HEURISTICS AND USABILITY GUIDELINES FOR THE CREATION AND EVALUATION OF FUN IN VIDEO GAMES

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Abstract: This study examines the implicit and explicit heuristics and usability evaluation processes utilized by a leading game developer. Five people from a single game team, each contributing in a different way to the game development process, were observed for one business day and interviewed. At the time of this study, the participating game team was at the tail end of their first month of prototyping in the pre-production phase of development. The data collected and literature reviewed combine to suggest that instituting more formal usability evaluation processes could be helpful to the game development process. The heuristics created in this study are a starting point for the construction of a standard list of game heuristics for use by the game development community.

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Note: Since the vocabularies of the fields of usability and game development have few terms in common, a glossary was created for the ease of the reader (Appendix 2).

INTRODUCTION

Video games have different design considerations and usability issues than other types of software. The ISO 9241-11 definition of usability includes three independent measures including efficiency, effectiveness, and satisfaction. In the case of video game usability, effectiveness and efficiency are secondary considerations in relation to satisfaction. A consumer may need to purchase or use other software to perform necessary tasks, but a game is bought on a voluntary basis purely for entertainment value. If a game is not fun to play, it will not sell in the marketplace. To ensure the satisfaction of game players, considerable care is required in the game design process and could be better guaranteed with the use of formal usability evaluation procedures by game developers.

Though heuristics have been identified for software (Nielsen, 1994), as far as I can determine, only T.W. Malone (1980; 1982) has attempted to develop a set of heuristics specific to the unique software category of games. Since games are a rapidly changing type of software due to constant technological advancements, and Malone's study was conducted over twenty years ago, the concept of game heuristics is worth revisiting. While the focus of Malone's research was instructional games, this study's foremost concern is games developed with the primary objective of entertaining the user.

To examine this topic I visited a leading game development company to seek out the current implicit and explicit heuristics involved in game design, as well as the usability evaluation processes in place within the game development cycle.

Game development companies could benefit, like other software industries have, from a greater understanding of usability principles. Implementing formal evaluation procedures can often save time and money, contrary to the common belief that usability testing increases overall production time and overhead costs on projects.

Other software industries could benefit by gaining a better understanding of the principles at work in designing games, because games succeed in several areas that other types of software struggle and often fail. Roger Grice (2000) mentioned two of these areas at an IBM conference: (1) People can learn to use games without manuals or training; (2) People develop their own strategies to improve their performance. If the game design process was better understood and documented, perhaps other software industries could learn these techniques and make the implementation and usage of their tools in businesses much more cost effective. Software developers could also benefit from learning to make their products more fun, because we know that people often believe that things are usable simply due to their aesthetic value (Tratinsky, 1997), and assess things that are fun as more usable (Carroll and Thomas, 1988). The result of software packages being perceived as more fun could potentially alter buying decisions by consumers (Carroll and Thomas, 1988). Therefore, learning a few valuable lessons from games could make other software more attractive to consumers and less costly for companies to implement.

LITERATURE REVIEW

Defining usability in relation to games:

The current ISO definition of usability (9241-11) includes three measures: effectiveness (accuracy and completeness of users achieving set goals), efficiency (the resources expended to complete goals), and satisfaction (the users' attitude). Frokjaer, Hertzum, and Horbaek (2000) argue that these components should be considered as separate and independent aspects of usability. Like other types of software, games have an interface that needs to provide an efficient and effective means for the user to interact with the program. But, when looking past the interface to the playability of the game, which is integral to a game's usability, it is evident that all three measures are not equally important or applicable.

Efficiency generally equates with expending the least amount of resources to complete an end goal. Users play games to achieve a goal. If there is no challenge to the player while obtaining the goal, the game is boring and not fun. Therefore, if the game is efficient and requires few resources on the part of the player, it may not be successful in its mission to provide entertainment. And, as Nielsen (1993) notes, since the activity is for entertainment, a user may wish to spend a lot of time playing.

If there is a definite endpoint to a game (a set point to consider a game complete) and an ideal path to get there (a way to determine accuracy), effectiveness could feasibly be measured for that game, though in many cases there is not an ideal path nor one set endpoint, so this measure would be impossible to make and not applicable to the overall usability of a game. One goal of the game developer, as

described by Peter Bickford (1997) in his book on interface design, is to keep the user "'in play' as long and as deeply as possible" (p. 178). If the goal of the developer is to keep the user playing as long as possible, then there is no sense of when a game is truly complete. Often a goal is determined as complete by the individual and that point may vary considerably by different users. Even if there is a definite endpoint to the game, there may be multiple paths in which to achieve it, and the player may keep returning to the game in order to discover more, which ultimately clouds the determination of what path is accurate in obtaining the goal.

Efficiency and effectiveness measures are typically used to judge the productivity of software, though this outcome is not useful for games since often people are seeking escape from productivity by playing them.

The one aspect of the ISO definition of usability that relates easily and directly to both a game's interface and playability is satisfaction. Measuring satisfaction should be central to the evaluation of the usability of games since the goal of a game is entertainment not productivity. Satisfaction for games is a multi-dimensional concept involving fun, immersive environments, and compelling experiences. How then, do designers define and create fun, immersive, and compelling games?

What is fun?

Games provide entertainment through escape. Chris Crawford (1982) believes they are superior to other means of escape because they are participatory. Often it is argued that to provide escape, media must immerse the audience in the

environment provided. In cognitive psychology terms, Lombard (2000) describes the immersion or the "illusion of nonmediation" as an occurrence when "a person fails to perceive or acknowledge the existence of a medium in his or her communication environment and responds as he or she would if the medium were not there" (p. 77). Therefore, in order to create immersion in an interactive environment we must make the user actually forget they are participating through a medium. Thus, it makes sense that in the game development community interfaces are considered best if invisible or at least unnoticed by the player (Sanchez-Crespo Dalmau, 1999).

