The Effectiveness of Transient User Interface Components

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Abstract
With small screen devices, including mobile and tablet based systems, becoming more common, the effective use of available screen space has become a critical skill in the design of user interfaces. Transient interface components are one technique that allows for a more complex interface to be displayed, in the form components that are only visible “on-demand”, without a significant or permanent on-screen footprint. This paper describes a study of transient user interfaces and the users perception of transient interface systems of different types, as applied in visually rich 3D environments. The primary objective of transient components is to free the screen space of unwanted interface controls, allowing space to be allocated to the main content, thus creating a more immersive experience for the user. This research involved a randomized control study looking at how users interacted with 3D worlds containing transient interfaces and in particular whether their experiences were enhanced with transient systems when compared with both permanently displayed and totally invisible interfaces. Results indicated that users did feel an enhanced level of immersion when using transient interfaces, but that the detail of how and when the transient components were displayed presented challenges. Those challenges, particularly in terms of the users sense of control of the interactive systems, play an important role in how effective such transient interfaces are. Overall the study found transient interfaces to be an effective way of providing users more immersion within a rich 3D space, while also offering improved access to interface controls and information.

Keywords: Human Computer Interface, 3D Interface, Transient Interface, Natural User Interface, Usability.

1 Introduction
Human computer interfaces exist in many forms, ranging from simple 2D interfaces through to complex immersive 3D visualizations and environments (Agrawala et al. 2011, Myers et al. 2000, Marcus 1998). In all of these interfaces the users experience is very closely tied to the animated and interactive visuals that are displayed. From the earliest human-computer interfaces, featuring typography based textual information on-screen, through the early 2D graphical user interfaces and further to the interactive 3D environments presented in virtual reality (VR) and 3D games, visuals have been the dominant form of communication (Agrawala et al. 2011, Sutherland 1964). These interface visuals can be displayed in many forms, but the bulk of these are screen based, either 2D or 3D, graphical representations of information (see Figure 1).

Figure 1: Example Interface Visuals (Patterson 2003)

More complex viewing systems, including projections, view-through device styled systems (as seen in augmented reality (AR) systems) and others, exist, but are not commonly used in the mainstream (Blascovich & Bailenson 2011).

For the current user, on-screen graphics dominate the user interfaces they interact with. The attributes of the physical devices, provide significant variation in terms of screen sizes and resolutions from device to device. This raises the question of how to most effectively use the limited, and precious, resource of screen space most effectively.

The changing landscape of screen based devices, often shrinking in screen-space, presents some additional issues for interface designers. Mobile and tablet based systems have become more common and these systems present issues in terms of small screens and large (relative to screen size) interaction devices (in the form of fingers and touch gestures). In these environments the ability to place additional information on screen is even more limited (Brewster 2002). In order to present more information in less space, interface designers have developed a range of systems. These systems involve mechanisms to present smaller or less opaque (see through or partially transparent) versions of information and controls (Lee et al. 2013). Another option is to use the concept of transient interfaces. Transient interfaces, are essentially user interface components that are visible on-screen for some of the time, while at other points they are invisible or diminished. Hence instead of making the component small or less visually present, they remain larger or more significant on screen, but become time based and only present at particular points in time (as determined by the
interface application). Usually being triggered by inputs or gestures from the user.

For this method to function effectively the “interface” is broken down into specific “interface components” each of which can be shown or hidden based on inputs and events. This enables the interface to, at any point in time, function being visually represented by only a select set of components (the full set is transient and the user or events can bring them up).

In this type of interface the user experiences some components as being attached (or always visible) and others as being transient (popping up with information only at certain times). Early ideas around this included presenting the user interface components to the user visually in the form of carry with tools, navigation aids and situational warnings. Several early examples are shown in Figure 2 and Figure 3 (Staples 1993, Stoakley et al. 1995, Patterson 2003, 2007).

