Principles, Techniques, and Ethics of Stage Magic and Their Application to Human Interface Design

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ABSTRACT

Magicians have been designing and presenting illusions for 5000 years. They have developed principles, techniques and ethical positions for their craft that this paper argues are applicable to the design of human/computer interfaces. The author presents a number of specific examples from magic and discusses their counterparts in human interface design, in hopes that human interface practitioners and researchers will, having recognized the applicability of magic, go further on their own to explore its domain.

KEYWORDS: HCI Design, Illusion, Design, Misdirection, Simulation, Dissimulation, Time, Response Time, Magic, Magician, Principle, Technique, Ethics, Anthropomorphism, Characters, Theater

INTRODUCTION

Human interface designers are struggling to generate more effective illusions for purposes of communicating to their users the design model of their applications [9, 13, 18-22]. At the same time, they are confronting serious issues of ethics: when does an attempt to create an empowering illusion become trickery, when does an attempt at anthropomorphism become cheap fraud [13, 23-24]?

Our profession has primarily drawn its lessons from psychology, computer science, and graphic design. While these have supplied much valuable material, we are still busily re-creating organized knowledge in our field that Laurel [13] points out has been well understood for thousands of years.

Perhaps no field other than magic is tied so closely to the field of graphical interface design: The people working at Xerox PARC in the 1960's and early 1970's were aware of the principles of theatrical magic when creating the first graphical interfaces, to the extent that David Smith named the interface itself the "user illusion" [12]. We are designing interfaces for an interface system based on magic, yet there is almost nothing written about it in our literature. (An exception is a single page by Heckel [9].) Magicians have been struggling with the principles, techniques, and ethics of illusion for at least 5000 years [2]. There is much we can learn from them.

This paper is not exhaustive. On the contrary, it barely scratches the surface. My goals are to introduce other HCI professionals to the teachings of this parallel profession of magic and to excite interest in what I believe to be a powerful set of tools for interface designers. I have been an amateur magician for as long as I've been a professional interface designer and have applied the principles, techniques and ethics of magic routinely in my design work. I have found them to be applicable and valuable.

EERIE CORRESPONDENCE

It's hard to read through a book on the principles of magic without glancing at the cover periodically to make sure it isn't a book on human interface design. These books clearly delineate the basic principles and techniques that support graphical user interfaces:

- Consistency: Much of these books on magic technique dwell on the various aspects of consistency: "Consistency is the key to conviction.... No matter how effective an inconsistent part may be, the damage that it does to the routine as a whole more than offsets whatever advantages it may have in itself."— Nelms [15]. "Irregularities destroy naturalness and conviction. When naturalness disappears, and when something unnatural is evident, the spectator's attention immediately becomes vigilant and alert. In the normal course of events, this is disastrous to deception."— Fitzkee [6].

- Unity: "No first-class success in any type of entertainment, whether it be in the form of a motion

picture, a stage attraction, a novel, a short story or any other type of diversion, can be achieved without endowing the undertaking with some degree of unity, no matter how fragile the connecting thread may be."—Fitzkee [4]

- Keep it Simple: "The Japanese define an artist as 'one who has the ability to do more and the will to refrain.'"—Nelms [15].

- Use of Real World Metaphors: The magician's tools should be disguised to look like objects in the real world. "If these things are common things, objects with which the spectator is familiar, this spectator will accept them in terms *as he knows them.* He will assume the device to be the same as the common article with which he is acquainted."—Fitzkee [6].

- Technique of User Testing: Nelms [15] gives a complete précis on user-testing, including the importance of choosing spectators from the target population: "If you try to dramatize a routine for a brother conjurer, you will merely bore him—unless he sees something in your routine that he can use in his own act.... When you work out a routine for laymen, test it on a friend who knows nothing about conjuring. Ask for his detailed criticism. Then try your routine on another friend and get his opinion. If several laymen find fault with the same spot in your routine, it is bad." He goes on to detail the pitfalls of taking the spectator's diagnosis too literally: "A layman's diagnosis of what is wrong will usually be false and will often be absurd, but he almost always puts his finger on the point where the problem lies."

Sound familiar?

