Interactivity in the Context of Designed Experiences

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Interactivity is something researchers study, advertisers promote, and designers create. It's not something people do. People use the internet, watch TV, shop, explore, learn, send and receive email, look things up... The word interactivity and its derivatives are used to represent so many different meanings that the word muddles rather than clarifies the speaker's intent. The word is worth salvaging carefully to propose a potentially useful theory of interactivity and to point to interesting underdeveloped realms of inquiry. This article offers a conceptualization of interactivity and suggests domains for operationalizations intended to be useful for researchers and designers.

The Muddle: Common uses of interact and interactive

Interactivity is an overused, underdefined concept. Everything a human does to or with another human can be called an interaction. Human interactions that use media are mediated human interactions. Everything a human does to or with a computer is a human-computer interaction.

The curriculum development group of the ACM Special Interest Group on Computer-Human Interaction (www.acm.org/sigchi/cdg/) suggests, "there is currently no agreed upon definition of the range of topics which form the area of human-computer interaction." Instead they offer a brief definition followed by a chapter-long elaboration.

"Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them (Chapter 2 p. 5)." Most germain to this article, "on the human side, communication theory, graphic and industrial design disciplines, linguistics, social sciences, cognitive psychology, and human performance are relevant. And, of course, engineering and design methods are relevant."

Ted Hanss (1999) used the word interact or interactivity 17 times in a recent talk about Internet2 applications. In addition to PEOPLE and COMPUTERS, here are some things he mentioned that humans interact with using Internet2:

INSTRUMENTS (scanning electron microscope)
DATA (atmospheric, oceanographic)
ENVIRONMENTS (fly through spaces, collaboratively view and annotate virtual environments)
SIMULATIONS (a farm over four seasons)
VISUALIZATIONS (construct, record, and preview scientific visualizations; MRI brain scans)
MEDIA CLIPS (audio library)

Interactivity is frequently discussed by designers, often meant as a synonym for navigation and sometimes just generally to refer to good web site design. For example, "interactivity on a website is the ability to make the interface with a visitor an easy rather than a difficult process (http://www.webbonanza.com/interactive.html)." Some software manuals and design books use interactivity to refer to mouse events (mouse up, mouse down, roll over). Others reserve interactivity to describe more complex programming in Javascript to provide logic for gaming or database calls to dynamically compose content. Alan Cooper (1999 p. 22) describes a broad domain he calls Interaction Design -- "the selection of behavior, function, and information, and their presentation to users."

Using Interactive to Emphasize Changes in Passive, Traditional Media

Before the Internet, before PCs were common, mass media industries (newspapers, books, movies, radio, and television) created and marketed packaged content to be consumed by passive

audiences. Mass communication researchers studied the one way flow of programming sent by media industry sources over media systems to consumer audiences. In the mid 1980s, communication researchers began to write about new technologies bringing interactivity to mass media. Rice (1984 p. 35) described new media as communication technologies that "allow or facilitate interactivity among users or between users and information."

Reacting to expanded channel lineups brought by cable TV, remote controls, and prototype videotext systems, Heeter (1989) offered seven observations about interactivity in emerging media systems:

1.) Information is always sought or selected, not merely sent.
2.) Media systems require different levels of user activity. (Users are always active to some extent).
3.) Activity is a user trait as well as a medium trait. Some media are more interactive than others; some receivers are more active than others.
4.) Person-machine interactions are a special form of communication.
5.) Continuous feedback is a special form of feedback in which behavior of all users is measured on an ongoing basis by a source (e.g. videotex system) or gatekeeper (e.g. cable operator).
6.) The distinction between source and receiver is not present in all media systems.
7.) Media systems may facilitate mass communication, interpersonal communication, or both.

When new technologies and services are introduced which change a traditionally passive media experience to be more active, it makes sense to talk about interactive television or interactive drama. On the other hand, describing a video game, computer program, or web site as interactive doesn't mean much since all video games, computer programs and web sites are, to some extent, interactive.