**Figure 2:** Worlds In Miniature (Stoakley et al. 1995)

**Figure 3:** “Carry With” - Swiss Army Knife (Patterson 2003)

As the list of ‘extras” that are sought to be carried (viewed on-screen) with the user increases, the interfaces ability to present clear simple information is lost. That is to say, the screen becomes overloaded with information and controls, and this complex visual presentation actually has the opposite effect to informing in a beneficial manner, as it causes confusion for the user (Hürst & Darzentes 2012).

The concept of a transient interface, designed to simplify these systems, by only showing a subset of the full list of available interface components at any point in time, can be applied in many types of applications from media controls and information in video and audio playback, through to immersive environment navigation systems, such as maps in games. In many ways these components provide the user with meta information about the world or content they are interacting with. Depending on the particular use, this meta information can be critically important, such as a critically low health level in a game, or unimportant additional factual information such as walking speed in the same game.

The value of the information will be dependant on the circumstances, the immersive nature of the space, and the users personal preferences. Using the earlier example of walking speed, in most circumstances this would be meta information of little importance, yet if the game involved escaping from the monster (that was chasing at 10km/h) then that speed value becomes of great value to the user in the specific scenario. The difficulty for the interface designer is determining how and when to “show” the specific interface component to the user. Just as important as when to “show”, is when to “hide” the component to allow the users attention to return to the main content of the space.

With VR and immersive 3D games being set in realistic 3D environments, the importance of maintaining the illusion of the user being inside the virtual space is high. As a result having numerous interface components, presenting meta data, popping up will reduce the players sense of immersion in the space (Cairns et al. 2014, Brown & Cairns 2004).

In these scenarios a minimal or invisible interface may provide the greatest sense of immersion. The concept of making the interface “content centred” (where the content item (in the game case the 3D world, in the movie case the movie frames)) allows the interface to be essentially invisible to enable greater immersion in the content space.

Natural User Interfaces (NUI) incorporate this principal by establishing a technique that, in theory, involves the user being presented with no (or as little as possible) in the way of visible user interface controls, components or items. The NUI system then uses “natural gestures” from the user to interact with the content (Wigdor & Wixon 2011, Vetere et al. 2014). Significant academic debate over the value of NUI based systems exists, with some studies showing significant gains in user experience (often VR and AR systems where natural gestures are more comfortable than using abstracted devices), while other studies clearly identify that these systems require significant training before the user “understands” them effectively enough to be able to benefit from their features (making them less than “natural”) (Norman 2010). In essence the issue with these systems is that by hiding essentially all of the interface components, the user has no meta information and also has no concept of what tools or information may be available to them. As a result it takes time for users of these systems to learn the tools and how to access them before they become proficient (Scarr et al. 2011, 2012, Petersen & Stricker 2009).

A simple example of this is a video playback interface, using a NUI based approach. In such a tool the movie would start, take over the full screen displaying frames (to achieve immersion) and simply begin playing. For the user they are immediately immersed in the content item (the movie) and not encumbered by any interface controls or information. Such a system puts the key focus on the content item and the users immersion in that content.

If the user wished to interrupt the movie, and access the interface controls, they would need to provide a gesture that the tool recognizes. In most simple cases this
would simply be any interaction (for example a hand wave in spatial game systems, a touch in touch interfaces or a move or click in classic mouse/pointer based desktop systems). On that gesture the interface would display the key interface components (ie. The classic play, pause video interface).

For a simple interface like the video example, this works quite well. The common case user just watches and feels immersed, and the user who wishes to interact easily (and “naturally”) brings up the relevant interface controls.

The challenge is in designing NUI based systems for more complex interfaces and environments. An example being an interface with several interface tools available. On a “gesture” any one of the set of tools could be brought up, but to minimize the unwanted on-screen components the user will have to give a “specific gesture” to identify the specific tool. Either that or have all tools appear on-screen on every gesture, which would defeat the purpose of minimizing “add-on” interface components. As a result, for the user to quickly bring up specific interface components, they will need to understand a potentially complex “gesture language” (the more interface tools or components the more unique the gesture set needs to be).

It is for this reason, based on the fact that the user will need to learn how to get to the tools, that the critics of NUI interfaces find them less effective for many complex user applications. Clearly experienced users find them empowering and natural, but new users are confused, and, without interface prompts, do not know how to engage the interfaces capabilities (Norman 2010).

