Pervasive Gaming in the Everyday World

An empirical study examines to what extent the vision of pervasive gaming is becoming reality in the context of SupaFly, an everyday-world pervasive game.

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When computers become pervasive, they change from being a localized tool to a constant companion, enabling continuous interaction and promoting informal, unstructured activities without clear starting or ending points.[1] Pervasive games implement and exploit this new role of computational technology to enhance computer game design and the computer-gaming experience. Pervasive technology offers three particularly promising dimensions of computer game play:

- mobile, place-independent game play,
- integration between the physical and the virtual worlds, and
- social interaction between players.

Pervasive-game research has produced various types of games and game prototypes, emphasizing different aspects of pervasive interaction.[2–5] For example, the mixed-reality chase game Can You See Me Now? implements all three dimensions in an experimental game design.[6] In the game, mobile runners in the streets using handheld computers with wireless network connections and GPS technology chase virtual representations of online players trying to avoid capture. Another example is Human Pacman, which combines the physical world with the classic video game Pac-Man.[7] Finally, Songs of North demonstrates technical and design solutions for pervasive games.[8] Players move through the physical world to move their character in the virtual world, using a shaman drum as a bridge between the worlds and as a game world map.

The research underlying these games has revealed interesting and important findings related to pervasive gaming's basic issues. However, it has also revealed limitations. One such limitation is that people play few of the existing pervasive games in their normal everyday life, which makes studying the games' role and effect in these situations difficult. Such research is necessary to help commercial designers create successful pervasive games and to help identify and explore the issues arising when such computer gaming becomes situated in the everyday world.

We've made an initial attempt to explore the three dimensions of pervasive game play in the context of people's everyday life. Using an advanced prototype of SupaFly, a pervasive game developed by the former company It's Alive (now part of Daydream, www.daydream.se), we've evaluated how people perceive and play the game in normal, everyday settings. Our evaluation focused on how the players judged the designers' attempts to incorporate the three dimensions in the game.

SupaFly

The game is a community-based virtual soap opera, where the players create characters and then interact through them. By making and maintaining relationships with other players, players score points and gain status. All interaction occurs through mobile phones and SMS (short-message service) commands. In addition,

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Figure 1. A SupaFly player uses the SMS (short-message service) SAY command to send the text "Hello!" to another player whose character is named Lisa.

a Web site lets players manage their characters and track their development in the game. The Web site complements the SMS part of the game by providing a media-rich, stationary platform for some game activities.

The following short scenario describes the basic game play and some of the actions that the players perform. Player A sends the command "SAY Hello, wanna be friends?" to Player B. Player B responds with the command "SAY Sure!" and sends the command "RELATION Player A Friend" to set the status of the relation between the two players to be friends. Both players thereby score points, some for the conversation and some for the strengthened status of their relationship.

A player's goal is to reach the highest level of status in the community—to become "Supafly." Every action in the game generates news that the game displays in *Hype*, its online magazine. Depending on the sensational value of the news (determined by the action and the status of the players involved), the game categorizes the news clips and publishes them at different levels of the magazine. The levels award different amounts of points; news with the highest sensational value appears on the front page, rewarding many points to the players involved. This overall objective and the means for accomplishing it (interaction with other players) implements the dimension of social interaction to create an amusing gaming experience. The game's design, objectives, and technical platform all aim to enhance this interaction.

The main idea is to make the game persistently available to the players anytime, anywhere, thereby drawing on mobile, place-independent game play to improve the game play experience. SupaFly has no starting or ending points; it's just there for the players to pick up and play. Because the most critical game-playing actions are player driven (incoming and outgoing SMS messages) and the game platform offers constant access to the game, the players can initiate actions at any time. This ability also implies that any player at any time might receive the outcome of another player's initiated action, in the shape of an SMS message.

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Two aspects of the game exploit location to integrate the physical and virtual worlds. First, virtual objects (such as clothes and other items for the characters) are distributed at various locations (coordinates) in the physical environment. For instance, the game engine might place a virtual pair of jeans at the location of a physical street corner in a city. A player can then identify and pick up an object if he or she is within a specified range of it. Second, the game continuously calculates the active players' geographical positions through triangulation in the GSM (Global System for Mobile Communications) mobile-phone system. The game uses these positions to enhance the player's awareness and understanding of other players. For example, when a player performs the SMS LOOK command, the game presents a list of other nearby players whom the player can approach for interaction.