VIRTUAL REALITIES

Both human interface designers and magicians create virtual realities. We bring ours alive on computer displays; magicians bring theirs alive on the stage. We capture our "performances" in code so they can continue to occur long after their writing; magicians traditionally appear live during their performances. We depend on our knowledge of the "mechanics" of computer technology, the aesthetics of graphic design, and the science of psychology. Magicians depend on their knowledge of the "mechanics" of their tricks, the aesthetics of showmanship, and the science of psychology.

Mechanics

Competent magicians can work fluidly with apparatus, so that the spectators are unaware that the card seemingly dealt from the top of the deck came from the bottom, or that the rabbit that seemingly arrived from out of nowhere had been residing in the magician's pocket, munching peacefully on carrots. Magicians must be competent at the mechanics of their craft, yet such competency does not make someone a magician, any more than knowledge of a rapid-prototyping system makes someone a software designer. It sets the stage. It makes everything else possible.

Showmanship

Showmanship seems like an unimportant aspect of human interface design, but an exploration of how it applies to magic reveals some unexpected results.

What is this thing we call a human interface? Lawyers will tell you it's the "look and feel" of the software, but when you press them they will be at a loss to explain what that means. (They will also bill you $250 dollars for their failure.) Don Norman calls it the "System Image," the physical embodiment of the designer's "Design Model" [18-20]. Rubinstein and Hersh call it an "external myth" [21]. Ted Nelson calls it "virtuality" [16]. As mentioned earlier, Alan Kay and his cohorts at Xerox PARC, in deliberate reference to magic, called it the "user-illusion" [12]. All of these words are descriptive, yet all are abstract and, therefore, somewhat elusive.

Magicians work to produce illusions, but they don't call their stage presentation an illusion, they call it an act. That's a good, down-to-earth term you can get your hands around. It comes equipped with expectations: we know that an act should inform, excite, and entertain us. If it doesn't, we know what to do about it, which might or might not involve computing trajectories for rotten fruit, depending on the poverty of the performance.

Look at the most famous contemporary magicians—Doug Henning, Paul Daniels, Penn & Teller, Siegfried & Roy, David Copperfield—all are consummate showmen. Indeed, an examination of David Copperfield's tricks shows them all to be rather old and prosaic, but he performs them in such a theatrical style and on such a grand scale, that we are enthralled. Most magicians, with a suitable trap door, can perform Servais Le Roy's turn-of-the-century "Asrah" illusion, making a comely young person disappear in thin air, but David Copperfield has made a 100 ton steam locomotive disappear into thin air. Most impressive.

Many principles of magic showmanship are directly applicable to human interface design. Here are just a few from Fitzkee [4]:

- Character: "No chef would prepare a dish without seasoning. Character is the seasoning which makes your entertainment dish palatable. Everything has character, even though the character be weak and uninteresting. Your job is to develop a quality of character in your routine that makes it tasty to the spectator. Otherwise you have a mere assembly of ingredients—tasteless, unsavory, unappetizing, lacking zest."

- Smoothness: "Perfect smoothness is necessary to any routine. In no other way will your act seem finished to the spectators. Smoothness, which is a word meaning you have planned thoroughly and well, gives confidence both to the performer and to his audience."

- "Get to the point. Be Brief. Keep interesting them. Quit before they've had enough."

I submit that showmanship has an important place in computer software. It certainly was a conscious component of the Lisa and the Macintosh. As one example, we didn't adopt the trash can for file elimination just because it fulfilled the requirement of a "real-world" metaphor. We chose it because it seemed "neat," and we kept it because, when other people saw it, they loved it.

Showmanship does not mean, to use Ted Nelson's term, "adding ketchup" [17]. It implies the application of a deep understanding of human nature to the task of making software seem vital, involving, and fun. Magicians learn showmanship the hard way, by standing on a stage, receiving instant and often painful feedback from a live and lively audience. One way people can learn how to inject showmanship into software designs is through a similar, if less painful mechanism: by dragging prototypes to customer sites, computer stores, club meetings—anywhere one can find an audience.