The rapid growth of interfaces for mobile and handheld devices has influenced this area as “apps” generally are smaller pieces of software dealing with less information, as a result they will generally have less to display and potentially simpler gesture systems. Unfortunately while they are smaller they also function on significantly smaller displays (often handheld or tablet in nature). Thus making the potential importance of how transient interface components are applied even higher on the mobile platform.

The need for a user interface to present its information effectively, whilst also being as unobtrusive as possible, has always been a challenge for designers. GUI systems, such as the desktop, menus and icons all applied “transient” concepts from the beginning (Myers et al. 2000). The menu itself is a classic example of this technique. Initially a menu simply shows a single menu item/heading, yet more options (in the form of clickable interface components) become available when the “gesture” of moving over the menu item is completed. When the mouse moved over menu bar (the gesture) the menu is shown offering additional information and options. Hence the concept of “transient” interface components is by no means new. The major difference between the NUI and GUI approach is in the visual presence of guiding items.

For the GUI the user is presented with a visual item representing the menu (the menu bar with relevant heading item). This lets the user know there is a tool (or set of tools available to them). In contrast the NUI gives no guiding visuals and assumes that the user will know how to activate the interface component they need through “natural gestures”.

In essence both systems have advantages. The NUI works very well for content driven applications (the video example) where the user wants to be quickly immersed in the content and not encumbered by interface items and information. On the other hand the GUI works very well in providing the user with an immediate understanding that there are tools available, and they can be accessed via the guide visuals that are present on screen.

The concept of transient interface components fits between these two systems. It potentially offers the ability to hide the interface (giving the immersive experience of the NUI) while also showing guiding items at appropriate times (giving the assistance/guiding of the GUI). The challenge is how to effectively hide and show the components to provide this system in a form that works for real world users.

At the heart of the NUI system is the objective of greater immersion in the content. Studies such as those by Bowman & McMahan (2007), suggest that immersion is related more to the immersive on-screen content than to the devices used to present the content (highlighting the fact that immersion does not appear to require special VR type devices, but can be achieved through effective visuals on screen).

Other studies, focusing on the users perception of their immersive experience, such as those by Brown & Cairns (2004), indicate that interfaces without “add-on” or overlaid interface components generate higher user ratings for immersion. As a result the principals applied in NUI systems should, and do, generate greater levels of immersive user experience.

But in the larger picture, as outlined in Gameworld Interfaces by Kristine Jorgenson (2013), although one system provides more, or less, immersion than the other, that altered level of immersion does not relate directly to user satisfaction with the game or media experience. Jorgenson’s studies showed that satisfaction was equal with both systems. Hence the “add-on” visual components did reduce immersion, but also provided useful information, and in an overall sense of user satisfaction, these factors appeared to cancel each other out.

As a result this raises the question of how effective transient interface components are, and how and where they can most effectively be utilized. Do they need to provide a deep sense of immersion in the “interface world” or are they just as effective when presented as separate overlaid interface components? This research project sought to better understand this issue.

2 Experimental Testing
To test the role and importance of transient interface components, a randomized control trial was implemented. The trial involved participants using interfaces with different levels and types of transient interface components. These transient components were placed inside two different types of application, one being a mobile 3D application with which they had no prior experience (see Figure 4), and the other being a 3D application type (3D online role playing game) that they had used previously (see Figure 5).
The purpose of using the two types of applications (both being 3D and interactive, but one totally new to the participants and the other an interface they recognized) was to measure the impact of prior interface experience on the value of the transient interface components being tested.

2.1 Simple 3D Interactive Apps & Inexperienced Users

The first experimental trial was implemented as a randomized control trial with 22 participants ranging in age from 18 to 48 years (average age of 24.2 years).

Each participant was randomly allocated into a group (either “no interface (control)”, “transient interface” or “permanent interface”). They then interacted with the 3D interactive app before answering a series of questions about their experience.

