, positive values are represented in green by default, with negative values in red. The colors were chosen based on the stop light metaphor. The neutral value is represented by gray. Since gray is an entirely unsaturated color, the saturation of the color is used to represent the intensity (distance from zero) of the value. In other words, a positive value of five has a much higher saturation than a positive value of one. A value of five will appear greener than a value of one. The same applies to negative values with the color red. To handle physiological (e.g. color blindness) and cultural issues, the hues for positive and negative can be reconfigured.

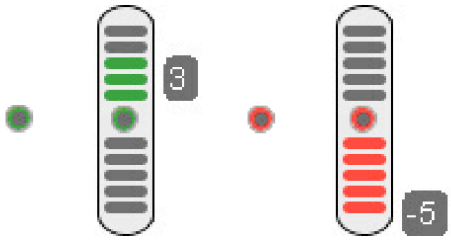
The navel and layer 0 activator provide mechanisms for visualizing the value of an In-Context Slider even when the slider is not activated to the third level. Inside the navel is a light gray ring that changes color to match the current value (see Figure 4a, c). This allows the In-Context Slider, while not fully expanded, to visualize whether the current value is positive, negative, or neutral and provide some indication of the intensity of that value. The layer 0 activator of an In-Context slider can also have its appearance adjusted to reflect the current value. For example if an activator is a textual word, the color of the word will change to match the color for its assigned value. This provides quick feedback in context to the user about the currently assigned value.

2.3 Interacting to Change a Value

To change the value of an In-Context Slider, the user moves the mouse cursor up or down over the layer 2 slider body. We chose move instead of drag to minimize effort. All bars from the navel (center) to the current mouse position are highlighted with the appropriate color (see Figure 4). A small popup textbox with the current visualized value appears to the side of the slider vertically matching the current mouse position. Once the desired value is visualized, the user clicks the left mouse button to set the value, and, depending on whether the mouse cursor is currently over the activator or not, the In-Context Slider either reverts to the collapsed navel-only form or disappears entirely. The user can choose not to change the value by simply moving the mouse off the In-Context Slider without clicking. If, after moving the mouse off, the mouse cursor is still positioned over the layer 0 activator, the In-Context Slider layer 1 remains in collapsed navel-only form. If the mouse cursor ends off the layer 0 activator, the In-Context Slider is fully deactivated, removing it entirely (both layer 1 and layer 2) from the screen.

2.4 Activating Multiple Sliders

In the iterative design process, it was discovered that a user might wish to assign the same value to multiple objects at one time. To accommodate this action, multiple layer 0 activators can be activated at once. Layer 1 navels remain visible for each activated object through the course of the activation sequence. The process of multi-activate is similar to that of marking a route on a map through a set of waypoints. The waypoints are the navels. The user enacts multi-activate by holding the left mouse button down while over the navel and dragging the mouse cursor. A fuchsia-colored line is drawn from the center of the navel to the current mouse cursor position. While dragging, the user can mouse over another layer 0 activator, causing another navel to appear. In this case, there is no delay for showing the navel, since the intention to activate additional In-Context Sliders is clear from context. If the user ends drag by releasing the left mouse button while over the



(a) (b) (c) (d)

Figure 4: Visualizing an In-Context Slider value: (a) collapsed positive value, (b) expanded positive vaue, (c) collapsed negative value, (d) expanded negative value.

new navel, the fuchsia line disappears and a persistent gray line is drawn connecting the center of the two navels, just as a connecting line marks a route segment between two waypoints on a map. Since the user is now over a navel, the slider body is activated. The user can continue activating In-Context Sliders by repeating the same process from one navel to the next. After activating the desired sliders, the user changes the value of the last activated slider. This changes the value for the others. Multi-activation is cleared when the user either sets a value or deactivates an activated In-Context Slider.

When activating multiple sliders, it is not required to end the mouse drag on a navel. If the mouse drag is ended anywhere on the layer 0 activator, the slider will be activated, moving the mouse cursor to the navel center, displaying the slider body, and drawing the persistent gray line between the navels. Multiple-activation doesn't have to start at the navel. It can also start from the slider body. The process is the same as when starting from the navel (hold left mouse button and drag). The difference is that when activating another slider (by ending drag), the current value for the newly activated slider is set to the value of the previously activated slider. In other words, by starting multi-activation in a slider body, the current value is propagated to each slider activated afterwards in the activation sequence. This multi-activation sequence provides flexibility in assigning the same value to multiple objects. If at any point in the process the user decides a different value is appropriate, that value can easily be assigned from the current slider, and the sequence can continue.