When setting out to design Apple Presents... Apple, the first in-box microcomputer tutorial back in 1979, Dave Eisenberg and I forwent the goal of teaching everything about the computer in favor of the more attainable goal of teaching a few fundamentals in such a way that new users would become interested and confident enough to want to learn more on their own.

The application started with an "attract mode" that gently cajoled the reluctant user to "just press the Return key." It continued with a building set of "success experiences," until after approximately five minutes, even the most fearful users were usually zipping away inside the application, feeling fully in command. During its design, we tried the application on more than 300 people, making it more lively and interactive with every pass. Within six months of its release, the Apple independent dealers identified it as their most valuable sales tool: they reported it made prospective owners love the computer and that the sale was then easy.

Not everyone will immediately agree that showmanship in spreadsheets is as important as showmanship on a Los Vegas stage, but consider this reality: software must be bought before it can be used. Showmanship does not imply the injection of irrelevant frills and fancies. Showmanship is the gentle seduction of the users, leading them to accept, believe in, and feel in control of the illusory world we have built for them.

Psychology and Dichotomy

"The art of illusion is at least 95% applied psychology.... When [modern conjurers] use more than one part of trickery to nine parts psychology, they cannot hope to create the maximum impression."— Nelms [15].

The act *is* the entity in magic. The mechanical devices and techniques are there solely to support the act, showmanship is there to enliven the act, but psychology makes the act "work."

Actually, there are two simultaneous acts performed in magic: the one the magician actually does—the magician's reality—and the one the spectators perceive—the spectators' reality: The magician's reality consists of all the sleights of hand and manipulation of gimmicked devices that make up the prosaic reality of magic. The spectators' reality, given a sufficiently competent magician, is entirely different: an alternate reality in which the normal laws of nature are repeatedly defied, a reality where the magician, as well as his or her tricks, appear supernatural.

On the surface, this defiance would seem in direct contradiction to human interface design, where we more often engage in making our "supernatural" machines appear natural. However, at a deeper level, both camps spend their time doing the same thing: making people believe one thing is going on when quite another is really taking place: the Macintosh has no actual, physical trash can, and no amount of rummaging around inside with a screwdriver and a pair of wire-cutters will reveal one.

Magicians' spectators, with the exception of young children, are adversaries, there for the specific purpose of finding the magician out. Magicians often reflect their adversarial relationship in their vocabulary: "The deception the magician seeks to accomplish is an attack upon the spectator's mind. Specifically, it is an attack upon his understanding."—Fitzkee [6].

Because of the natural suspicion of their spectators, magicians have had to develop the psychology of the illusion to a high level. If we apply their techniques with our users, who are not suspicious (unless we insist on "burning" them a few times), we surely will achieve a believable result. Let's look at a few key techniques magicians use to generate their simultaneous, but alternate, reality:

Misdirection

"[Misdirection is] the psychology of deception and the application of craft and artifice for accomplishing the magician's objectives"—Fitzkee [6].

Fitzkee identifies six techniques for causing misdirection: simulation, dissimulation, ruse, disguise, monotony, and

maneuver. For purposes of this paper, let us examine just the first two:

- Simulation: "Simulation is a bewildering way of saying that something is made to look like what it is not."—Fitzkee [6]. Simulation is our most powerful misdirection tool in human interface design. It is the underlying principle of Norman's System Image, Rubinstein and Hersh's "external myth," Nelson's "virtuality," Smith's user-illusion. It is used by professional designers for the express purpose of creating a dichotomy with the programmer's reality.

- Dissimulation: "Dissimulation means the act of concealing the real fact by pretense."—Fitzkee [6]. A trash can instead of a dialog requesting track and sector identification for zero-overwrite is simulation. A nicely laid-out dialog box for requesting "file name" identification for file "removal" is dissimulation: the essential reality is fully present; it is just being covered up.

Simulation and dissimulation are both important magic techniques: the magician who wishes to simulate a coin disappearing into thin air from his or her right hand had better be proficient enough at dissimulation that spectators don't notice the coin actually sliding into a pocket from the magician's left hand. However, dissimulation is there to cover-up, not to startle and amuse. For example, in the "Asrah" illusion, the assistant slides through a trap door, but appears to still be lying on the platform. Dissimulation. Dull. It is when we as spectators believe we see the assistant, shrouded in silk, slowly rising into the air with no visible means of support, following the beckoning of the magician's wand, that we become interested. Then, when the magician suddenly whips the shroud away, to reveal nothing but empty space, we are left dumbfounded and amazed. Simulation.