Fun relates to more than just the user interface of a game; it also relates directly to game play. Since the concept of a game "implies that there is an 'object of the game'" (Malone, 1980, p. 34), or goal, it is not surprising that Myers (1990), in his study of Game Player Aesthetics, found 'challenge' to be, "the most preferred characteristic of a favorite game" (p. 383). As Karat, Karat, and Ukelson (2000) point out in their discussion of interfaces and motivation, people find satisfaction in mastery of a tool to reach a desired goal and so are willing to invest a great deal of time in doing so. Offering challenge and the opportunity to master a skill seems to provide sufficient motivation for people to engage in games. The resulting satisfaction makes the activity fun. MicroProse's Dan Bunten believes that fun lies in unexpected opportunities for growth and that games offer an intrinsic reward of needed brain stimulation (Aycock, 1992).

Myers' (1990) results also displayed that curiosity, for video arcade game players, rated low on preference, and fantasy seemed unimportant in popularity determination. Several others have disagreed with his conclusions. Malone found that

fantasy was even more important than visual and auditory performance feedback (1982). Malone's discussion in his dissertation regarding fantasy preference might explain why Myers received those results. Fantasy may be a factor that is very specific to the individual, so large differences in fantasy preference might reduce the overall correlation between fantasy and preference (Malone, 1980). Malone is not alone in his belief that fantasy is one of the biggest reasons people like to play games. Richard Garriott who assisted in the development of Ultima claims that what makes that particular game fun is its immersion in a separate reality (Aycock, 1992). Perhaps, though, it is the immersion rather than the fantasy that is so enriching about the experience. That would be a possible area for future investigation.

A final caveat about Myers' (1990) findings is that his research was based on arcade play, which may involve a different type of engagement, player, game type, and time investment than home play on a PC or console. When games are developed, they are created specifically for specific platforms. Typically speaking, console games require great dexterity, PC games are more cerebral, and arcade games, because they are not savable, and because the goal of the game is to encourage a user to spend as much money as possible, must require a much smaller time commitment per play than either PC or console games. Perhaps becoming a part of a completely fantasy based world takes a longer time commitment than can be offered through an arcade game.

What aspects of games can be evaluated?

Chuck Clanton (1998) offers a way to encapsulate the different usability

issues of games into three areas: game interface, game mechanics, and game play. Game interface is the device through which the player interacts with the game. Game mechanics are the physics of the game, which are developed through a combination of animation and programming. Game play is the process by which a player reaches the goal of the game. All three relate to the game being both functional and satisfying and require design and evaluation.

Each person on a production team for a game will be responsible for one or more of these aspects of game design. These terms are easy to breakdown into usability terms, and are familiar to game designers. Typically usability language is not used within the game industry, and in fact, I found that everyone in my case study had great trouble relating to the term usability itself. So, it is important, when discussing games, to use language that is understandable to both the game developers and those looking at games from a standard usability background. Though each of these areas of a game affects the other, and an argument can and has been made that the game is the interface, and the interface is the game (Cherny, Clanton, and Ostrom, 1997), it is still helpful to break the concept of the game down into components for discussion purposes.

Game interface includes whatever is used to physically control the game such as a controller, joystick, mouse, or keyboard. Also, it is the visual representation of software controls that players use to set up their games, engage in a tutorial, move through a game, obtain their status in the game, save their games, and exit the game. The interface is not typically identified as being a major aspect of user satisfaction, though it is noted on *Gamasutra*, an online resource for developers of electronic

games, that a poorly constructed interface can keep a player from enjoying game play (Shelley, 2001). The main aspect of the user interface that has the potential to affect user satisfaction is the scoring device because it can provide flattery, and research by Fogg and Nass (1997) found that users rate systems that flatter more favorably than those that do not.

Game mechanics are the aspects of the game that are typically tested by Quality Assurance (QA) personnel in game companies. The job of QA is to ensure no broken games (games with programming bugs) get shipped. Game mechanics include the ways the player is allowed to move through the game environment (walk, run, jump, drive a car, drive down the road, drive off the road, etc.). Animators build these features, programmers implement them into the game engine, and then level designers place them into the game environments. These three processes provide game mechanics.

Game play includes the problems and challenges a player must face to try to win the game. Crawford (1982) defines game play as pace and cognitive effort. Bruce Shelley (2001) agrees in *Gamasutra* by equating fun with interesting decisions having to be made in a required amount of time.

All of these aspects differ according to genre (e.g., adventure, role-playing, first person shooter) and platform (e.g., coin-operated machine, personal computer, console). For instance, adventure games have typically been played on the computer, but are now moving to consoles. How will this change the genre? Adventure gamers are not accustomed to the buttons of a controller, and console gamers are not used to the cerebral puzzles involved in adventure gaming. The usability of a game is similar

to other software in this manner; the usability of the product cannot be evaluated without taking context into consideration.

Game heuristics gleaned from the literature:

After reviewing the available literature, I identified the following heuristics of game design and related each one to the three areas of usability identified by Clanton (1998). Later in this paper I will compare this list to the data collected from my case study to see if these heuristics are actually being applied within the game development and evaluation processes.

Table 1: Game heuristics from the literature

a.	Game Interface	Controls should be customizable and default to industry standard settings	(Bickford, 1997; Sanchez-Crespo Dalmau, 1999)
b.	Game Interface	The interface should be as non-intrusive as possible	(Sanchez-Crespo Dalmau, 1999)
c.	Game Interface	A player should always be able to identify their score/status in the game	(Malone, 1982; Shneiderman, 1992)
d.	Game Interface	Follow the trends set by the gaming community to shorten the learning curve	(Sanchez-Crespo Dalmau, 1999)
e.	Game Interface	Interfaces should be consistent in control, color, typography, and dialog design	(Sanchez-Crespo Dalmau, 1999)
f.	Game Interface	For PC games, consider hiding the main computer interface during game play	(Bickford, 1997)
g.	Game Interface	Minimize the menu layers of an interface	(Shelley, 2001)
h.	Game Interface	Minimize control options	(Shelley, 2001)
i.	Game Interface	Use sound to provide meaningful feedback	(Norman, 1990)
j.	Game Interface	Do not expect the user to read a manual	(Norman, 1990)
k.	Game Mechanics	Feedback should be given immediately to display user control	(Bickford, 1997; Malone, 1982; Sanchez-Crespo Dalmau, 1999)
l.	Game Mechanics	Get the player involved quickly and easily	(Bickford, 1997;