Here is a table of present day interactive television services (company names and categories from a table in Evans 1999). The range of services is diverse; the common thread is each is somehow a different viewer experience than traditional passive one-way television.

category	interactive services
Internet-On-TV	
◆WebTV www.webtv.com ◆AOLTV ◆Morecom www.morecom.com ◆Worldgate www.wgate.com/splash/main.html	*Adds concurrent activities during viewing of typical broadcast television.* Viewers can link to companion web content (using set top box controller, viewed on your TV set) corresponding to broadcasts offering play along game shows, voting, web browsing, eCommerce. *Adds mediated interpersonal communication with other viewers and with TV personalities to viewing experience.* Chat, email, instant messaging synchronized with broadcast TV.
Personal TV	
◆ReplayTV www.replaytv.com/home.htm ◆TIVo www.tivo.com	*Changes the program selection process.* Digitally records and saves up to 30 hours, recording synced to daily online program guide for point and click automated recording of weekly shows and even genres. Learns from your viewing behavior and rating of programs. Suggests shows. *Changes viewing behavior.* Slow motion replay, pause live TV and resume where you left off, fast forward with quickskip.
Program Guides	
◆Gemstar www.gemstar.co.uk/en/showview/ ◆Source Media	*Changes the program selection process.* Interactive program guides for search, favorites, parental control and pay per view ordering.

www.sourcemedia.com/ ◆TV Guide www.tvguide.com	
Video-On-Demand (VOD)	
◆DIVA www.divatv.com ◆Sea Change ◆Intertainer www.intertainer.com ◆TVN www.tvn.com	*Adds choice of time as well as choice of program with preview.* Navigate VOD choices, offered in full motion video or HTML. Find, buy, preview content.
Enhanced TV	
◆ACTV www.actv.com ◆Wink www.wink.com	*Content and outcomes within a live broadcast vary depending on user choices at branching decision points.* Interact with live television by changing channels (up to 4 ACTV channels carry synchronized related content such as different camera angles of the same event, or different answers to the same trivia quiz question) – you be the director of music video or football. Answer questions, choose endings, synchronized with broadcast TV, programming, and advertising. *Viewers can instantly purchase a product while it is being advertised on TV.* Purchase advertised products online.
Hybrid TV	
◆ICTV www.ictv.com	High speed TV browser set top terminal technology (no particular services announced yet)

Video on demand is a vastly different form of interactive television than chatting online in a corner of the screen with the star of a show while the show is on. Most of the interactive services involve more viewer activity of some kind, although the Personal TV Services may actually result in less viewer activity because the intelligence in the box does program selection for you. Marketing each of these services as interactive television helps inform consumers that the service will be different from the traditional television viewing experience they're accustomed to. But from a research and design standpoint, a more clear, better differentiated conceptualization of interactivity is needed.

Wrestling with this challenge eventually lead me to transcendental phenomenology philosophers Heidegger and Husserl for fundamental definitions of human experience as a foundation for a theory of interactivity.

Fundamentals

Situated in Time

> Humans exist in a temporal horizon "situated in the Now, being there in imminence of the Future in relation to the impinging past (Nehaniv 1999a citing Heidegger 1972)."
>
> This broad *temporal horizon* is "evidenced by emotions such as hope and regret, concern with planning for future actions and storytelling about past or imagined events" (Nehaniv 1999a).
>
> Humans therefore tend to approach and recall interaction in a way that makes narrative sense. Humans possess narrative intelligence – we have awareness of our own and the objects and beings in our world's history and expectations for the future (Murray 1997). We make inferences that go beyond our observations to construct coherent stories and interpretations of events.
>
> Affect for humans is an aspect of situatedness in time…. Temperament, mood, and emotion each occupy a point in emotional space. Dietz and Lang (1999) have mapped affect to a cube along Aroused-Calm, Pleasant-Unpleasant, and Control/Dominance dimensions. Temperament

is a fixed coordinate that defines one's rudimentary personality. Mood is our persona at any given time and emotion is our emotional state at the moment.

Situated in Space (embodied)

We perceive the world from the point of view of our bodies, situated in time and space, mediated by the senses. Our bodies are our interface to the world. They represent us to the world, and they present the world to us.

If the self is an embodied being whose life is manifest in action, the relation to the surrounding world will inevitably assume the form of an interaction (Macann 1993 p. 53). The physical body directly interacts with its environment while psychic states endow a distinctive point of view. It is via judgment or inference that we connect with the physical world, but it is via action that we interact with the world.