3. EVALUATION

3.1 Participants

Forty-three student volunteers participated in the experiment. Undergraduate members of the "psychology subjects pool" fulfilled a requirement of their introductory psychology course by participating. Concurrently offered sections of the course had a total enrollment of more than 1000 students. The subjects represent a spectrum of undergraduates, with no focus on computer or information science majors. The experimenters were not personally familiar with the participants.

3.2 Method

Two tasks were designed to evaluate the In-Context Slider in comparison to a Typical Dialog Box Slider interface for interest expression. The Typical Dialog Box Slider interface consisted of a draggable slider with a knob inside a dialog box with OK and Cancel buttons. The dialog box was activated through a right-click popup menu. Before completing each task, an instructional video was shown explaining the task and how to use each interface to complete it. Participants were given a brief practice session before using both interfaces.

In Task 1, participants were asked to rate a collection of images of automobiles according to their personal taste, using the two different interfaces, the In-Context Slider and the Typical Dialog Box Slider. Images were displayed four at a time, each labeled above with a single letter.

Task 2 was different from Task 1 in that rather than rating images, participants were asked to rate single words in a text editor. The context was as if one wished to express interest in particular words in the context of an editing task. The two rating interfaces, the In-Context Slider and the Typical Dialog Box Slider were the same as before. The layer 0 activators were words, instead of images. Further, in this task, instead of spontaneously and personally rating words, participants were provided with a value to assign to each word. This value was located in the text, in parentheses, following the word, to maintain contextual continuity. Words

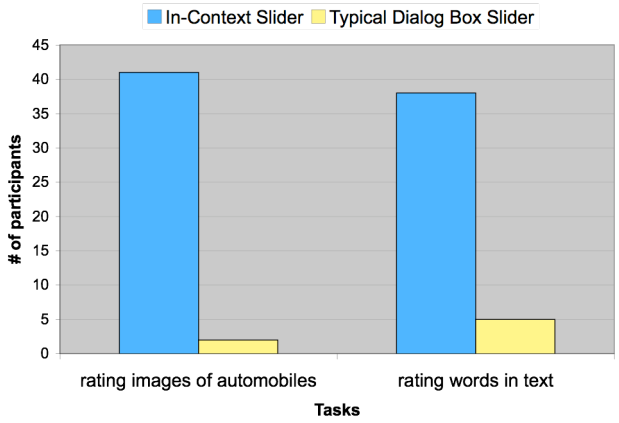


Figure 5: Time performance: with which interface were participants faster?

that required rating were presented in bold face to distinguish them from the other words.

The experiment was a 2x2 within-subjects design where the independent variable was the interface used for the task. All participants completed Task 1 first and Task 2 second. The independent variable conditions were counterbalanced, so that an equal number of participants used each interface first or second on each task.

The mouse interactions of participants for both interfaces in both tasks were logged. This enabled us to compute statistics about the times and answers for each condition.

3.3 Results – Quantitative

We measured how long it took participants to perform each task with each interface. Of the 43 participants, 41 (95%) [X^2 (1) = 35.372, $p < 0.0001$] for Task 1 and 38 (85%) [X^2 (1) = 25.326, $p < 0.0001$] for Task 2 were faster at rating with the In-Context Slider (see Figure 5). Average completion time for Task 1 with the In-Context Slider was 72.39 seconds, while that of the Typical Dialog Box Slider was 122.68 seconds. The difference was statistically significant [$F(1,42) = -13.263$, $p < 0.0001$]. Average completion times for Task 2 were 82.04 seconds with the In-Context Slider and 107.21 seconds with the Dialog Box Slider, and the difference between these is statistically significant [$F(1,42) = -4.535$, $p < 0.0001$] . The accuracy measures for Task 2 for the two interfaces were not significantly different.

We asked each participant which interface was easier to use. The possible responses were In-Context Slider, Dialog Box Slider, or both the same. For Task 1, 37 (86%) of the participants said the In-Context Slider was easier to use, and the results were statistically significant [X2 (2) = 54.326, p < 0.0001] (see Figure 6). For Task 2, 40 (90%) participants said the In-Context Slider was easiest to use [X2 (1) = 28.488, p < 0.0001]. Only one participant felt the Typical Dialog Box Slider was easier to use for Task 1.