Game play

Players send SMS commands to locate other players (their geographical position) or communicate with them. The commands go to a phone number specific to the game and are then rerouted to the receiver. With this solution, the players become anonymous and stay in their game character because the perceived sender will be that phone number and the name of the sending player's character. For example, figure 1 shows a player using the SAY command, which sends a text message to another player. We'll look at some of the commands in more detail later.

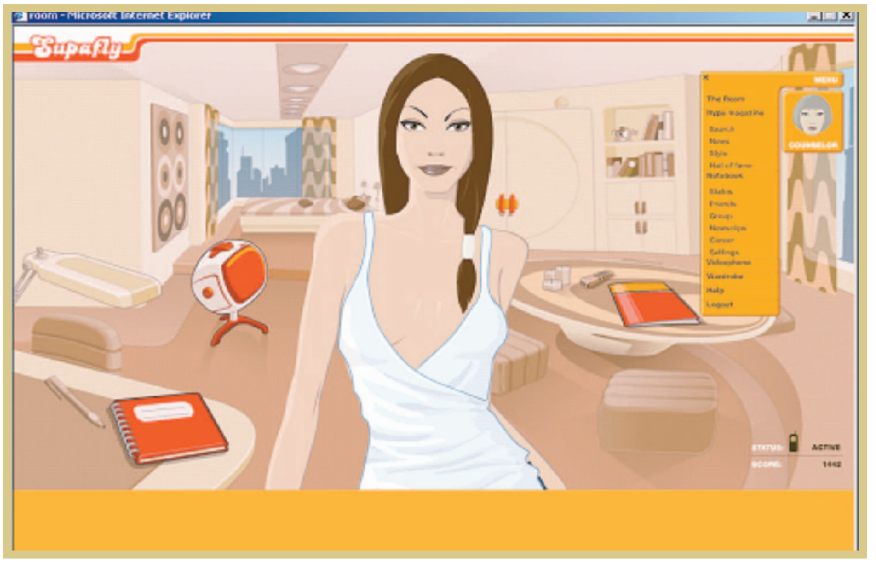

Figure 2. The Room—the main page of the SupaFly Web site. The page shows the graphical presentation of a game character, *Hype* magazine on the coffee table, the Notebook to the character's left, the Wardrobe in the background, and the Videophone just to the left behind the character. (image courtesy of Daydream Software AB)

Figure 2 shows the Room, the Web site's main page, which has links to the Notebook and Wardrobe sections, the Videophone graphical interface, and *Hype*. Players can use the Notebook (see figure 3) to manage and keep track of their relationships. They can change their character's appearance in the Wardrobe, locate other players via the Videophone, and read *Hype* (see figure 4). (The magazine is also available in an abbreviated edition via SMS.)

Designers' predictions of the game play

From oral and visual presentations and discussions about the game, performed in project meetings with members of the design team, we have abstracted a view of how the designers predict the game play.

By delivering constant game access through well-known everyday technology (mobile phones and the Web), the game should blend in as a natural element of the players' everyday context. By using the players' geographical proximity to each other, the game should connect the virtual community to real-world physical places. Making players aware of other players in the surrounding geographical area should enhance the feeling of a constantly ongoing (anytime, anywhere) game. Such awareness should help remind the players about the ongoing game's existence and provide interaction cues (triggering conversation and communication). Furthermore, the mobility of the pervasive technology on which the game is implemented should let the players carry the game throughout all the different contexts of everyday life. So, players should also play the game in immobile or private contexts. They should play at homes, as well as at work, at school, in public transportation, or in other public spaces such as bars, coffee shops, or malls. The situations and contexts in which players choose to use the game should depend purely on their personal requirements and on whether they wish to have fun at a given moment.

User evaluation

We evaluated SupaFly in two iterations; the first iteration's main purpose was to develop our test methodology and design.