	and Play		Clanton, 1998; Sanchez-Crespo Dalmau, 1999; Shelley, 2001)
m.	Game Play	There should be a clear overriding goal of the game presented early	(Clanton, 1998; Malone, 1982)
n.	Game Play	There should be variable difficulty level	(Malone, 1980; Norman, 1990; Shneiderman, 1997)
o.	Game Play	There should be multiple goals on each level	(Malone, 1982)
p.	Game Play	"A good game should be easy to learn and hard to master" (Nolan Bushnell)	(Crawford, 1982; Malone, 1982)
q.	Game Play	The game should have an unexpected outcome	(Malone, 1982)
r.	Game Play	Artificial intelligence should be reasonable yet unpredictable	(Bickford, 1997; Crawford, 1982)
s.	Game Play	Game play should be balanced so that there is no definite way to win	(Crawford, 1982; Malone, 1982)
t.	Game Play	The game must maintain an illusion of winnability	(Crawford, 1982)
u.	Game Play	Play should be fair	(Clanton, 1998)
v.	Game Play	The game should give hints, but not too many	(Clanton, 1998)
w.	Game Play	The game should give rewards	(Bickford, 1997; Clanton, 1998; Shelley, 2001; Shneiderman, 1992)
x.	Game Play	Pace the game to apply pressure to, but not frustrate the player	(Clanton, 1998; Shelley, 2001)
y.	Game Play	Provide an interesting and absorbing tutorial	(Shelley, 2001)
z.	Game Play	Allow players to build content	(Shelley, 2001)
aa.	Game Play	Make the game replayable	(Shelley, 2001)
bb.	Game Play	Create a great storyline	(Shelley, 2001)
cc.	Game Play	There must not be any single optimal winning strategy	(Shelley, 2001)
dd.	Game Play	Should use visual and audio effects to arouse interest	(Bickford, 1997; Malone, 1982; Shelley, 2001)

Of these heuristics identified in the literature, 10 concern the user interface, 2 concern the game mechanics, and 19 involve game play. This could mean that of the three factors, game play is the most important element to the usability of the product. This finding agrees with Clanton's (1998) statement that, "game designers and publishers alike are adamant that game play is the deciding ingredient of a good game" (p. 1).

Why bother with heuristics?

Usability heuristics are identified usability principles that trained evaluators use to assess the goodness of software design. This particular usability evaluation method is rather quick and inexpensive, usually requiring three to five evaluators each spending one to two hours to do two passes through an interface while producing a list of heuristic violations (Nielsen, 1994). Heuristics also provide a clear understanding of the principles with which a design is built.

This tool, typically used to evaluate the usability of software interfaces, could also be helpful in evaluating the usability of games. In game development, game heuristics could be used to produce successful games more consistently; in other types of software development, a list of game heuristics could be used to find ways to incorporate fun into new products to possibly increase customer satisfaction. Game heuristics have not yet been identified and verified through research, though conceptually would work much like the existing heuristics. They would be guidelines for the creation and evaluation of a usable game. If a usable game is one that satisfies

the user by providing entertainment, then game heuristics should encompass design elements that ensure the satisfaction of the user.

Could Nielsen's heuristics be helpful in evaluating game usability?

Nielsen's (1994) "Ten Usability Heuristics" are often used to perform heuristic evaluations on software and web sites. Are they applicable to games as well?

Nielsen's Heuristic 1: Visibility of System Status

This heuristic applies to games, typically through score and/or level information. Not only do scores assist in telling the player where they stand, it is a form of positive feedback that encourages mastery of the game (Shneiderman, 1992). In addition to visual feedback, audio cues can offer the player useful information regarding their status in the game.

Related game heuristics: (c), (i), and (k)

Nielsen's Heuristic 2: Match between the system and the real world

Games do not necessarily need to relate to the real world since they can be completely fantasy based. However, user interface metaphors or analogies to the real world often help players understand how to navigate through an environment and interact with other characters or objects during game play.

Related game heuristics: (b), (d), and (l)

Nielsen's Heuristic 3: User Control and Freedom

Nielsen's third heuristic has to do with offering an "undo" function which is not relevant to games, but the concepts of user control and freedom are still important to game design. If the user feels restricted, they will most likely become frustrated, and the result can be disinterest in the game (Norman, 1990). Therefore, the user needs to feel that they are in control not only of the actual movements of the character, but the manner in which they explore their environment. In order for the player to feel in control of the actions occurring on the screen, their actions need to be responded to within 0.2 seconds (Bickford, 1997, p. 179). One easy way to offer users additional control is to allow them to reset their input device so that the buttons function in the way they are most comfortable with. Players should also be given the ability to save games at different states, which gives them the freedom to explore the game at the time and pace of their choosing.

Related game heuristics: (a) and (k)

Nielsen's Heuristic 4: Consistency and Standards

The game user interface, as with all interfaces, should be consistent throughout. Industry standards for controller functionality should be adhered to when possible to allow players easy access to the game.

Related game heuristics: (d) and (e)

Nielsen's Heuristic 5: Error Prevention

In general, preventing errors requires careful usability testing. Ways in which usability evaluation methods can be applied to the game development process will be discussed later in this paper. The phrase error prevention can also include warning messages such as "Are you sure you want to quit?" or "Do you want to save this game before quitting?" that assist the user in making less grievous errors.

Nielsen's Heuristic 6: Recognition rather than recall

Instructions for the system should be retrievable within the game, though quite often games are built with the intention to teach skill early in game play so that instruction is unnecessary. Manuals should not be relied upon for initiating game play.

Related game heuristics: (j) and (l)

Nielsen's Heuristic 7: Flexibility and efficiency of use

Games should be able to be played by players of different skill levels. Often this flexibility is provided with variable difficulty levels.

Related game heuristic: (n)

Nielsen's Heuristic 8: Aesthetic and minimalist design

Game controls and on-screen interface should be simple and non-intrusive to provide easy access to the game environment.