Physical aspects of interaction in the world are, with appropriate instrumentation, directly observable. These include direction of gaze, focal point, body position and motion, speech, facial expression, and all other physical actions and reactions.

Accompanying internal dimensions of interaction with the world and with ourselves (selective attention, perception, interpretation, intent, thinking, feeling, imagining, wanting, anticipating, etc.) are not subject to direct observation.

Lived Experience

Paraphrasing dictionary definitions, to experience something means to participate in or live through an event or a series of events. It implies being present in space and in time. According to Husserl, a lived experience is whatever is actually lived out (perceived, thought, imagined, remembered) (Macann 1993).

Differentiating Self and Other

How do humans distinguish self from non-self? Spatially, our body is "here" and everything else is "there." Throughout early childhood our differentiation of self and nonself solidifies. Husserl emphasizes bodily movements, and the kinesthetic experiences where the "I" comes into contact with other corporal objects. One's body 'holds sway' over objects of the world through actions such as lifting, moving, knocking over, etc. (Phillips 1994).

Our body/mind is self and everything else is non-self. Schuemie (1999) suggests we first distinguish self and nonself, and then further divide non-self into social and environmental components. We differentiate living and nonliving things, human and nonhuman.

Our conceptualization of other beings is based upon our own experience -- we must recognize another body as a lived body like ourselves – another "I" which is embodied and holds sway. We recognize it as the body of a person, or at least a sentient being… (Miller 1984, Phillips 1994).

Humans tend to attribute human, self-like qualities not just to other humans but also to other animate and inanimate objects. Humans since prehistory have attributed human- or god-like personalities to living and nonliving entities and forces in their worlds. Tlinget Indians in Southeast Alaska revered the spirit of the cedar trees they selected and used to carve totem poles. The ancient Greeks suffered through dealing with deities for the seasons, for wind, the sea, fire, wine and much more. Today we attribute human characteristics to our pets (and our computers). We are fundamentally social beings, and in the absence of strong evidence to the contrary, the default hypothesis is that the other is like us.

Affordances

Schuemie (1999) suggests organisms perceive objects in terms of their affordances, the possible interactions with the element for the organism. Husserl's notion of 'holding sway' over

objects, and Heidegger's description of assessing the 'handiness of objects' are consistent with J.J. Gibson's concept of affordances (described in Norman 1998). "A rock can be moved, rolled, kicked, thrown, and sat upon – not all rocks, just those that are the right size for moving, rolling, kicking, throwing, or sitting upon. The set of possible actions is called the affordances of the object."

When we assess our immediate environment, we are aware of the some of the affordances each object offers. Chairs to sit on or throw, doors to open or close, kitchens to cook, lights to illuminate. An affordance is not a property of an object as much as it is a relationship between an object and the organism that is acting on the object (Norman 1998 p. 123). The same object can have different affordances for different individuals. A child might scan a kitchen and notice playthings and treats, a non-cook might notice possibilities for eating quickly -- a microwave, refrigerator, and bag of potato chips, while a chef would see myriad tools and ingredients.

Not all affordances involve physical action. Affordances such as learning, mental arousal, or relaxation may require no physical action on the part of either the human or the world.

In the design of experiences, real affordances are not nearly so important as perceived ones; it is perceived affordances that tell the user what actions can be performed on an object and, to some extent, how to do them (Norman 1998).

Interaction

An interaction is an episode or series of episodes of physical actions and reactions of an embodied human with the world, including the environment and objects and beings in the world. These actions and reactions are actual interactions, a subset of the range of potential interactions of the human and the world at that time and place.

Designed Experiences

A designed experience is a human attempt to structure an environment to create affordances for a human participant. Mediated designed experiences are of particular interest for this article, but architecture, interior design, museums, and event planning are examples of non-mediated designed experiences. Storytelling (in person) is a form of designed experience – it lets listeners imagine real or fictitious worlds and others as conceived and presented by the storyteller.

Fundamentals of Communication Technologies

The body separates, integrates, and represents a human in the world. Communication technologies further separate, integrate and represent the body in a mediated world. Communication technologies alter the human experience of time and space. They limit, eliminate, and sometimes amplify or alter our normal body input/output perceptions and interactions. Context is less visible and must be inferred to a greater extent.