Amateur designers are far more likely to cover up a reality than alter it, but so are professionals who are deprived of sufficient resources to "do the right thing." In the early days of Lisa and Macintosh, we at Apple were given all the resources we needed, and we used simulation widely and effectively. Now our entire industry seems bent on power at the expense of everything else, and programs and interface systems are showing the symptoms of dissimulation. For example, Apple's confusing System 7 feature, Publish and Subscribe, is essentially raw technology, with just the lightest sugar coating (dissimulation).

In contrast, human interface and graphic designers designed Apple's QuickTime video animation tool from the ground up as a simulation responsive to the needs of its users. They repeatedly tried out the software on real users under real conditions, to see whether the design illusion was realistic, productive, and responsive. It ended up being all three.

Attention to Detail

Magicians continually stress that illusions don't work without attention to detail. Fitzkee [6]:

> When a magician simulates placing something into a container—any kind of a container, a hat, a tube, a can, a box—he goes through the exact motions he would make if the object were actually placed in the container. His attention is upon the hand apparently containing the object. It follows along as the object is placed in the container. The opposite hand, holding the container, adjusts itself to accommodate the additional weight. The performer's attention then follows the apparent presence of the object. Meanwhile, as he would if the object actually were placed in the container, he ignores the hand which formerly seemed to, or actually did, contain the object.
>
> ....No matter what type of simulation is used, no matter what the simulation is for, the magician is acting out a role. He must do this well or the simulation will not be effective. He must do it convincingly or he will not convey the impression he is trying to accomplish. He must do it naturally or it will seem artificial and will arouse suspicions.

Magicians talk about the "delicacy" of the illusion: a bit of light escaping from what is supposed to be a dark box or the errant corner of the assistant's dress protruding from the trap door destroys forever all hopes of maintaining the illusion. Fitzkee [6]: "The performer should be particularly careful that his handling of all of his properties, *in every respect,* is in keeping with what they are purported to be, *at all times.* If they are handled as if they are what they seem to be, this contributes to convincingness and conviction.... Naturalness is the most powerful weapon at the disposal of the magician when he seeks to deceive."

The spectator doesn't have to know details of the deception to know deception occurred, thereby destroying the illusion. In fact, the spectator can be dead wrong in his "explanation," and still the illusion evaporates: Fitzkee tells the story of a time when he was filming Howard Thurston performing "The Levitation of the Princess Karnac," in which the woman playing the Princess is actually levitated, without benefit of shroud. Fitzkee, meanwhile, was up in the balcony of the auditorium, filming the procedure, when, "several spectators heard the camera operating. They immediately connected the camera with the levitation. I could see them nudge their companions, call their attention to the camera, then point to the activity on the stage. From the way they relaxed and settled back into their seats, I am positive they felt they had solved the mystery" [6].

Most of us have seen—or even been involved in—software projects where attention to detail was slight or

nonexistent, resulting in software with unclear System Images, flashing redraws, unresponsive feedback, or, even worse, a dangerous lack of forgiveness. Such breeches result in software that is confusing, awkward to use, and even frightening—not exactly our normal design goals.

Overcoming Objections Before They Arise

Once an objection, or even a suspicion, arises in the mind of the spectator, the trick is finished. Magicians put great effort into making sure their illusions develop in such a way that the spectator is not even given to questioning why a certain action is taking place. They do this by providing a motive within the spectators' reality for every action taken within the magician's reality. For example, in the "Asrah Levitation," the assistant will not actually be present during much of the performance, having slipped through the trap door. The device that takes the place of the assistant, the device that floats up into the air, is made of metal, rather than flesh and blood. It is therefore given to a certain unnatural stillness. If the spectators slowly became aware of that stillness, they might become suspicious, so to avoid their potential objection, the assistant is first seen to be hypnotized or forced to drink some poisonous elixir, thus seemingly rendering her as still as the apparatus that will replace her. The magician has overcome the objection before it arises.