Related game heuristics: (b), (f), (g), and (h)

Nielsen's Heuristic 9: Help users recognize, diagnose, and recover from errors

As is pointed out by Ben Shneiderman (1992), error messages are not necessary during game play because commands are made through physical actions instead of syntax and results of actions are obvious and can be reversed easily. In contrast to game play issues, this heuristic is relevant to the game's user interface which has the ability to assist the user in the recovery or prevention of errors (as discussed in the passage on *Nielsen's Heuristic 5: Error Prevention*).

Nielsen's Heuristic 10: Help and documentation

Help needed to engage in game play should be primarily displayed through a tutorial. Smaller help items can be offered through the interface of the game.

Related game heuristic: (y)

The majority of Nielsen's heuristics appear to be helpful when analyzing the interface of a game, but fail in the ability to address game play issues. Of the total 30 identified game heuristics, 14 naturally fit into one of Nielsen's heuristics. Ten of those 14 were interface issues. The remaining 16 game heuristics not addressed by Nielsen's top ten all related to game play. This result is not surprising since Nielsen's (1994) heuristics were not developed with games in mind and are intended for use by Human Computer Interaction (HCI) professionals to evaluate software interfaces only.

Numbers 5 and 9 of Nielsen's Heuristics did not have corresponding game heuristics. These two heuristics deal with error prevention and recovery and seem not to apply to game play but could be helpful in the evaluation of game interfaces. It is

in a game developer's best interest to reduce player frustration, and a solid user interface that assists the user in avoiding or recovering from errors can only add to overall player satisfaction.

Usability experts might think it is only appropriate to develop heuristics for the interface or mechanics of a game, not game play, but I believe all three elements should be explored because they all ultimately affect user satisfaction, which is, as I have argued, the most important measure for the usability of games. Therefore, I think if a set of heuristics is formally developed for games, they should encompass the three major areas named by Clanton (1998): game interface, game mechanics, and game play.

Clanton (1998) argues that HCI professionals could be involved in the evaluation of interface and mechanics issues, but I think HCI professionals could offer feedback on all three areas of game development (mechanics, interface, *and* game play) if they also had prior gaming experience. In addition to being able to contribute to the development process in a greater way, HCI evaluators with gaming experience would also be more likely to be accepted into the process with this background because traditionally in the game development industry, testers are always gamers (Collins, 1997).

How game developers evaluate their games:

Gamasutra had several articles advising developers on game testing procedures. One article described the methodology for play testing (Collins, 1997). Play testing is defined as in-house, formal observation of temporary consumer testers.

The author suggests finding testers familiar with the genre of the game being developed and performing the evaluation at a time when bugs have been fixed, but the game is not too far into development to be changed significantly. During play testing, the ratio of monitors to testers should not be less than one-to-one, and monitors should be noting places where the players get stuck, questions they have, subjective comments, and emotional reactions they have while playing the game, such as boredom or frustration.

Though the author describes what the testers should be looking for, she offers no suggestions on how to quantify the results to make them useful for the development team. Collins also suggests that this testing be done at a point when bugs are out of the game. Games are typically at Beta or a few months from shipping at the point that there are no bugs, and this is just too late to affect the design process significantly. Collins admits that QA testing often begins too late, but does not offer suggestions on how this testing can be done early enough to affect change, but late enough to provide useful feedback to the designers.

The solution to this dilemma is to develop a prototype and then test it. Bruce Shelley (2001) explains in *Gamasutra*, "One of the values of early prototyping is that it can reveal whether or not a game is going to work early in development" (p. 8). If the game has a major design flaw, the project can either be adjusted or ended at a point when the investment is still small. Shelley (2001) also says that, "Designers are usually left guessing until their games can be played" (p. 3). A full-scale production seems like an awfully large investment for a development company to embark on

when the assessment of its likelihood for success is based solely on hunches made by designers.

Prototyping is named as one of the major successes in the development process of the game *Oz* in Jackie Turnure's (2000) Postmortem article published on *Gamasutra*. The *Oz* design team began testing programmer art prototypes, audio prompts, and puzzles on children, their target market, very early in development. This helped the team to discover which art was effective, whether the difficulty of the game was appropriate, and what audio prompts to record. Turnure's (2000) concluding thoughts were, "Every single usability test raised new issues and illuminated problems . . . our feeling is that one cannot test too much" (p. 8).

The design team for an interactive movie game called *A Fork in the Tale* actually brought in an outside usability expert to assist with some user interface design problems (Johnson, 1998). Johnson had two major difficulties during his time with the project. First, he had trouble implementing changes to the design because the game designer was mainly concerned with aesthetics while he was mostly concerned with usability. Also, there were budgeting constraints, which meant that any testing on the interface had to be done in quick, cheap ways. Most likely the communication difficulties and the budgeting issues were results of the evaluator being brought in too late in the development process.

Much of the content of these articles for game developers mirrors the state of usability testing with other types of software. Usability testing is often considered too expensive or too time consuming to engage in fully, but when performed, often has

useful results. Usability experts are often not a part of the design team at all, and many times are brought in too late in the process.

The available published literature regarding usability evaluation among game developers seemed to imply that the concept of usability is gaining importance among leaders in the game industry. Ultimately, I decided to examine a game development team in person to find out whether this was true.

METHOD

Introduction:

In order to gain insight into the usability evaluation processes within the game development industry and to research the explicit and implicit heuristics of game design, I spent one business week with a game team in a leading game development company in the San Francisco Bay Area of California. Each day I observed a different person on the team including the Director, Art Lead, Lead Level Designer, Lead Programmer, and Producer. Each participant gave me permission to record our conversations, so I taped a formal interview with each person during the day that I observed them.

Research questions:

What are the implicit heuristics being applied within a game development company?

What are the explicit heuristics being applied within a game development company?

What usability evaluation measures are being used within a game development company?