Computer interactions result in behavior unconnected to physical forces, resulting in cognitive friction (Cooper 1999). For example, typing ERASE ALL on a typewriter results in a page of type that says ERASE ALL, while typing ERASE ALL on a computer could erase the contents of a hard drive.

Situated in Time

Communication technologies enable human mediated interaction and human machine interaction to occur asynchronously. Messages or commands can be sent and received later. Events can be recorded and experienced later. The human participant always experiences composing or receiving a communication in the present, even when the overall experience is asynchronous, separated in time. When we compose a message to be received later, we attempt to tailor the message to be received and understood later. When we receive an asynchronous message, we attempt to take the time warp into account as we interpret it.

Latency is a problem in mediated experiences. Cheshire (1996) writes, “whether we're dealing with people or objects, interaction is essential. We perform some action, and when we observe how the person or object reacts we modify our behavior accordingly. Sometimes the reaction needs to be very quick, like when we're having a conversation or fighting with swords, and sometimes a slow reaction is adequate, such as carrying out a lengthy postal correspondence with a distant relative…”

Nielsen (1999) believes fast response times are the most important design criteria for web pages. Furthermore, he says the response time should be predictable and consistent. Nielsen (1999, pp. 43-44) quotes Robert B. Miller’s classic 1968 paper at Fall Joint Computer Conference on minimal response times for a media system:

- One tenth of a second (0.1) is about the limit for having the user feel that the system is reacting instantaneously.
- One second is about the limit for the user’s flow of thought to remain uninterrupted, or for the user to feel they are moving freely through information space, even though the user will notice the delay
- 10 seconds is about the limit for keeping the user’s attention focused on the dialogue…

Both Biocca (1999) and Reeves (1999) talk about human bandwidth – matching transmission speeds with the information processing capabilities of users. Already the Internet and broadcasting carry more information than any human could process. But the amount of content in an individual transmission is usually far less than we experience physically through our real world bodies.

Situated in Space (embodied)

In the physical world we are here and everything else is there. We exist in an environment surrounded by objects and forces. Traditional media recognize our spatiality not at all. They are another object within our space, and we do not exist within their space.

Communication technologies allow us to experience spaces we could not visit before -- spaces which do not exist in the physical world and spaces we cannot physically visit. They afford us new means of experiencing spaces (point and click, fly) while they deny us familiar kinesthetic means of bodily exploration.

Communication technologies can invoke a sensation of presence at a fictional or distant experience. Lombard (2000) compiled this definition of presence:

> Presence (a shortened version of the term "telepresence") is a psychological state or subjective perception in which even though part or all of an individual's current experience is generated by and/or filtered through human-made technology, part or all of the individual's perception fails to accurately acknowledge the role of the technology in the experience.

He defines time to be an essential aspect of presence (Lombard 2000).

> Presence occurs during an encounter with technology and not before or after this encounter (although the consequences/effects of presence can occur after the encounter). Presence occurs in an "instant by instant" manner. Although it appears that presence is a continuous rather than dichotomous variable, it has not been determined whether 1) presence can exist in varying degrees at each instant (as it seems) or 2) our sense that presence is continuous is the result of the cumulative effect of instants, which may be as short as milliseconds, in which presence either does or does not exist.

I suggest a slightly different definition, inspired by Lombard and build upon the assumptions defined here so far. Presence is the sensation of being spatially and temporally located within a mediated experience. The sensation may be fleeting or it may continue for a longer duration. For example, jumping when a dinosaur on the movie screen lurches toward you suggests, in that moment, you felt spatially and temporally located with the dinosaur. The affordances changed – at

that moment one possible interaction between you and the dinosaur was to be eaten. Using a flight simulator recreates the visual illusion and controls of flying, often yielding an extended period of feeling spatially and temporally present in the cockpit of a virtual world.

Humans are not represented directly by their physical bodies when they use communication technologies. Our physical voice, mediated by telephone and phone lines, represents us in phone calls. In traditional media our bodies are represented not at all. Computer mediated experiences reduce the body's representation to mouse actions, keystrokes, or low bandwidth audio. Humans and agents may be represented by (embodied as) avatars in some internet and virtual reality chat systems, but the capabilities of these avatars are more constrained than a physical body in their range of expression and motion and means of control.