Participants were also asked which interface was more natural for expressing interest. Again, both the same was the third possible choice. From the 43 participants, 33 (76.7%) for Task 1 [X^2 (2) = 37.023, $p < 0.0001$] and 32 (74.4%) for Task 2 [X^2 (2) = 32.977, $p < 0.0001$] found the In-Context Slider to be a more natural interface for expressing interest (see Figure 7).

3.4 Results - Qualitative

The participants answered open-ended questions about their experiences, from which we obtained qualitative data. Many of the participants that found the In-Context Slider to be the easiest to use noted that the In-Context Slider required less effort to use in terms of mouse clicks.

"The traditional slider was just more cumbersome to use. Having to right click then select your choice. The in context just seemed easier."

Several of participants recognized that the In-Context Slider's representation of values for interest level with red for negative and green for positive promoted comprehension.

"It was just easier. The red and green helped identify the levels easier."

The colors also provided some participants with a realization of the affect of interest expression. To them, the experience of using the In-Context Slider was tied with emotional expressivity.

"The colors made it easier to know how you felt. The pop-up was just setting a value while the in-context was almost setting an emotion."

The handful of participants that found the Typical Dialog Box Slider easier said that it was a more familiar interface. IThey were accustomed to it, and had used before. The In-Context Slider was a completely new and somewhat daunting.

4. INTEGRATING INTEREST EXPRESSION WITH AUTHORING

Providing ratings of image and text surrogates, which visually represent documents and their constituent ideas, is an important part of the user interaction in combinFormation. combinFormation (cF) is a creativity support tool that uses composition of images and text to represent collections of information resources [9]. The user directly manipulates the composition and the collection process through a set of design tools within the software. The agent semi-automatically collects, and arranges within the composition space, image and text surrogates extracted from online resources. A model of information semantics and the user's interests forms the basis for the agent's semi-automatic actions. In character with the human-centered design of cF, the user's act of providing feedback, which shapes the model, is called "expressing interest," instead of "providing ratings." The user can express interest in an information object at any time, but never has to. Prior versions of cF provided a modal toolbar-based interface for interest expression. Among the problems with this interface was the need to look away from the focus object, to the toolbar, in order to express interest. The In-Context Slider replaces the toolbar creating a fluid interface that maximizes expressivity and minimizes cognitive load and task disruption through layered activation.

Authoring tasks with combinFormation involve conceptualizing, finding, editing, designing, and composing collections of information resources [9]. The user's information needs may evolve in the course of a session, in response to the spontaneous stimulus of found information. We call tasks in which the user's goal is to have ideas while searching, browsing, and collecting, *information discovery tasks* [8]. combinFormation supports the user by using an agent to assist in the collection of information resources. However, the agent needs direction in order to effectively work in service to the user's information needs. Image and text clippings from documents in the composition space serve as affordances for interest expression, in addition to functioning as surrogates for the documents they come from.

4.1 Using the In-Context Slider for Interest Expression

As the combinFormation agent collects images and text surrogates, it also gathers metadata about each surrogate, such as the caption for an image, the title of the document the surrogate represents, and additional semantic fields, when available, such as author and keywords [9]. The terms from this metadata, and also

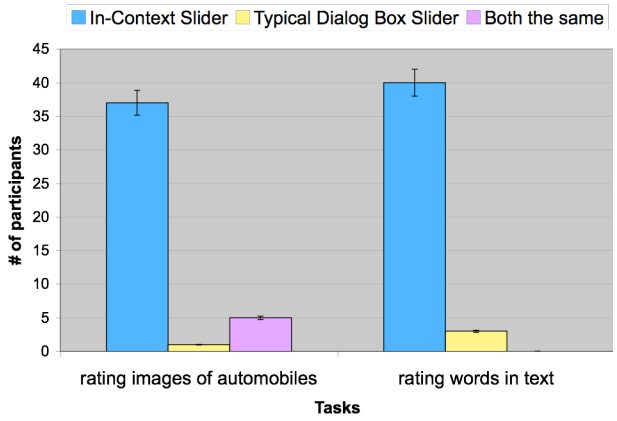


Figure 6: Participants experience reports: which interface was easier to use?