Participants:

Pseudonym	**Role on Project**	**Age**	**Gender**
Paul	Director	42	Male
David	Art Lead	30	Male
Ian	Lead Level Designer	32	Male
Tim	Lead Programmer	38	Male
Jerod	Producer	47	Male

Company information:

The company studied in this project is a mid-sized game developer and publisher based in the San Francisco Bay Area of California.

Procedures:

To arrange the observation, a preliminary study plan was sent to a company representative (See Appendix 1). Upon approval of the plan, this representative arranged contact between the development team and I. The visit with the company went according to plan.

I studied one person per day for five consecutive days from one game team at the company. This particular game is on a two-year production schedule where five months are dedicated to prototyping. The week I spent with the team was the tail end of their first month of prototyping in the pre-production phase of development. This team is the first in the company to embark on a full-scale prototype of a game prior to production.

At the beginning of each day I explained my project to the participant. I informed the person that I was a graduate student studying both game design and usability and that I was attempting to learn what design guidelines are used when developing a game and how that game was later evaluated for usability. I explained that usability has not really been defined for games and that they would have time to explore their thoughts on the subject with me during the interview at the end of the day after the observation period was over.

The observation period lasted about seven of the eight business hours each day. I instructed each participant to go about their business as usual, and not to pay any special mind to me as they worked. Two of the individuals spent much of their time focused on me, obviously trying to make my experience as informative as possible; one person allowed me to silently follow them and attend meetings; and two people went about their day as usual while thinking aloud so I could better understand what they were doing. Though I had hoped to simply be able to silently observe each individual, it was understandable that most were uncomfortable with simply having a stranger looking over their shoulder all day. Also, most of the participants spend the majority of their time working alone at their computer and probably felt I would not gain anything by simply watching them type. I found my time with those who thought aloud to be the most comfortable and most productive for both parties.

In addition to being able to observe the five participants, I was allowed to attend team meetings and review team documents including the game production plan, design document, prototype description, and prototype plan.

Near the end of the business day, I asked the participant to allow me to interview them for 30 to 60 minutes. Most of the interviews lasted nearly the entire 60 minutes of time allotted.

Interview Questions:

Questions specific to the individual's philosophy:

Define usability as it relates to games.

Do you think usability evaluation is important for creating a successful game? Why or why not?

Who do you think should evaluate the usability of games?

When do you think usability evaluations should be performed?

What do you think usability testing should evaluate about a game?

What elements do you think help to create a successful game?

What design elements add to the usability of a game?

Do you think usability evaluation techniques vary according to game genre? If so, how?

Questions specific to the company:

When / at what stages of game development does usability evaluation occur within this company?

How is usability evaluated for games that are developed within this company?

Who performs the usability evaluation in this company?

How important do you think usability is to this company?

Questions specific to the job role:

What is your job title?

What part does usability evaluation play in your employment position within the company?

Do you have a success or failure story regarding usability and a game you have worked on?

Pilot test:

I was unable to pilot the entire study, but I did pilot test the interview with a person involved professionally in game design prior to my case study and found that she had difficulty understanding the vocabulary included in my questions. Even though I anticipated from the pilot that the questions might make the participants uncomfortable, I wanted to try to have the case study participants discuss games in usability terms to see how each person would eventually come to define and discuss it. I did not change anything in my methodology as a result of the pilot study results.

Analysis:

Notes were taken during observation periods and the interviews were transcribed verbatim from audiocassette. The notes and transcriptions were read for heuristics. As each heuristic was identified it was coded for a specific game usability area (interface, mechanics or game play). These coded heuristics were then listed and a count was made for how many times each heuristic was noted or mentioned. Finally, this list was compared with those identified from the literature. In addition to heuristics, general feelings and thoughts concerning usability evaluation procedures within this company and outside of this company were noted and are discussed later in this paper.

RESULTS

Definitions of 'Usability':

As anticipated, participants found discussing the concept of the usability of games to be a difficult task. Two people thought the usability of a game could be determined by how easy it was for a player to pick up a game and begin to enjoy it. One person stated that the usability of a game only concerns the screen interface and controls. Another believed that the interface and game play together composed a game's level of usability. And the last simply stated that usability is equivalent to the level of immersion the game could provide.

Usability as a term appeared to be foreign to all but one of the participants. One person explained the term's problematic nature by saying that 'usability' made him think of a tool, which seemed like an odd word to apply to a medium that exists to entertain. He thinks of 'usability' as a measure of a tool's ability to aid in productivity and a game's goal is often quite the opposite. If a game is immersive then it often leads to a loss of time, rather than a gain.

Though the interviews began awkwardly with a bit of grappling with the term usability, each participant eventually spoke of what features they found to be important in the design and testing of a game. The two discussion topics that most often elicited this information were "What makes a game fun?" and "What aspects of a game should be evaluated?" both of which opened the door for the participants to discuss the usability of games with greater ease. Their replies included a mixture of

game play, interface, and mechanics issues, which have been added in the form of heuristics to Tables 2, 3, and 4 of this report.

Explicit and implicit game design heuristics:

The heuristics identified during observation and interviewing closely matched those I identified from the literature prior to my investigation. Only eight of the thirty total game heuristics listed earlier in this report went unmentioned or unpracticed by the design team I studied. Of these eight heuristics (a, d, f, g, o, q, v, and x), five concerned game play while three related to the game interface. My guess is that the team is using a majority of these heuristics, but some of them seemed unworthy of mention because they appeared obvious (game should have a goal; game should have an unexpected end) or irrelevant (i.e., interface issues because they did not have an interface designer involved yet).

One of the game play heuristics that was not mentioned by any of the participants was pace. Pace is one of two defining characteristics of game play, supposedly the most important aspect of a game to designers (Clanton, 1998), and yet it was absent from the discussions I had with all five people. The team is developing a game where pace is really determined by the player, so perhaps that is why it went unmentioned.

Chris Crawford (1982) claims that games should not be solvable, but instead should provide the illusion of winnability. This heuristic was contrary to a comment made by Paul, the Director in my case study, who claimed that games should ultimately be solvable because everyone's favorite game is the one they have

managed to complete. Perhaps Crawford's statement is simply an ideal since a perpetual illusion is nearly impossible to maintain. Either way, the concept that winnability is important to the player is present in both people's understanding.