The interactive 3D app that was used was a diabetes blood sugar visualizer (see Figure 4). This app was selected because it had not previously been used by any of the participants in the trial (and hence would provide information on how transient components behave with inexperienced users). The app had a rich 3D visual interface but also a set of additional meta information and controls that could be added to provide extra information and adjustment.

**Figure 4:** The Diabetes Visualizer App Interface (Patterson 2014)

The app was presented in three forms. The first form, as used by the “no interface (control)” group showed the red blood vessel and the blood sugar cubes only (with no additional components visible).

The second form, as used by the “transient interface” group used the most complex interface system. One that initially showed all of the meta data and control components (as shown in Figure 4). Each of these then faded out, before re-appearing on events (examples being a user touch (user input causing component to show), or a change in value for blood sugar level (app event causing component to show)). The intent of this “show” and “hide” process was to provide the user initially with a visual display showing the tools that were available, and then to only activate those tools (show on screen) on app events that related to them, or when the user touched that screen region.

The final form of the interface (as used by the “permanent interface” group) that was presented showed all of the interface components (meta and controls) as fully visible at all times.

Each participant was then asked to interact with the specific interface they had been allocated for a period of time (maximum 30 minutes). Following that interaction period, the users were asked a common series of questions regarding how immersed they felt in the interface, how in control they felt in the interface and how satisfied they were with the experience.

2.2 Complex 3D Interactive Applications & Experienced Users

The second trial involved participants using a more easily recognized 3D interface (an online 3D role playing game). This experimental trial involved 25 participants, 64% of whom were male (16) and 36% (9) were female, ranging in age from 19 years up to 55 years (with an average age of 25.8 years).

To understand the representative nature of the group a set of initial questions were asked to gauge the participants pre-existing experience with immersive 3D games on differing platforms. In response to these questions the users reported that 100% had played games on their personal computer, 96% indicated that they regularly played computer games and 84% had played games on both a personal computer and a mobile device. These results indicate that the study group was representative of experienced game players on a selection of platforms.

Following the initial questions the participants were then asked to interact with the 3D game interfaces (half of these included transient interface components and half included no interface components (see Figure 5).

**Figure 5:** The 3D Online Role Playing Game Interface (without components on left and with components on right)

Following that interaction period the users were asked a common series of questions regarding their experience with the interface.

Overall these trials presented users with an interactive 3D interface. For some users (those in control groups) their interface featured the minimal amount (in most cases no components) of on-screen interface components (example as seen on left of Figure 5). This interface style closely matches the NUI principal of the user being immersed in the content and the interface being hidden.

For other users (those in the “permanent interface” groups) their 3D interface featured interface components that were always visible on screen (as seen on right of Figure 5). This interface style closely matches the well known graphical user interface that shows controls on screen in a permanent form.
The final group were the “transient interface” groups whose interface featured components that appeared (through a fade-in/out) at specific points in time, but were otherwise absent. The intent of this interface style is to attempt to provide both a clean “immersive content space” as desired in the NUI system but also give users a sense of the available tools and information through transient components.

Overall these studies sought to identify the importance of transient interfaces, identifying whether they work to improve user experience, immersion or satisfaction.

3 Results

Results from the studies indicated that transient interfaces were effective, but depending on the scenario, the type of interaction the user sought, and type of content, they were not always the most highly rated option. In the case of the simple 3D app, the three levels of on-screen components were rated by users in terms of their sense of immersion, control and satisfaction with the overall experience.

In terms of immersion the “no interface (control)” rated highest averaging 5.8 (on the 7 point Lickert scale) followed by the “transient interface” averaging 5.1, and the “permanent interface” 4.1.

For the sense of control the results were directly reversed, with the “permanent interface” rating the highest at 6.1, the “transient interface” averaging 5.4 and the “no interface (control)” averaging just 3.3. In this case the “permanent interface” gave users a statically significantly higher sense of control than the “no interface (control)” group.

For the complex 3D interface (online role playing game) the findings were similar, with users rating the transient systems highly, but indicating that there is a strong need to gain better control of what is shown and when.