Differentiating Self from Others

Humans interact with other disembodied humans, or with a device, or an agent. Reeves and Nass' (1996) research shows that "individuals' interactions with computers, television, and new media are *fundamentally social and natural*, just like interactions in real life." Reeves and Nass conclude, "all people, automatically and unconsciously, respond socially and naturally to media." Even command line and text interfaces are, to a certain extent, infused with social signifiers (Reeves & Nass 1996)

Reeves and Nass' explorations have been of media. There is no basis for setting limits to human's social orientation to objects. It is likely we respond to our refrigerator and alarm clock socially, too. One complication for research is that humans deny that they interact socially with media. Yet research clearly shows they do. Thus, the phenomenon cannot be studied directly by asking about it.

Computers are not real. Computer agents are not real. But the automatic response is to accept what seems to be real as in fact real. For researchers and designers, distinguishing between real and virtual environments, and between human communication with other humans versus human communication with computer agents is natural. But it may not be always be important from the human participant's perspective. At some point…"we will no longer be interested in whether the characters we are interacting with are scripted actors, fellow improvisers, or computer-based chatterbots, nor will we continue to think about whether the place we are occupying exists as a photograph of a theatrical set or as a computer generated graphic or albeit whether it is delivered by radio waves or telepresence (Murray 1997 pp. 271-272)."

At least before they grow accustomed to using computers, humans expect entities they interact with to have awareness of the history of interaction and they expect their interaction partners to construct a picture of them in the course of interaction (Nehaniv 1999). Yet the narrative structure of our computer-human interaction is disposable or forgotten. Computer behavior and emotionally stilted, inhuman interactions may seem strange to us at first but we get used to it. We develop "calluses" after spending a lot of time using computers, so like a violinist who practices fingers on strings we can play without pain.

Nehaniv (1999) suggests three ways computers could improve their apparent narrative intelligence:

- recognizing narrative structure
- expressing narrative structure (storytelling)
- having narrative structure (an autobiography, being temporally grounded)

Computers and other media are changeable. They take on different personalities based on the program running at the time. Thus, they are schizophrenic, insensitive, emotionally retarded entities with poor human communication skills. Roz Picard founded the Affective Computing Group at MIT, working to make computers sense human affect, recognize patterns of affective expression, understand and model human emotion, and synthesize (have) emotions (www.media.mit.edu/projects/affect/). Dietz and Lang (1999) endowed an onscreen computer

agent with a substantial range of emotion using a model of expression mapping. The affect of the agent changes appropriately over time as the human accomplishes tasks.

Creation of personas is an important part of designing experiences. Whether or not there is intent to introduce a personality into an interface, humans respond as if technology is human. What happens if another real human is present in the mediated experience – does that presence overshadow or eliminate the persona of the device? How many different personas can (or should) be concurrently present in a device or experience? When there are multiple personas, such as when a communication technology is mediating human communication, I am guessing that the dominant persona can overshadow the other(s). For example, with the telephone, we think about interacting with the other person and not much about interacting with the intermediary device (the phone). Perhaps Reeves and Nass would discover that we are also polite to the phone itself. Or perhaps in the face of a real human, the device becomes less prominent.

Cooper (1999) describes desirable characteristics of an interface designed for politeness. From the human participant's perspective, a polite interface should be:

- interested in me
- deferential to me
- forthcoming
- have common sense
- anticipate my needs
- responsive
- taciturn about its personal problems
- well informed
- perceptive
- self-confident
- stay focused
- fudgable
- give instant gratification
- trustworthy

Not only are devices and other humans disembodied, but so too are we when we participate in mediated experiences. Biocca (1999) and Nowak (Nowak and Biocca, 1999) are studying embodiment as representation from the perspectives of representation of self and judgments of others based on their embodiment in virtual worlds.

Reeves (1999) summarizes his predictions for what the coming increases in network bandwidth will do for communication technologies. When the Internet's bandwidth is less limited, latency will improve and new, richer sensory channels of interaction will be possible. Reeves suggests "social" bandwidth will increase, allowing more of human physical perception to occur over mediated channels. Emerging communication technology will bring more socially complete exchanges. Social Bandwidth will enable compelling automated social relationships and enable technology to automate social interaction and to become social actors themselves. Technology will enable different social opportunities, and new forms of interaction.