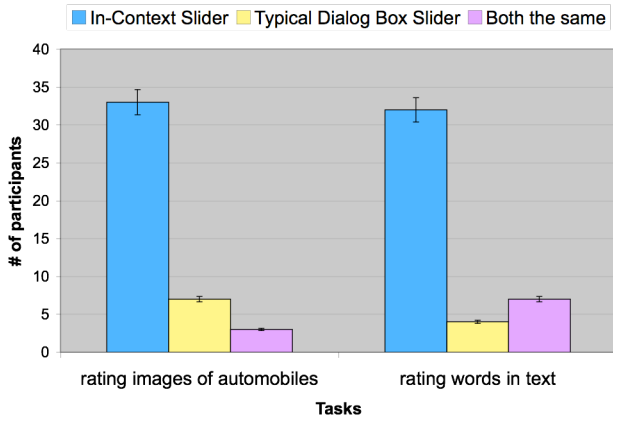


Figure 7: Participants experience reports: which interface was more natural for expressing interest?

the terms from within text surrogates, are used by the agent through the interest model to determine what new surrogates to bring into the composition, and which links to crawl. These information retrieval components [1] of the interest model store interest values for each term. As the interest values in terms change, the agent looks to obtain surrogates whose metadata contains terms with positive values. Users have asked for finer grained control of interest expression. The In-Context Slider gives the user the ability to directly affect the interest model on a per term basis, as well as on a per surrogate basis, in order to obtain the most relevant and interesting results from the agent.

5. USER EXPERIENCES: EXPRESSING INTEREST TO DEVELOP COLLECTIONS AS COMPOSITIONS

5.1 Participants

Twenty-two subjects participated in a user experience trial. Qualitative experience reports were elicited. Once again, the subjects were students from an introductory psychology course. This was a different set of subjects than those who participated in the experiment reported above.

5.2 Method

Participants were asked to complete two information discovery tasks [8] using combinFormation. They used the in-context interface for one task, and the modal toolbar interface for the other.

Figure 8: Composition of surrogates created by a study participant for the summer internships information discovery question. An In-Context Slider can be activated for each surrogate and each word.

The interfaces were counterbalanced across participants, so that half the participants used the in-context interface first while the other half used the traditional interface first. The two information discovery tasks were:

- Your department adviser has suggested participating in a summer internship. What would you enjoy doing for a summer job? Where would you work?
- If you could spend a semester studying anywhere in the world, where would you choose to go? What would you study while there?

The two tasks were selected because of their similar levels of personal interest for the undergraduate student participants.

Prior to doing each information discovery task, participants were shown an instructional video explaining how to use combinFormation with a given interface. The video for the second task contained only an explanation of the changes between the two interfaces. The participants were given a brief warm-up session to gain familiarity with combinFormation and the interface. The participants were given 22 minutes to complete each task. The final compositions were logged for each participant on both tasks. After completing both tasks, the participants were asked to describe their experiences with the two interfaces.

5.3 Results

We collected qualitative data regarding the participants' experiences. Figure 8 depicts an example composition created by one participant. The composition shows the participant is interested in obtaining a summer internship in journalism, possibly as a news reporter. Many of the images depict news broadcasts. Several of the textual elements point to reporter jobs. An interest in international affairs, particularly relating to Africa, is also expressed.

We collected comments about the experience through open-ended questions:

"[The In-Context Slider interface] was easy to express interest with because you could do it on the fly without having to go back and choose your interest each time."

"I could easily rate the picture I selected because the [navel] would immediately open instead of a tool bar where I had to click elsewhere and a few more times."

6. RELATED WORK

This research is related to prior work regarding recommender systems and fluid interfaces.

6.1 Ratings in Recommender Systems

Recommender systems are agent-based tools that work to find documents relevant to a user's interests. Providing ratings is a quintessential component of these systems. Recommender sys-

tems use the ratings, and techniques such as collaborative filtering [11] and information retrieval models [2] to make choices about what information resources from a larger collection to retrieve for a user. Providing ratings is personal and contemplative, requiring focus and attention. The process necessitates that the user make decisions about how interesting things are. The user must assign a valence, a positive or negative value, regarding relevance.