Four of the heuristics that were present in the literature were mentioned by three or more case study participants, which highlighted them as either of greater importance or greater proliferation. These were:

Table 2: Game heuristics verified in the case study

l.	Game Mechanics and Play	Get the player involved quickly and easily
r.	Game Play	Artificial intelligence should be reasonable yet unpredictable
bb.	Game Play	Create a great storyline
dd.	Game Play	Should use visual and audio effects to arouse interest

Heuristics identified in the case study but not found in the literature:

The following heuristics were not found in the literature but were either mentioned or practiced by one or more participants in the case study:

Table 3: New game heuristics identified during the case study

Game Interface	Controls should be intuitive and mapped in a natural way
Game Interface and Play	Art should speak to its function
Game Mechanics	Mechanics should feel natural and have correct weight and momentum
Game Play	Include a lot of interactive props for the player to interact with
Game Play	Every puzzle should relate to the story
Game Play	Teach skills early that you expect the players to use later

Game Play	Design for multiple paths through the game
Game Play	One reward of playing should be the acquisition of skill
Game Play	Build as though the world is going on whether your character is there or not
Game Play	If the game cannot be modeless, meaning the player can only engage in certain functions in certain modes, it should feel modeless to the player, thereby not affecting the player's feeling of control over actions in the game (an aspect not mentioned in game literature, but discussed as important to user control and freedom by Johnson (1995) in a retrospective examination of the Xerox Star)

Observations on evaluation procedures within the company:

Informal is the only way to describe the evaluation process in place at the company concerned in this case study. On a daily basis, the team members evaluate each other's work. It occurred constantly during my week there. David stopped by to check the animator's progress, pointed to the screen and said, "The pivot point on the ankle looks funny." Tim sat down next to Ian and together they fixed a bug in the code for the cameras. Paul, Ian, and the team's Game Designer met to decide how to provide continuity in the game with the establishment of time of day in different levels. David looked at the props being textured by the Modeler and said that the style would need to change due to some game physics restrictions Tim had informed him of that morning.

At the time of my visit, the game was in its infancy. Months later in development, when the components start coming together to form a playable game, the team members will ask for constructive criticism from other employees in the company. Even later, about three quarters of the way through production, a large group from the company will gather to play the game and offer feedback on a

questionnaire. Though the game team will acquire a great deal of feedback at this event, the game will be nearing the final stages of production and major changes to game play will be impossible to implement before final milestones are reached and shipping occurs.

Even though a full prototype is a new strategy for the company, this portion of the development cycle is being planned for and implemented in a very structured way. The prototype is considered a full phase of the production cycle, coming just after the initial design phase and just prior to production. In the prototype/pre-production phase most of the employees involved are the Leads who will manage a number of others in production when the development team grows by 150% in size. There are no QA personnel involved in this stage. In fact, only two QA testers will be involved with the team during the next phase, production, and the majority of testers will come on board at beta, which is three months before the product is to be completed. So, even though QA testers appear to be testing all three major areas of game usability, their help is only being acquired at the end of the development cycle.

In order to guide the skeleton team during pre-production, the Director, Game Designer, and Producer developed several documents including a production plan and a prototype description. The production plan divides the six-month prototype period into phases that include milestone dates and descriptions of what art, animation, game play, design, technical, and level-building elements need to be complete at each step. The prototype description is much more detailed and gives the team specific scenarios or vignettes to build. With these scenarios, the team will be able to test the riskier elements of the play, art style, and technologies of the game.

The team expressed praise for the concept of prototyping. Paul explained that this time period not only helps them to find out whether the technology will be able to support their vision, but also offers them time to gel as a team, figure out the distribution of roles and responsibilities, and establish important standards like naming conventions for files. Marketing will have a clearer picture of the game much earlier than usual and will be better able to create a plan to promote the game. Everyone, including upper management, will be able to play the game and offer feedback at a time when large-scale changes are still feasible to make. Initially, while drafting the design document for the game, Paul insisted on this prototype period because this game is striving to blend two genres of game play together which is a somewhat technologically risky endeavor.

When asked if the prototype is going to increase the amount of time or money needed to develop the game, Jerod responded that the prototype phase is actually lowering both. The game will now only be in full production for a year and a half instead of two; and the initial months will be spent in pre-production with a small core team. Employing the talent is the largest cost of making a game, so scaling down the initial amount of staff required significantly reduces the cost of developing the game.

The benefits of prototyping the game are easy for everyone to see. Unfortunately, even though the company is allowing this more formal usability precaution to be taken, they still have no plans to formally evaluate it. The prototype, like other games in development, will be tested only by a few trusted friends of the

team (who will be external to the team and internal to the company). Testing will include informal play testing and non-structured verbal feedback.

DISCUSSION

Suggestions for implementing more formal usability procedures:

Though the members of the team spoke of a greater involvement and interest by management in the evaluation of the games in development, a greater investment would be needed to truly establish a user-centered approach to game design.

Prototyping:

It seems reasonable that prototyping should be done for nearly every game. In the past, certain games have been financial failures for the company. Prototyping could prevent that from happening again, or at a minimum, allow the company to discern that a game is not going to work before full production has begun and major financial investments have been made. Prototyping not only allows for problems to be identified at a much earlier stage, it also provides time for the core development team to develop working relationships and systems that build a solid foundation for the production process.

Prototyping is not enough to ensure that disasters will be avoided. Testing needs to occur in tandem with prototyping. It is true that games cannot truly be tested until you can play them, so a prototype allows a slimmed down version of the game to be available for formal evaluation purposes.

Confidentiality seems to be a major issue, so for most games, testing may need to be done with users internal to the company. Evaluation is occurring already internally, but it is informal and the results are not necessarily recorded or interpreted

in any quantifiable way. Perhaps the company could pool from the resources it already has and structure time every month for each employee to engage in play tests for games that are in development. Every person I observed at some point mentioned that watching others play your game is the best way to find problems with it. Perhaps these play tests could be established in a setting where testers can play and the design team can watch. The test could be set up in a verbal protocol manner where players offer feedback while they test the game. Whoever is moderating the test could take notes on problems or reactions by the players.