Affordances

What are the affordances of communication technologies? Uses and gratifications research looks at affordances sought and achieved with media – reasons why people say they watch TV or read newspapers. Things like to be informed, to have fun, to relax, because I'm bored, to know what other people in the world are doing, etc. A telephone lets you talk to people. The range of affordances is vast (order pizza, ask for information, visit socially with a friend, conduct business, etc.) Humans may invent or perceive affordances not intended by the designer. Mitchell points to the example of the answering machine – people found it could be used to screen calls in addition to taking messages.

The actions you can perform with the physical device of telephone or television are straightforward and limited. The options are to turn it on, change channels, and watch for TV, or to dial, talk and

listen for telephone. The computer is confusing object because it can afford so many different actions, albeit with limited input-output through keyboard or mouse. Designers try to make obvious to the human what actions are possible at any time, and what affordances are available within an application or web site. Information appliances are and will increasingly be more specialized, limited devices with less functionality than a computer. They will be designed to do only one or a few things, and thus can be optimized for those functions.

Cooper (1999) advocates goal-directed design, focusing on human's goals rather than on tasks or navigation. He starts by developing a precise description of a hypothetical archetype of an individual for whom the software will be designed.

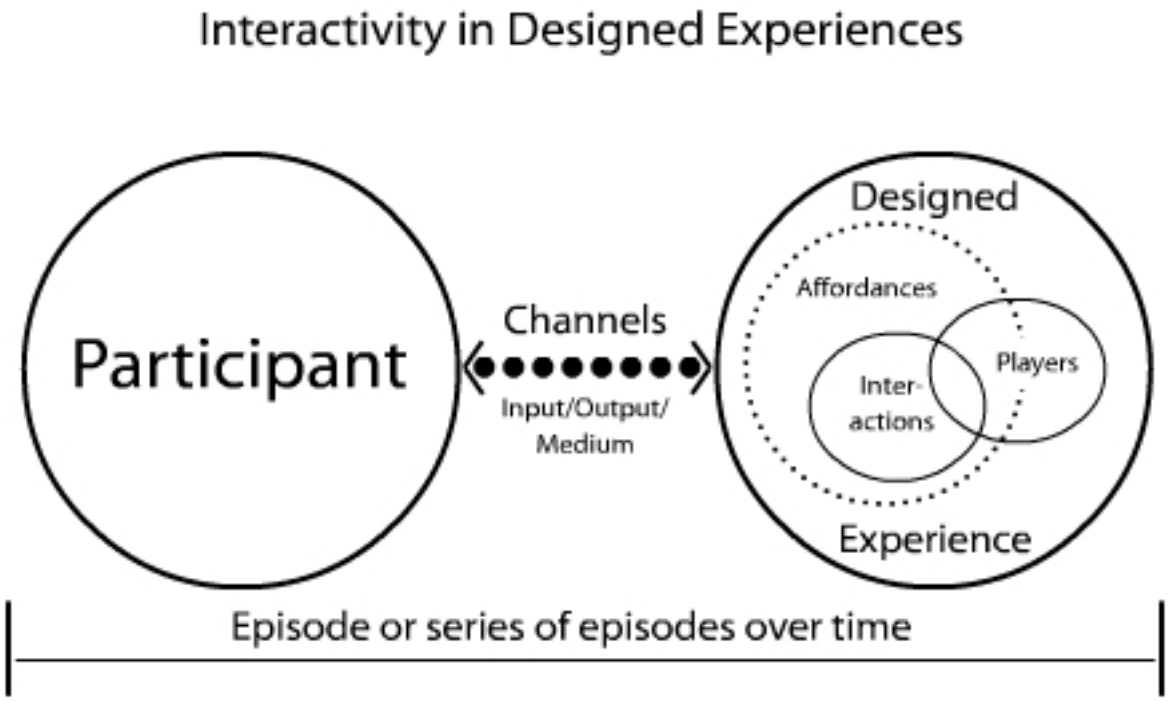
Interactivity

Communication has been modeled as flow of message from source to receiver over sensory channels, exemplified by Berlo's (1960) classic SMCR model.