Despite the benefits of ranking recommendationss, the extra effort required may discourage users. McNee et al. researched differences between a user-controlled and a system-controlled recommender system [11]. By user-controlled, they mean a system in which the user decides when to make recommendations. They discovered that while the user-controlled system increased user burden, this system also provided users with more relevant results. While the user-controlled system required more time to use, some users did not seem to notice, due to a sense of increased engagement. However, the greater effort required by the user-controlled system resulted in fewer users completing the assigned tasks. combinFormation is also a user-controlled system in this sense. The present research reduces the effort of interest expression, to more easily engage users.

Others describe similar problems with getting users to provide ratings. Fab is a hybrid recommendation system using two types of recommendation methods as a way to obtain equivalent or better results with fewer ratings required by the user [3].

6.2 Fluid and Contextual Interfaces

FlowMenu is a marking menu designed for a display surface with a pen input device and allows for in-context execution of commands by making gestures with the pen device [7]. FlowMenu applies several of the same interaction principals designed for the In-Context Slider. FlowMenu uses motions that are natural and intuitive to the user to improve performance.

FaST sliders combine marking menus and the typical slider to create a new slider interface component with three stages [10]. In the first stage, a marking menu [e.g. 7] selects the value to be adjusted. The marking menu is activated by holding the control key while selecting an object and clicking the mouse. The second stage adjusts the value. The third stage allows the use of additional controls to affect the value. The FaST slider was designed for use by expert users. This mitigates issues in the lack of visibility of the activation mechanism. The In-Context Slider was designed to be used by first-year undergraduate students, many of whom lack a technical background. The In-Context Slider was also developed to integrate smoothly with authoring tasks such as text editing. In the case of text editing, mouse gestures used by the FaST slider such as click and drag are already used for positioning a text cursor and selecting text, respectively. The FaST slider requires the user to first position the slider, and then adjust the value using extra mouse click and mouse drag actions. These mouse interactions, as noted by the authors, can lead to setting the wrong value if the user moves the mouse while ending drag or releases the mouse button too soon. It also requires more effort than the layer 0 mouse over, and layer 2 mouse move motions used to adjust a value with the In-Context Slider.

Fluid links are a mechanism in hypertext for displaying information about a hyperlink in-context to help the user decide which hyperlinks to follow [e.g. 11]. When a user mouses over a fluid link, the visual layout of the hypertext document is modified by the addition of new information about the link placed on the line below the link, moving all lines below down a few lines, or in a margin to the right or left of the fluid link. Fluid links are similar to the proposed in-context interface in that layers of activation are engaged when the user mouses over a fluid link.

Side Views is a user interface component that provides on-demand details along with persistent and dynamic previews for a given command [15]. Side Views supports open-ended tasks in which case it is unclear the sequence of steps required to reach the desired final solution. Side Views provides in-context visualization by displaying previews directly next to the point a command is selected and executed (e.g. a menu item from a drop-down menu).

Local Tools is an alternative to tool palettes and arguably the antithesis of the In-Context Slider [3]. Local Tools provides the user with tools that can be picked up, used, and then dropped anywhere on the screen. This idea differs from the standard tool palette in that tools are not fixed to single location allowing placement of tools near the point of interaction. The In-Context Slider addresses a problem that Local Tools inherited from the standard tool palette: the user must still shift focus to select the tool.

Data Visualization Sliders use information visualization techniques to enhance sliders [6]. Data Visualization Sliders use a slider's screen real estate to visualize information in the form of graphs with both continuous and discrete values. Each graph shows information related to the data value adjusted by the slider.

See-Through tools are translucent tools located on a plane above the interactive space [5]. The user interacts with objects through these tools to apply the tools' effects to the objects below. The tools can be moved around the screen, between applications, and layered on top of each other. The In-Context Slider is not a See-Through tool; it shares the translucence quality. The layers of activation, although serving different functionality, are similar in concept to See-Through tools' layering capabilities.

7. CONCLUSION

New interaction modalities require new integration of functionalities. Providing different kinds of interactivity in context, so that, for example, the user can fluidly switch from authoring to rating and back without visually context switching, is an interaction design challenge. The In-Context Slider meets this challenge by integrating its visual representation with that of surrounding content, and minimizing the cognitive and physical effort of activation.