Hormuz was an early program written in the PILOT language. It featured a character that would "speak" with children through the screen and keyboard. The character introduced himself as an ancient Arabian, then urged the child to "come close to the fire, for the light is weak." He then went on, after asking for the child's name, to request the child's gender: "My eyes grow dim with age: are you a little boy or a little girl" (words approximate). Having established the character as old, having established that it was dark out, the designer is then able to ask what would otherwise be an insulting question of a child. The designer has overcome the objection before it arises.

Believing in the Illusion

Magicians live in both the world of their mechanical tricks and the illusory world they are creating for their spectators, but they "believe" in the spectator's world: "All of the most successful showman-conjurers agree that you must believe in your own magic; you cannot hope to convince an audience unless you first convince yourself."—Nelms [15].

In my experience, programmers face an ongoing struggle to believe in their own illusions. They continually want to slip back into the comfort of their mechanical world down below. In the early days of software, the System Image directly reflected every convolution and limitation of the structure of the program, the programming language, and the operating system. Today's best visual interface systems are designed before the underlying systems are built, so that, while we continue to design for the expected *capabilities* of our systems, we need no longer design to a pre-determined *structure*. Instead, we design our System Images to reflect the structure of the Design Model [19, 20, 24]. Later, when the programmers lay out the software, they tend toward a structure in general conformance with that of our System Image, neatly reversing the historical sequence.

Programmers who have not made the transition to the design model's illusion are easy to spot: they meet any attempt on the designer's part to create a new and interesting design model with, "Yes, but that's not the way it really works." The last thing a magician wants is for his spectator's model of the act to bear any relationship to "the way it really works."

While we don't share the magician's pressing need to hide this "reality," we often gain advantage by offering the user a well-constructed illusion. For example, ISDN, the new all-digital telephone system in the US, can complete a call connection in a few milliseconds, instead of today's 5 to 10 seconds, exchange data in brief, high-speed bursts, then log-off, terminating billing charges, after an additional few milliseconds. By being faithful to the realities of ISDN, we could offer our users a much faster log-on procedure, but consider how much more we can accomplish by separating the illusion of the interface from the realities of the hardware: With "instant" log-on, high-speed communication, and short-duration transmission, we can create the illusion that the user is always connected. Any time the system sees the user perform a task that requires transmission, such as dropping an addressed document in an out-basket, the system can sign on, send the document, and sign off, all without the user's conscious awareness. As far as the system is concerned, it is saving every precious penny of the user's money. As far as the user is concerned, he or she is "connected" 24 hours a day, seven days a week.

Manipulation of Time

Magicians manipulate time, as well as space. Here are two of their ways:

• Offsetting Time of Reality from Time of Illusion

Magicians use two techniques to offset the actual time a trick (the essential working of the apparatus) takes place from the time of the spectators think it takes place: Anticipation, where the magician does the trick early, before spectators begin looking for it, and Premature Consumption, where the magician does the trick late, after spectators assume it has already occurred.

I once saw a magician on television, seated before a small, 1 inch thick table, performing one of the oldest magic tricks known: Cups and Balls, described by the Roman philosopher, Seneca, in the first century AD. The spectators attempt to guess under which of three cups (or, in this magician's case, stainless steel pans) the ball lies,

while the magician makes sure they cannot. The magician began with the usual sponge ball, about the size of a golf ball, which, when squeezed into the palm, becomes the size of a pea and is rather easily inserted beneath any pan desired. After the people around the table had, predictably, failed to identify the correct pan on a couple of occasions, the ball began to grow. And grow. And grow. By the end of the trick, the man tilted the pan forward, then lifted it away to reveal a bowling ball beneath. (The bowling ball, while no wider than the pan, was a great deal taller than the pan was deep.)

The table was not gimmicked in any way. The man had, from all appearances, not lifted any heavy objects. Rather, he had been very busy talking with his spectators when the bowling ball suddenly appeared.