Designers create game flow documents and then level designers actually establish ideal paths for the user through each level of the game. Since this documentation already exists for each game in pre-production, it would be logical to include this in the analysis of the play test. Where are the players making mistakes? How can the level be better designed to lead the player down the correct path?

Prototyping could be expanded as a technique. One interesting interface design method I found in my research was team prototyping. Paul and David both expressed an interest in being involved in the conceptualization of the interface design, so it would make sense for them to meet with the Interface Designer as a group and use this method to produce the first iteration together. In team prototyping, the interface designer connects a drawing tablet to a projected screen and manipulates blocked items on the screen as layout and function are discussed. This is not to say this method should replace paper prototypes, though, for they are fast and easy to create and have been found to be very effective in usability tests (Virzi, Sokolov, and Karos, 1996).

Another form of prototyping, storytelling prototyping (Salomon, 1989) could assist with puzzle design. In this method users are given sections of a piece of media and they verbally explain what they think should happen next. This method could help identify whether players will be able to solve puzzles or stay on track within the game.

Postmortems:

One of my participants mentioned that he did not think enough company-sanctioned postmortems were happening. Discussing what went wrong or right in the development process of a game after it is over and then publishing it company-wide would help to prevent errors from being repeated. The company intranet would be a great place to establish a method for the sharing of this type of material.

User tests with external subjects would be possible in this stage as well since confidentiality is no longer an issue after a game is shipped (assuming the game was finished and shipped before the development cycle was ended). Having users play the game and evaluating their satisfaction and success with the game could provide enlightening feedback that could later be incorporated into a postmortem document or be made available should a sequel to the game be developed in the future.

Expert evaluations:

When usability testing is not possible, expert usability evaluation methods could be helpful in determining problems with a game. Cognitive walkthroughs could help determine whether it is likely a player will follow the ideal path of the

game identified by the level designer. In this method an evaluator walks through a scenario and tells a convincing story about whether the determined path for the player would be the path they would actually take (Wharton et al., 1994). This process is time consuming and tedious, so a better option might be the streamlined cognitive walkthrough that was established to be used by large software companies (Spencer, 2000). This method is an adaptation of the original cognitive walkthrough that attempts to reduce the time required to perform the method, eliminate designer defensiveness, and reduce lengthy design discussions. If game heuristics were further studied and verified, then heuristic evaluations (Nielsen, 1994) and heuristic walkthroughs (Sears, 1997) would also be ways in which games could be evaluated quickly and cheaply.

Resources to implement usability:

A usability evaluator who possesses gaming expertise should be on staff within the company. Even one person could help interface designers in the creation and evaluation of prototypes, assist with running user tests, perform quick heuristic evaluations when necessary, or lead a streamlined cognitive walkthrough with a game design team.

For usability evaluations to be performed soundly, they need to be completed by trained HCI personnel. One study found that a novice who was taught the cognitive walkthrough evaluation method was ineffective at identifying real problems in a multimedia tool (John and Mashyna, 1997).

Having an HCI professional on a game development team could lead to better overall designs. Most designers believe they can predict how a user will relate to a system, but repeatedly it has been shown that they cannot (Norman, 1990). Bailey's (1993) study even displayed that HCI professionals create better original interface designs than designers. HCI professionals can therefore offer a fresh sensibility to both the design and the evaluation of software products, and if they also have gaming experience, could apply that knowledge successfully to the unique software category of games.

Limitations of the study:

If I could go back and gather data again, I would try to spend a day with Quality Assurance. Since the game team I observed was not at the stage yet where QA becomes involved, it did not appear to make sense for me to spend my time with that section of the company. I also did not pursue observing someone from QA because I was under the impression, until my final day, that they only test for broken programming. However, while listening to a conversation between Jerod and a tester, I learned that they actually analyze all aspects of the game including game interface, game mechanics, and game play. So, in order to get a complete picture of the heuristics and evaluation techniques involved in the game development process, it would be necessary to observe and interview a QA tester.

Suggestions for future research:

Additional case studies within other development companies could provide a means to compare and contrast the data collected in this study. It would be interesting to know what other evaluation processes are occurring in other places and how well they are working. Follow up research on my study with this company could include the actual implementation of some formal evaluation procedures to see what affect they would have on the design process and mentality of the design teams. These evaluation procedures could include in-house testing of a prototype or even user testing of a shipped game (to avoid any confidentiality issues).

A last suggestion for further research is to verify the following compiled list of heuristics identified in the literature and case study. Feedback from other individuals involved in game development could help to accomplish this. Participants could add to or edit the list, or even rate the list as Lund (1997) had participants do in his study of maxims of graphical user interface design.

Table 4: Compiled list of game heuristics

Game Interface	Controls should be customizable and default to industry standard settings
Game Interface	Controls should be intuitive and mapped in a natural way
Game Interface	Minimize control options
Game Interface	The interface should be as non-intrusive as possible
Game Interface	For PC games, consider hiding the main computer interface during game play
Game Interface	A player should always be able to identify their score/status in the game
Game Interface	Follow the trends set by the gaming community to shorten the learning curve
Game Interface	Interfaces should be consistent in control, color, typography, and dialog design
Game Interface	Minimize the menu layers of an interface