Results indicated that 72% of participants indicated that current game interfaces do not include too much information. Yet at the same time 70.8% of participants rated interfaces with no on-screen information as preferable to the transient component system. Overall this indicates that users have a strong desire for good immersion (which is achieved best through a minimal interface) with 75% of users preferring to view more of the game environment rather than the interface. These figures would indicate that the concept of a minimal transient interface would be suited, and the user responses matched this with 83% indicating that they found the transient interface improved the immersive experience when compared to fully visible interfaces.

Feedback from the participants in the study also revealed some interesting points, particularly in relation to control of the interface and what was shown. Below is a comment from one participant, but it reflects a common theme, that being that the idea of transient interfaces is good, but that the task of managing what to show and when is very challenging.

“I think it's good to have transitional they just need the right ones up at the right time. Or maybe just able to minimize. Would be good if say for chat you could mouse over the area to make it appear and if you wanted it to stay you could lock it in place. Or maybe it just fades, so you can still vaguely see it but when you mouse over you can see it properly.”

Anonymous Study participant quote.

One of the most interesting points about the comments and feedback from users, was the fact that many indicated a strong desire to have the capability to stop an interface item from showing. Clearly these components are useful, when displayed at the right time, but users were finding them intrusive when they “self displayed” without the user being able to stop or control them. This concept links very well with the principal of giving the user control of the interface. And as discussed with NUI interfaces, the content centred approach (with the addition of transient components), perhaps takes too much control out of the users hands.

It is clear from the study results that transient interfaces offer significant potential (as indicated by the statistics, and also by the user perceptions of potential). However the current implementations are far from reaching the potential as desired by the users.

The needs of users are highly specific to the application being used as well as the scenario at that point in time. Interestingly when asked what they would want on screen, the item with the highest rating (in the role playing game) was a “health-bar”, with 13 of the 19 comments including the word “health” in response to this question. Yet when asked specifically only 50% of users indicated that they always wanted the health bar on screen. This variability demonstrates the specific situational needs of the user and also the fact that a
Transient interface component needs to be finely tuned to those situational needs to be effective. The health bar is obviously important to users, yet 50% of the time it would be in the way if on-screen. For the designer working out when that 50% should be, becomes the key challenge with these transient systems. To create a permanent carry-with (on-screen) visual item (like those in Figure 2 & Figure 3) would use too much screen space for 50% of the time. In the case of the health-bar, this is for the single most highly listed item in terms of need for information on screen, yet even it would not be effective as a “permanent component”. For the bulk of the components (which received less than 20% of users indicating they wanted them on screen) there visual presence is likely to be short and need to be very specifically timed and targeted.

Another good example of this related to the questions regarding what interface information users would want at particular common points in gameplay. Given the nature of the interface controls and meta data, it was thought that users may use less intense moments (e.g. walking time) to access the interface features and information. When asked what level of interface they preferred for walking 70% of users indicated that no-interface was their preference. Overall it is clear that transient interface components have potential to assist in allowing more time in a minimised “more immersive” interface mode. Yet to be effective it is also clear that the mechanisms used to determine when to actively show interface components are critical. The user feedback was consistently clear in wanting greater levels of control over the interface. This was observed in both the inexperienced users and the experienced users, as noted by the high rating levels of the “permanent interface” in regards to how much control users felt and the low ratings of control in the “no interface (control)” groups.

The effectiveness of transient components was consistent across both the mobile and desktop platforms with similar results in both trial systems, indicating common strengths, including greater immersion in content, but also common challenges, particularly in terms of providing users with greater control of their interfaces.

4 Analysis, Findings & Applications

This study identified that transient interface components are effective, but further work is needed to gain a more specific understanding of the type of transient systems that are most effective in specific user scenarios. In this study a simple fade-in and fade-out system was used to show and hide components and this was effective. Interestingly participants in the simple 3D study were presented with one example of an immediate appearance/disappearance and this generated several responses, all of which indicated a preference for slower change. When the complex game group were questioned on this, 76% rated slower fade-out as better than immediate disappearance. This again highlights the fine detail that needs further investigation in transient components.