SOURCE MESSAGE CHANNEL RECEIVER

When considering interaction in the context of designed experiences, I propose an alternative participant-channels-experience model.

PARTICIPANT – CHANNELS - (DESIGNED) EXPERIENCE



Designed experiences are created with intention to impact, involve, and/or enable a human participant. There is usually more available to be experienced in a designed experience than what is actually experienced by a single participant. Thus, an individual participant partakes of some portion of the potential experience.

The designers' goals may or may not overlap with the goals of the participant. Designers intend certain affordances for participants. Participants perceive affordances based on their own goals and the clarity and design of the experience. So, there are intended, perceived, and achieved affordances.

Whether or not the designers construct personas within a mediated experience, the participant is likely to infer personas. Unless the personas are either real humans or agents with human characteristics, the participant is likely to be unaware of their own reaction to the hidden, embedded persona. Analysis of interactivity should try to define the players or personae within a designed experience. Who or what does the participant believe they are interacting with? Returning to Hanss' (1999) list, is it other humans, data, instruments, an environment, an agent…

The actual realm of interactivity is limited to physical actions and reactions by the participant and the experience. The actions and reactions are mediated through the body, and, if communication technologies intervene, through technology which limits or extends normal physical channels.

More interactivity is not necessarily good. A poorly designed interface is likely to require more separate interactions and take longer to achieve a sought affordance than a well-designed interface. Norman (1998) proposes the ultimate interface is invisible. You don't even know you're using a computer. No participant interaction is needed for the system to meet the participants' needs. An example might be a refrigerator that keeps track of the quantities of food, and orders more online when quantities get low. Perhaps it communicates with the participant through a "shopping list" attached to the front of the refrigerator that automatically builds itself, then awaits a human signature to proceed with the order. Even that small amount of participant interaction deserves a polite, friendly, efficient interface and personality.

Some interactions have obvious one to one action-reactions, such as navigating a menu structure. Each time the participant clicks on a choice, the screen changes. Others are more hidden, where a single interaction launches lots of behind the scenes actions the participant never sees. If an unseen agent gathers news articles for you overnight every night, compiling them into a personal newspaper to read, you may be aware of reading the paper but not particularly aware of the agent working for you. Similarly, you might program your Replay TV to record every episode of Star Trek. That single action on your part will cause the Replay TV to record Star Trek episodes every time they are on until you tell it to stop doing so.

Since I am proposing a participant-centered perspective on interactivity, I will limit what is considered an interaction on the experience side to experience actions the participant is capable of observing through one or more senses over whatever channels exist to connect the participant to the experience.

Orientation to interactivity is a personality characteristic. A participant's general dispositions help to define their overall orientation toward designed experiences. Screven (1999) studies museum designs created for "freely moving, voluntary, leisure-oriented people in public environments." Visitor research has identified different visitor dispositions at a museum:

- Linear disposition
- Exploratory disposition
- Visual orientation
- Action orientation (visitors predispose to touch and manipulate exhibits and take part in activities involving control, goal achievement, competition, and challenge to skills)
- Social orientation (visitors, usually in groups of 2 or 3, like to talk, perform, and share social context that may directly or indirectly compete with exhibit activities.)
- Time orientation physical and psychological fatigue, hunger, other commitments

In addition to overall disposition, the participant's context and history affect the level of motivation, attention, and effort they exert at particular exhibit elements. Factors studied by Screven include:

- Environmental motivating factors which facilitate or inhibit information processing
- Whether the attention they devote is passive/casual or active (compare, ask questions, look for connections)
- Background knowledge and history
- Time expectations (how long will this take, how long do I have right now)
- Mindful versus mindless attention (Screven 1999 p. 139)

Depending on participants' goals, one form of well-designed interactivity has the characteristic Czikszentmihalyi (1990) describes as "flow." He derived a set of six criteria to characterize experiences individuals consider optimal. Optimal experiences:

- require learning of skills
- have concrete goals
- provide feedback
- let the person feel in control
- facilitate concentration and involvement
- are distinct from the everyday world ("paramount reality")

What is the duration of an interaction? Studying interactivity from the participant perspective, granularity can be considered as small as a single interaction – one participant's action and the experience's response. Or an interaction can be a single uninterrupted period of participation in a designed experience for a single participant. Depending on the focus of interest, it might be a single block of time spent at a single website, or else time spent using the Internet in general. It could be the cumulative set of time spent using a single web site, or a medium.