By chance, I had videotaped the performance and was able to study it in detail. The magician had used a technique I call counterpoint: for the entire course of the act, his trickery had preceded its revelation by around 5 seconds: as he would engage in a vociferous explanation of why the spectators had failed on the last round, gesticulating with his hands for emphasis, he was actually placing the load for the next round. The choreography was superlative: like the rich counterpoint of Bach or Händel, the notes of his own reality blended perfectly with the reality he was presenting his spectators. All of that man existed in the reality of his spectators—his intellect, his emotion, his gestures, his words, his apparent actions—except some tiny part of his mind, like some little demon, which went quietly about the task of preparing the next trick. It was a beauty to behold, and, try as I might, even examining the tape frame-by-frame, I could not catch him loading that bowling ball behind the pan.

"Pipelining"—drawing screens, gathering data before needed—is a form of anticipation. Printer buffering is a form of premature consumption. These techniques illustrate that the timing of the user's illusion need not track the reality of the operating system or hardware.

One caveat: illusion is sometimes shattered on our computers when something goes wrong: telling the user that "the document has been successfully sent to the printer" when the document has in fact only been spooled to the computer's internal print buffer would seem like a good idea, but not when a difficulty arises with the print buffer software and the user ends up dragging a properly-functioning 100 pound laser printer into the shop for repair. We need to consider the entirety of the user's reality, and that consists of both the expected and unexpected.

• Stretching Time to Create the Illusion of Difficulty.

Houdini, the great escape artist, was famous for his Milk-Can Escape in which he was squeezed, half-naked and hand-cuffed, into a three-foot tall vessel brimming with water. The top of the can was securely fastened from the outside with six padlocks, and then the apparatus was curtained off from the spectators. They grew increasingly nervous as they watched the minutes tick by as he attempted to make his escape. By the time some ten minutes had passed, the tension would build to an explosive level, not at all relieved by the mounting panic seen in the faces of Houdini's helpers. Finally, the helpers would be able to stand it no longer and would tear aside the curtain to smash open the milk can. But there beside the can would sit Houdini, nattily dressed in a suit and tie, calmly reading a newspaper [10].

Houdini's fondness for reading extended to magazines, too: after his famous escape from inside a locked safe behind a screen, which took mere seconds, he spent the next fifteen minutes back stage, idly reading a magazine, after which he dotted himself with water and burst forth, looking properly sweaty and exhausted [3].

Houdini understood the importance of not making a task look too easy; the designers at Fairchild did not: Fairchild produced one of the first home video game machines called Channel F, back in the mid 1970's. It featured a first-rate tic-tac-toe game with a tragic flaw: regardless of how long the player took to plot his or her next move, the computer would respond within one-half second with its next move. Combined with the machine's skill at choosing the best possible move, this fast reaction left the user feeling puny and inadequate.

Researchers from Robert B. Miller on have been studying the psychological effects of response time on the user [1,8,10,14,22]. What the study of magic offers us is a different perspective on the subject: we are looking beyond efficiency and accuracy; we are looking at the effectiveness of the "act" and its "big picture" impact on the user.

The throwing of the I Ching is an ancient ritual involving the repeated casting of yarrow-stalks in a meditative atmosphere. The process of a single prediction can easily be stretched to the better part of an hour, and no prediction is to be repeated on the same day. I will offer no speculation on the accuracy of the prediction (although the system was designed with enough ambiguity that the diviner can "tailor" the results to the question and circumstances at hand). What I will call attention to is the immediate beneficial effect on the subject, who is being honored with a great deal of the diviner's time and attention in a warm, spiritually-comforting atmosphere. It is the epitome of "quality time."

One of the earliest programs on the Apple II was an automated I Ching caster. It could electronically "cast the stalks" in less than 1 second. You could ask one question and get 60 completely different answers in less than 1 minute! It is probably safe to say the designer was unstudied in the ways of the Tao.

By applying the magic technique of time-stretching, along with a healthy dash of showmanship, we could write a quite different I Ching program. It would ask the user many pertinent and perhaps not-so pertinent questions, "cast the stalks" in a way that was both visually interesting and very time-consuming, deliver results in a quiet, dignified, poetic way, and refuse to answer the same question again on the same day. It would likely be no more accurate in its predictions than its faster cousin; it would surely be less productive, taking hundreds of times longer to use; but it would be far more responsive to the real (if imagined) needs of the person using it.