Game Interface	Use sound to provide meaningful feedback
Game Interface	Do not expect the user to read a manual
Game Interface	Provide means for error prevention and recovery through the use of warning messages
Game Interface	Players should be able to save games in different states.
Game Interface and Play	Art should speak to its function
Game Mechanics	Mechanics should feel natural and have correct weight and momentum
Game Mechanics	Feedback should be given immediately to display user control
Game Mechanics and Play	Get the player involved quickly and easily
Game Play	There should be a clear overriding goal of the game presented early
Game Play	There should be variable difficulty level
Game Play	There should be multiple goals on each level
Game Play	"A good game should be easy to learn and hard to master" (Nolan Bushnell)
Game Play	The game should have an unexpected outcome
Game Play	Artificial intelligence should be reasonable yet unpredictable
Game Play	Game play should be balanced so that there is no definite way to win
Game Play	Play should be fair
Game Play	The game should give hints, but not too many
Game Play	The game should give rewards
Game Play	Pace the game to apply pressure to, but not frustrate the player
Game Play	Provide an interesting and absorbing tutorial
Game Play	Allow players to build content
Game Play	Make the game replayable
Game Play	Create a great storyline
Game Play	There must not be any single optimal winning strategy
Game Play	Should use visual and audio effects to arouse interest
Game Play	Include a lot of interactive props for the player to interact with
Game Play	Teach skills early that you expect the players to use later
Game Play	Design for multiple paths through the game
Game Play	One reward of playing should be the acquisition of skill
Game Play	Build as though the world is going on whether your character is there or not
Game Play	If the game cannot be modeless, it should feel modeless to the player

I took the liberty of adding the following heuristics to the list above, because though they were not present in the literature and were not evident during the case

study, they seem like issues that are relevant to all software including games. They are at least points for further discussion of game interfaces:

Game Interface	Provide means for error prevention and recovery through the use of warning messages
Game Interface	Players should be able to save games in different states

The two heuristics I removed from the compiled chart of heuristics are listed below. The first I removed because there was some incongruity between the literature and the case study about the concept of winnability. The second I excluded from the compiled list because it appears to be a heuristic that would only apply to adventure games, and the above heuristics are meant to apply to the design of all genres of games.

Game Play	The game must maintain an illusion of winnability
Game Play	Every puzzle should relate to the story

If research in this area is to be expanded, a working language will need to be developed that both human-computer interaction professionals and game developers are comfortable using. 'Usability' is awkward to use in the game development context because those that are familiar with the term usually assume it only relates to an interface. In game development, if usability is to be assessed, the interface, game mechanics, and game play must all be evaluated. Therefore, the phrase 'user experience' might be a broader, more accessible term that could serve as an umbrella to describe all three areas of game usability.

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APPENDIX 1

Study Plan:

Project Title: Usability in the Game Development Process

Project Duration: Phase 1: Site Visit: 11/26/2001 – 11/30/2002
Phase 2: Data Analysis and Reporting: 12/1/2001 – 5/08/2002

Purpose of the Study:
The purpose of this study is to gain insight into the usability evaluation processes within a game development company and to research the explicit and implicit heuristics of game design.

Study Design:
The investigator will spend one business week at a successful game development company and observe a different employee within the company each business day. Ideally, the investigator will observe a person in each of the following job capacities: Art Lead, Interface Designer, Producer, Project Lead, and QA Manager. This process will allow the investigator to assess the contribution of each job type to the development process, specifically as it relates to usability.

Either during the business day (if time allows) or during lunch or after the workday, participants will be asked to participate in a one hour long interview regarding game design philosophies as well as understanding and practices of usability. The interview of each participant will be tape-recorded. Names will not be recorded, only job titles. The interview tapes will be destroyed upon completion of the project, which is anticipated to be in May of 2002.

This research will be done to collect data for a Master's thesis. No deception techniques will be used. Participants will be fully informed of the scope of the study prior to data collection.

Deliverables:
The collected data will be compiled and analyzed in the form of a written, qualitative report. The researched game development company will receive a copy of this report upon its completion, which is expected to be in August 2002. The finished report will be the thesis project of the investigator.

Confidentiality:
No names will be attached to the data and no names will be used in any reports on the data. All interviewed participants will be given a pseudonym. Any quotes used to illustrate trends will not be connected to a particular person. Much of the data will be reported in aggregates to help maintain confidentiality. The name of the game development company will also be kept confidential and will not be named in any

reports. No trade secrets will be revealed. A designated employee of the researched game development company will screen information regarding products under development.

Participation:
All participation in this study is voluntary. If given permission to pursue the study within a given company, the investigator will offer to call and/or email employees within that company to request their participation.

APPENDIX 2

Glossary:

artificial intelligence (AI): The ability of the computer to solve problems creatively.

beta: The second stage or prerelease stage of testing where the goal is to work out the glitches in a functionally complete software product.

cognitive walkthrough: A usability evaluation typically performed by usability experts where the evaluators follow an ideal path through a product and make a convincing story about whether the determined path for the user would be the path they would actually take.

console: In gaming, a console refers to a system on which a game is played that includes a game controller and an input device for the game and attaches to a television for playing.

director: The leader of a team who conceptualizes, designs and directs the creation of the product.

game interface: The device through which a player interacts with the game including on-screen elements like tutorials, scoring devices, and game management tools, as well as physical devices such as controllers, keyboards, mice, or joysticks.

game mechanics: The ways in which a player is allowed to move through the game environment.

game play: The problems and challenges a player must face to try to win the game.

heuristic evaluation: A usability evaluation performed by usability experts where the person spends one to two hours doing two passes through an interface and compares it with a list of heuristics and notes which design standards it violates.

heuristics: Identified usability principles that can assist in creating or evaluating a design.

human computer interaction (HCI): The study of the design, evaluation, and implementation of interactive computing systems.

ISO: The International Organization for Standardization

lead art: The person on a development team who leads the art team, which on a game team might consist of one or several modelers, texturers, art techs, concept artists, and animators.

lead level designer: The person on a development team who leads the level designers who are responsible for designing and lighting game environments as well as defining game play and mechanics elements.

lead programmer: The person on a development team who leads the programming effort for building the technology that runs the product.

modeless: If an application is modeless, it allows the user to do whatever they want when they want without being restricted to certain features in certain modes.

pilot test: The performance or practice of an experiment prior to collecting data with the goal of finding places needing of alteration within the study plan.

postmortem: An analysis or review of a completed project.

producer: The person hired to manage the schedule and budget of projects.

prototype: A model used to evaluate and improve a product during its development cycle.

quality assurance (QA): Quality assurance personnel play games that are in development to test them for technical errors or flaws in game play.

usability: The effectiveness, efficiency, and satisfaction of users in a particular context or environment.