Participants

To recruit participants, we used public posters and personal-recruitment

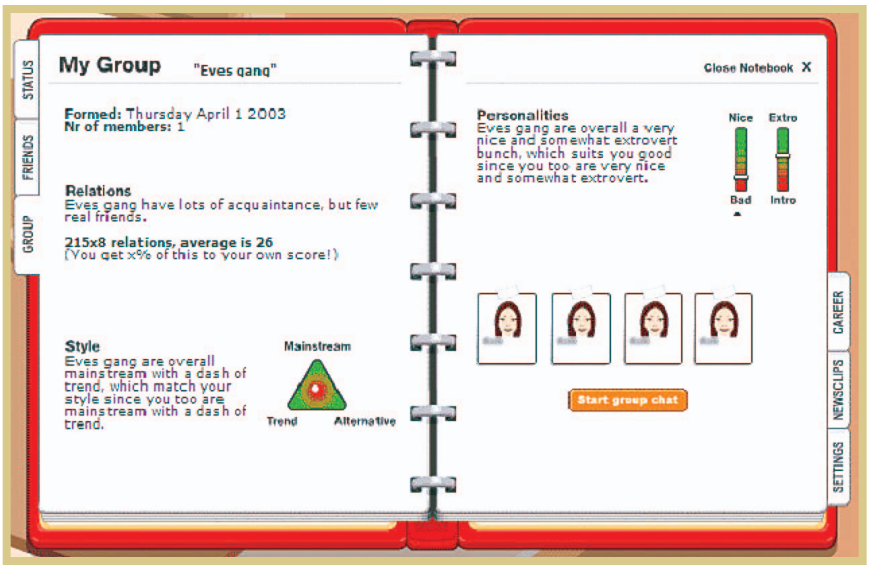

Figure 3. In the Notebook, players keep track of their status in the game, their relations, and their overall progression. Players can form groups to which they invite other players. This spread displays information about the other players in a group and the group's characteristics and personality. (image courtesy of Daydream Software AB)

campaigns on the Umeå University campus. This process let us include people who were genuinely interested in pervasive gaming but also led to problems controlling the test sample. Keeping track of possible social relations between players (for example, if some of them already knew each other) became difficult, which could affect the game's outcome. Statistical testing of the results also became difficult because we didn't randomly select the subjects.

For the first iteration, we recruited 16 subjects, of which nine (six males and three females) performed the complete evaluation. All nine were undergraduate-level university students who described themselves as experienced computer gamers (six played computer games every day; three played at least once a week). They also said they frequently used Internet chat rooms and communities (five visited chat rooms every day; four visited chat rooms at least once a week).

For the second iteration, we recruited 42 subjects. Of these subjects, 25 (15 male and 10 female) performed the complete evaluation. Their ages ranged between 15 and 48 years; 15 of them were between 22 and 28 years old. Fourteen of the 25 subjects were university students, and 11 were working. Their computer-gaming experience ranged from very experienced (three played computer games every day; seven played at least once a week) to rather inexperienced (seven subjects very seldom played games; three subjects played occasionally). Only three visited chat rooms every day; 18 never or almost never visited chat rooms or communities.

Methods and procedure

Researchers' ability to study a pervasive-game player's interaction with the environment and other players is often limited because the player's environment and corresponding ubiquitous artifacts aren't directly accessible.[4] Because It's Alive designed SupaFly to be played in everyday settings, anytime and anywhere, the game design posed several methodological challenges for evaluation. An ethnographical approach, which studies players in actual gaming situations, would perhaps be the first choice. However, such an approach would require us to continuously follow the players throughout their everyday contexts, both private and professional, to capture all potential situations of game play. Even if we had the resources to perform a complete study of this kind, serious issues would exist concerning the players' privacy and integrity.

Figure 4. The front page of *Hype* magazine, where all actions performed in the game become news. A player who initiates an action that becomes front-page news receives many points. (The URL in the picture isn't active.) (image courtesy of Daydream Software AB)

Instead, to compensate for the lack of opportunity to study the game play "live," we combined three other methods:

- system logs of user activities,
- a qualitative questionnaire, and
- focus group interviews.

