Coping with Information Overload in the New Interface Era

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It has been said that there is more information in a single, Sunday, New York Times newspaper than people saw in their entire lifetimes during the Medieval Ages. Newspapers themselves are giving way to new forms of media including television and the Internet. Between instant messaging, email, blogs, RSS feeds, web sites, we have more information instantly available to us at our desktops than ever before. This incredible inundation with information is often an opportunity, but at the same time, finding ways to effectively cope with the information overflow can be a tremendous challenge.

Widespread communication, in the forms of telephony and the internet, account for some of this increase, but in the past this has been primarily in a fixed location (desktop) due to the 'wires' necessary for connectivity. With the increase in wireless networks and mobile telephony and the advent of ubiquitous sensing, mobile interaction, and augmented environments, the amount of information available at ***any moment*** challenges us even further. Under these circumstances, we can't necessarily use the same standard (often not quite effective) techniques that we've evolved for managing that information on the desktop (such as standard sized displays, keyboards and pointing devices). We need to find new and different ways to cope with (and hopefully take advantage of) this surfeit of information.

While it is difficult to anticipate the technological innovations that will occur, there are some areas that we ***can*** predict with reasonable accuracy. Human capabilities such as sensory modalities, memory, and cognition will ***not*** improve on their own. Coping with the information will have to come from either automatic methods of filtering the data (I'm lumping these into 'AI' techniques) or more effective ways of representing and interacting with the representations (information visualization). Presumably some combination of both of these areas will define the kinds of interfaces we will use in the future.

Furthermore, it is not enough only to look at progress in the technology, but as practitioners in the field of HCI, we also need to clearly understand the tasks that we will be performing in the future. As such, this position paper will start a taxonomy of interaction, devices, human abilities, ***and*** tasks and how they might be altered by next generation UI technologies.

Human capabilities:

Human capabilities do not change to a large extent, especially in comparison to the rapid progress in technology. Our sensor modalities, our motor systems, and our cognitive systems are essentially the same for the last 50,000 (potentially 1 million) years. With the exception of direct implantation to or recording from the brain, we will likely use these same modalities to perceive information or affect change (Table 1), while this table is not exhaustive, it hopefully presents the kinds of thinking that will promote discussion in the workshop:

Human sensor modalities	**Devices for mobile interaction**	**Strengths**	**Weaknesses**
Visual:	Mobile displays	Always available, portable, private	Small, power consuming
	Expandable displays	(same as above)	Not available yet

	Projected displays	Potential problems for projection surface	Privacy, power
	Head mounted displays	Good resolution, potential for augmented reality	Obtrusive, tracking difficulties for alignment, power, can separate from others
	Displays embedded in the environment	Can use all the power necessary, can be large, multiperson	Privacy, potentially expensive
Auditory: **Verbal**	Synthetic speech	Can attend to other tasks	Not expressive enough, slow and linear feedback
Sound effects	General synthesizer	Easy to do, can be general purpose	need to learn 'vocabulary' of interaction
Tactile/haptic	Computer controlled Braille, pushpins	good potential in combination with others	not high in information bandwidth
Vestibular			not generalized
Taste/Smell		evocative of memories	difficult to do well, not well suited for high bandwidth communication
Other?			

Human control modalities

Human control modalities have also not changed significantly, though new sensing devices have enabled new kinds of input and control (Table 2).