This set of trial experiments used simple transient components mixed with rich 3D worlds (both mobile and desktop) and in these visually rich environments the users desire to be “immersed” in the content of the space was high. As a result this may have influenced the findings, as the users desire for immersion in these spaces may increase the ratings of the more “immersive” interface systems. If the same trials were run, with a word processing environment, it may be that the more permanent interface features would be preferred. This in itself is an important observation and highlights the likelihood that transient interface components of this type may be most suited to visually rich environments.

Within such rich environments, the ability to reduce the on-screen interface components requires the user to understand how to bring them back up when needed. This raises the issue of the importance of experience and the need to learn how to use such tools. Looking at the chart in Figure 6 highlights the fact that the interface with more on-screen information (“Permanent Interface”) had a much smaller range (95% confidence interval) of variability in its data, than the other two more immersive interfaces (that had less or no on-screen presence). This indicates that the differences between beginner user ratings and experienced user ratings was small for the more visually present “Permanent Interface”. However the difference between an experienced user rating and a beginner user rating of the “No Interface (Control)” system was significant.

In simple terms this shows that for the experienced user the minimal interface systems are most appropriate as they can allow greater immersion in the content and the user has the experience to access the interface when needed. But for the beginner user such minimal systems are not effective. These users need more on-screen information assisting them to function most effectively.

The findings of this study broadly agree with the findings of earlier studies, such as those by Brown & Cairns (2004), Cairns et al. (2014) and Jorgenson (2013) that show a strong relationship between a reduction in the on-screen visual interface components and an increase in the sense of immersion felt by the user. However it is important to note that the findings of this study also identified that immersion is not the only purpose of an interactive user interface. For many users, engagement, control and knowledge transfer are as, or more, important than immersion. In fact even in this trial (with rich 3D environments to be immersed in) users rated these other factors as being as just as important.

“As I take this, I wonder if immersion is being taken to mean 'good' for example social aspects of games rarely immerse me in the game world, because I use them to talk to people about other non-game related things, constantly. No-one speaks in character in social elements, and I prefer it that way, the social aspects are a strong draw, even though they are strongly not immersive”

Anonymous Study participant quote.

This finding indicates that the objective of increased immersion is not the same as the goal of increased satisfaction. Immersion is just one part of a larger interactive experience. For the beginner user the sense of control plays as important a role, and based on the findings of this study those users would feel more control...
with more on-screen visual components. For the experienced user the desire for immersion is strong, but not at the cost of control. A simple textual analysis of the written feedback to the open-ended survey questions, from the experienced users group, found that the word “control” was mentioned in more than 80% of the responses.

Finding the balance between the highly immersive no-visual interface component systems and the less immersive but better control systems (with more on-screen interface) is challenging and clearly needs differing options for different users and circumstances.

The findings of this research show that transient interface components fit in this gap between the two extremes and manage to produce an enhanced sense of immersion (with 83% of participants rating them as more immersive) while also enhancing user understanding of the availability of interface components. More research is needed to understand the details of how to best deliver transient elements, but at a base level they are a valuable technique in using screen space most effectively.

5 Conclusions

Transient interface components offer a mechanism to allow users to free their screen space of visual user interface componentry, by only selectively showing visual interface components at specific points in time. Thus creating a minimal, or invisible, interface that allows greater immersion in the content and space of the application. The results of this study indicate that transient interface components are effective as a technique to provide both an understanding of the available interface components whilst also giving an enhanced sense of immersion (by minimising the amount of on screen interface components). By freeing the screen space users gain a greater sense of immersion in the space and content being presented. The effectiveness of these transient components, and the biggest challenge in their successful implementation, is very closely linked to how well the application understands the users needs in terms of control and display of the interface items.

This research project has demonstrated that transient user interface components, are able to take the principals of invisible interfaces (as described in NUI systems) and enhance them through the use of time based, animated visual interface components that provide the user with guides to where tools exist in interactive 3D environments, without the need for those components to be permanently displayed on the limited screen space of the device.

6 References