Many of the current parameter value adjustment interfaces require extra effort and attention on the part of the user. These interfaces are often activated through a series of menus or keyboard commands and located in a popup window or a side bar that is not always located near the object of interest. Some use dedicated web-based forms with slow responses. Some waste screen real estate with non-transitory affordances [1]. Others use invisible control characters for activation, which novices may not recall. Thus, the user may fail to use the interest expression interface. Fluid in-context interfaces seem appropriately suited for interest expression mechanisms. The minimal effort required to use these interfaces can overcome the reluctance of users to express interest. A user's decision about the relevance of information occurs while that information is in the user's focus. Having an interest expression mechanism appear in-context allows the user to express interest immediately and directly. Integration with authoring enables the user to focus attention on more primary tasks, and perform interest expression spontaneously when it feels worthwhile.

The quantitative and qualitative results show that the In-Context Slider is quicker and easier to use than the Typical Dialog Box Slider. The In-Context Slider, through its fluid layers of activation, allowed the participants to more rapidly express interest with minimal distraction. The In-Context Slider's layer 0 and layer 1

activators provide less disruption of the interactive space than the typical right-click popup menu. The sleek, precisely positioned, and translucent In-Context Slider layer 2 body is likewise designed to blend with and contribute to the participant's focus of attention within the interactive space, in contrast with bulky opaque dialog boxes that obscure context.

More than three fourths of the participants found the In-Context Slider to be a more natural interface for expressing interest than the Typical Dialog Box Slider interface. This result points out a problem with many of the standard interfaces for rating. These interfaces were designed primarily to obtain data for agent software, rather than to support human users. A human-centered design approach changes the experience.

The results are striking, considering that the In-Context Slider is a new interface, with which the participants had no prior experience. This was borne out by the qualitative data, in which the few participants who preferred the typical interface told us that they preferred it because it was familiar. This discrepancy, though not large, would be reduced in a realistic usage scenario longer than a 60 minute laboratory experiment. The performance and ease of use findings are particularly significant since participants were not users with a particular background in interactive systems.

Shneiderman and Bederson proposed three strategies to help better maintain user attention: reduce short-term and working memory load, provide information abundant interfaces, and increase automaticity [14]. By automaticity, they were referring to designing command sequences such as keyboard shortcuts that reduce the interactive steps required to complete tasks. With the In-Context Slider, as a fluid in-context interface, we instead increase automaticity through visual design. By designing simple, distinguishable visual affordances such as the navel, the user is able to quickly recognize interaction possibilities.

The navel is a small, simple and clear affordance providing visual continuity between un-activated and activated states, and visualization of a value with minimal disruption of context. With the navel located in the center of an In-Context Slider, it places the mouse cursor at the center of interaction. The navel functions as a focal point for interacting with an In-Context Slider. It helps the user learn what the slider does and how it works, forming a recognizable affordance, that when seen again, a user will understand its function. While we used timeout for activation of the navel by novice users, control click can be used by experts.

User engagement in laboratory information discovery tasks using combinFormation with the In-Context Slider proved meaningful for personal growth and development. After viewing compositions that participants created, it became clear that some participants, such as the creator of Figure 8, went through a thought provoking process in which they obtained information and synthesized ideas that may actually affect future decisions in their lives.

The In-Context Slider was designed to minimize physical effort. This minimization should reduce any occurrences of Occupational Overuse Syndrome in comparison to other interfaces, which require more mouse clicks and a greater range of mouse movement.

A primary design concern when developing the In-Context Slider was screen real estate. In an instance where minimal screen real estate is not a problem, the In-Context Slider is not necessarily the best solution. In this particular case, a normal slider can be displayed in-context at all times; therefore, negating a need for a transitory interface like the In-Context Slider.

Authoring is an iterative process of creating, collecting, refining, and composing ideas. The process involves emphasizing certain ideas and discarding others. Expression is an important part of this process. When authoring with systems like combinFormation that use agents, expressing interest in relevant information is beneficial. Yet, it can take attention away from other task components. Thus, an interface for interest expression needs to minimize the demand on a user's attention, allowing action to be accomplished easily, as if expressed through the body, and not through a disembodied interface. The full set of design choices for the slider: color, fluidity, translucence, integration, fluid gesture, and lack of saccadic movements produce an embodied sense of affect that promotes expression.

8. REFERENCES

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