Illusion and the Threshold of Believability

I propose that there is a "threshold of believability," a point at which careful design and meticulous attention to detail have been sufficient to arouse in the spectator or user a belief that the illusion is real. The exact point will vary by person and even by mood, so we must exceed it sufficiently to ensure believability. Disneyland and Disneyworld are above the threshold of believability; county fairs are not. Lucas's *Star Wars* was above the threshold; *Attack of the Killer Tomatoes* was not. Penn and Teller cutting a live snake in two, then restoring it, on Saturday Night Live was above the threshold; Uncle Charlie's tired, old card tricks at Christmas were not.

The original Star, Lisa, and the early Macintosh all exceeded the threshold. Some of the graphical user interfaces appearing now, with their underlying dependency on dissimulation and their lack of consistency, are falling short. If users cannot trust the system, if they are occasionally but violently thrust into the programmer's reality, they can not, will not, and should not believe in the world we are making for them.

One need sacrifice no power in building a believable illusion. For years, Macintosh programmers have been able to recover from a crashed application by typing arcane incantations in their debugger, while regular users were left with no method of recovery at all. Now, in System 7, anyone can press Command-Option-Escape to achieve the same result. Recovery is not only achievable by every end-user, but is easier for the programmers.

THE ETHICS OF IMPERSONATION

"...magicians, if they are strictly ethical, are morally under obligation to insist that their methods are purely natural" (Fitzkee [5]).

Stage magicians have been impersonating "real" magicians (such as Merlin) for a long, long time. They've had plenty of time to experiment with the ethics of stage magic and have come up with workable solutions. I present these solutions because I find them applicable to the ongoing discussion of impersonation of people by computers (anthropomorphism).

Shneiderman [23] argues strongly against having the computer personify a human, although he does suggest that young children might be exposed to a cartoon character for the sake of visual appeal. Laurel [13] agrees in part, but has expanded his horizon: "...I have argued, not for the personification of the computer, but for its invisibility.... The representation of agents or characters is a different idea altogether than the notion of 'personified' computers." She goes on to argue the benefits of visible characters in the interface.

The mainstream of magic is in essential agreement with Brenda Laurel's view: "A magician is an actor playing the part of a magician."—Fitzkee [6]. Mainstream magicians find it important that spectators do not leave the theater under the impression that the magic performed or that the magician who performed it is supernatural. This is such an important issue to them that when people claim supernatural powers, magicians flock to expose them: Houdini spent much of the latter part of his life both seeking out a true spiritualist and utterly destroying all the fakes that lay in his path [7]. Uri Geller, who claims to bend spoons and start broken watches through spiritual intervention, has had his own personal exposer, in the person of James (The Amazing) Randi, who has taken great pains over the past 15 or 20 years, to duplicate any "spiritual" trick Geller attempts with plain old-fashioned magic techniques, much to Geller's discomfort.

Applying the "super-anthropomorphism" ethics of magic to software, I see it calling for Laurel's split between the invisible computer, on one hand, and the robust, visible character on the other. This fulfills the same requirement of honesty: the magician is not supernatural; the character he plays is. The computer is not capable of human intelligence and warmth; the character we create is. People will not end up feeling deceived and used when they discover, as they must ultimately, that the computer is nothing but a very fast idiot.

CONCLUSION

If, having finished reading this paper, you feel strangely unsatisfied, I have accomplished my aim: 5000 years of magic cannot be compressed into eight pages. We have much to learn from the best of the master magicians, and several important resources for doing so. First, Fitzkee's trilogy and Nelms single volume (all currently in print), when taken together, lay out the organized knowledge of illusion-making clearly and precisely. Reading just these four books will give you a firm foundation. Second, while perhaps you were not left so strangely unsatisfied by the paper that you are ready to apprentice to Penn & Teller, you may at least want to become a more active spectator by studying the performances of master magicians, many mentioned in this paper. Finally, there is no substitute for direct experience: learning to perform just one or two tricks well will instill many of the techniques and principles I have discussed at the level not achievable by either reading or watching.

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