From the experience perspective, one can consider the total set of experiences of all participants who visited a particular museum or web site or TV show. Computers can store data on every participant interaction, over time. That huge flood of data is difficult to analyze. Meaningful patterns must be defined, usually after some exploration of the data combined with behavioral expectations. For example, working with continuous data on TV viewership from a two way cable system, Heeler, D'Alessio, Greenberg, and McVoy (1984) defined three modes of viewing behavior: program viewing (at least 15 minutes without changing channels), sampling (3 to 5 minute periods of channel changes), and extended sampling (more than 5 minutes of frequent channel changing). Some households were frenetic channel changers, spending the majority of their viewing time changing channels constantly, while other households almost never changed channels.

Up front ethnographic research may look at how people satisfy particular goals in the real world, to help inform designs. For example, before creating a portable handheld pocket calendar, observe what people do with physical calendars – how and when they are used, what is written in them, whether there are different types of uses of pocket calendars for different people.

Often researchers pick a small number, perhaps 3 to 5 participants, and observe each one's interactions with the designed experience. Test participants may be assigned a set of tasks, and asked to "think aloud" while they use the system.

Usability is a specialized form of interactivity research designed to identify and correct usability design flaws. Usability testing's focus is more on how easily users can accomplish assigned tasks than on the overall gestalt of affordances and user goals. Nielsen (1998) describes a methodology of rapid usability testing likely to detect 80% of a site's usability problems by testing

with 5 users. http://www.useit.com/alertbox/980503.html Some usability research looks at critical incidents, videotaping test participants and editing together a compilation of exciting moments (either good or problematic) to provide feedback to designers.

Another approach to interactivity is to analyze and compare the designed experience. Below I have recreated Norman's (1998 p. 370) table comparing typical television and computer

experiences, and then added my own columns for non-mediated experiences and for virtual environments.

	Television	Computers
Screen resolution (amount of information displayed)	Relatively poor	Varies from medium-sized screens to potentially very large screens
Input devices	Remote control and optional wireless keyboard that are best for small amounts of input and user actions	Mouse and keyboard sitting on desk in fixed positions leading to fast homing time for hands
Viewing distance	Many feet	A few inches
User posture	Relaxed, reclined	Upright, straight
Room	Living room, bedroom (ambiance and tradition implies relaxation)	Home office (paperwork, tax returns, etc., close by; ambience implies work)
Integration opportunities with other things on same device	Various broadcast shows	Productivity applications, user's personal data, user's work data
Number of users	Social: Many people can see screen (often, several people will be in the room when the TV is on)	Solitary: Few people can see the screen (user is usually alone when computing)
User engagement	Passive: The viewer receives whatever the network executives decide to put on	Active: User issues commands and the computer obeys

	Reality	Virtual Environments
Screen resolution (amount of information displayed)	Full human eye capacity	3D goggles, large screen projection, or computer monitor
Input devices	Head and body movement, tactile, sound, sight, smell, taste, walking, running	Mouse and keyboard, head tracking, glove/gesture, wand
Viewing distance	Varies from inches away to miles	A few inches to six feet
User posture	Varies from prone to sitting to standing.	Sitting or standing.
Room	Anywhere	Research laboratory or gaming center.
Integration opportunities with other things on same device	Anything	Can connect with physical devices, sensors, virtual devices.
Number of users	Varies from solitary to large crowd	Solitary or small group or mass theater audience.
User engagement	Varies from active to passive	Active: not much happens unless the participant does something.

Let me conclude by citing Norman (1998) one last time for his advice for new and improved interactive interfaces. They should include:

- A central role of language (ask for things even if not visible)
- Richer internal representation of data objects including user history of interaction with documents, applications, web pages
- A more expressive interface
- Designed for expert users – optimize for people with decades of computer experience
- Shared control proactive computers and agents without human commands

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