Human control modalities	**Devices for mobile interaction**	**Strengths**	**Weaknesses**
Gestural:	Hands, free space or touch pad	Expressive, good control, can use simultaneous input	Fatiguing without appropriate supports, need to learn a vocabulary
	Whole body	Can have added benefits (exercise)	Same as above, privacy
	Device manipulation (pens, spaceball, etc.)	Mature form of input	Information bandwidth may be low

Verbal:	Speech recognition	General (perhaps too general)	Need to know context for commands, privacy
Controller	Keyboards	Potentially high in information bandwidth, familiar	Small keyboards can be difficult to use, even harder to be fast, difficult to use in the air
	Projected keyboards	Can be larger in size but still portable	No tactile feedback
	Alternate keyboards (chorded)	Potentially fast, portable	Learning curve
	Other controllers (remote controllers, game controllers, musical instrument controllers)	Comfortable to use, portable, can be expressive or relative high information bandwidth with learning	Limited controls, need to know/learn mapping
Tangible devices		Natural mapping between task and object	not generalized. May need many devices to perform task
Other?			

Cognitive Limitations:

While not sensory modalities, there are also perceptual and cognitive limitations for people that limit the style of the human computer interaction. Limited attention, limited memory, limited visual acuity, limited audio resolution, all have influences on the kind, number, and combinations of output devices that will be useful.

Information tasks:

Finally, in a one last table, we have high level information tasks that we need to be addressed by interfaces.

Notification	Bringing relevant information to the attention of the user. (Context can be very important for this, both spatial and temporal, ie. Bring information about where the user might be, or what the user might need to do at the moment.)
Acquisition	Learning new information
Search	Finding new (or old) relevant information
Organization	Keeping track of relevant information for synthesizing or communication (or to facilitate search).
Synthesis	Creating new information for self or others
Sharing	Communicating information to others

We have ways of coping with all these tasks but new interaction techniques and devices can make these tasks easier, can make users more powerful for performing current tasks (allow faster completion, make results better, and allow more tasks to be addressed at the same time). Furthermore, communication between individuals can be facilitated which might either be a task unto itself or enhance other tasks. And finally, this can all potentially be done in new and disparate locales.

Challenges in the design of new interfaces for information management:

Many practitioners in the field of HCI believe that clear task models are crucial for defining effective interfaces. User centered design, working with people facing real problems, is an important factor in coming up with polished interaction systems. But it is also clear that users seldom anticipate fundamental variations on existing methodologies. When asked how to steer the very first automobiles, the overall response from people was 'reins', since that was what people of the time were familiar with. It is appropriate to identify problems with currently performing tasks, especially given new, mobile domains, but solutions will need to be designed, prototyped, and tested with an open mind.

Conventions may be adapted from existing techniques for interacting with large amounts of information, but significant changes will need to occur as well. For example, direct manipulation has had an incredible influence on the style and types of interaction that we have on our desktop. Direct Manipulation interfaces have the advantage of showing affordances for interaction. This is one of the most significant advantages since occasional or novice users can often infer what needs to be done by the reflected state of the system. By contrast, command driven UI's need to be learned and context appropriate commands can be easily forgotten. However, in a mobile environment, natural pointing and interaction with abstract data objects can be difficult (unless using an auxiliary display and appropriate gestural recognition). It could be much more natural to use a speech command driven UI since we nearly always can simply speak, though, as mentioned before, command driven displays have their own set of problems. Furthermore, direct manipulation interfaces often have problems dealing effectively with large numbers of information. Repetitive tasks are not easily specified and transformations on groups can be difficult.

To date, I've been examining novel interfaces that use information visualization techniques, but aimed at casual or novice users to help them cope with large amounts of information. In particular, I've been focusing on enhanced display capabilities (powerful GPUs, and large screens), though I am interested in finding new ways to interact with these visualizations in mobile and other contexts. In particular, four interfaces (MediaFrame, TimeQuilt, Movie Variations, Remote Photo Browser) all represent novel ways of dealing with lots of media (photos and video). See http://research.microsoft.com/~sdrucker/interest.htm for videos and references. Finding ways to generalize these techniques to other kinds of information, as well as new interaction techniques will bring on exciting new opportunities.

Conclusions:

In thinking about the interfaces of the future, it is not enough to think only of the technology, or only of the users, but a combination of the challenges that will be facing us in the future, user abilities and limitations, as well as the technological directions that we are currently taking.