Both iterations started with a period of unrestricted game play. In the first iteration, we let players use either mobile phones or the Web to perform all the gaming activities, both communicative and administrative. The possibility of communicating through the Web resulted in low use of mobile phones. So, in the second iteration, we restricted the players to mobile phones for communicating and the Web for administrative activities, such as keeping track of their status and the community's overall status. In that iteration, we recorded all the activities performed through mobile phones (SMS commands and messages) in system logs to give a complete picture of the overall in-game traffic and the content of the players' conversations.

In both iterations, a qualitative questionnaire captured the players' subjective impressions of the game and their notion of the activities they had performed. The questionnaire included both open-ended questions with free-text answering and multiple-choice questions. Question topics included specific functions in the game, overall game play, usability and playability, and gaming behavior (contexts, situations and time of the day when the game was played, and so on). We distributed the questionnaire as a Web form, which subjects filled out immediately after the periods of game play.

In the second iteration, we invited nine participants to focus group sessions (one group of four and one group of five participants) to elaborate the results from the questionnaires. We selected the participants on the basis of their relative level of engagement in the gaming activities, ranging from those who were rather inactive (only a few SMS messages sent) in the game to persons who were very active (many SMS messages sent). The focus groups discussed issues ranging from general opinions of the game design and game play to overall impressions and experiences from the different contexts and settings in which the participants had played the game.

Table 1 summarizes the iterations.

TABLE 1
The evaluation iterations.

Period	Number of participants	Time spent with the game	Responses to questionnaire	Focus group participants
Spring 2003	16	3 weeks	9 (6 males, 3 females)	—
Winter 2003–2004	42 (27 males, 15 females)	2 weeks	25 (15 males, 10 females)	9 (2 males, 2 females & 2 males, 3 females)

TABLE 2
General gaming activities.

Summary of game traffic	Total
Number of SMS (short-message service) messages the participants sent	1,461
Average number of SMS messages each participant sent	34.8
Number of SMS commands used	67
Number of incorrect (non-SupaFly) commands used	38

TABLE 3
The 13 (out of 67) most-used SMS commands.

Command	Purpose	Total
LOOK	Locate nearby players and objects	300
SAY	Send an SMS message to another player	290
Y	Respond yes (to requests)	187
KISS	Try to kiss another player (the other player must accept the kiss)	126
HIT	Virtually punch another player	107
RELATION	Specify the relation to another player (examples are friend, good friend, enemy, and girlfriend)	78
WHISPER	Not a valid command*	69
STATUS	Show the personal status (level)	65
GIVE	Not a valid command*	46
SHOUT	Not a valid command*	46
CHAT	Not a valid command*	45
PICKUP	Pick up a virtual object near the player	45
SELL	Not a valid command*	44

*These commands are examples of some of the 38 non-SupaFly commands that players used (see table 2).

Empirical results and implications

Because we used the first iteration mainly to inform the second one, we focus on the second iteration's evaluation.

Table 2 summarizes the in-game traffic the participants performed. The highest number of SMS messages a subject sent in the game was 103; the lowest number was one.

As table 3 shows, the most commonly used SMS commands were LOOK and SAY. Because the game's major activity is player interaction, we expected this outcome. Players need LOOK to find other players to interact with, and SAY is the most immediate command for initiating interaction or engaging in conversation.

Were they playing anytime, anywhere?

Our evaluation revealed that the participants played the game in a rather unexpected way, considering the designers' intentions for game play. They didn't play the game in a mobile fashion (at a number of different locations and in different contexts) but in a rather immobile way in their homes.

In the questionnaire, 20 of the 25 subjects stated that they most often played the game at home in their spare time. Two questionnaire responses reflect our overall findings:

> *I generally played the game at home, in my couch. Mainly because this is the context in which I spend most of my spare time, when not working.* —*Subject A*

> *I mostly played the game at home, since I'm mostly at home when I'm not in school.* —*Subject B*

Of the other five subjects, two usually played at work, two usually played at the pub, and one usually played at her parents' house:

> *I played whenever I got incoming messages. This was mostly when I was at work.* —*Subject C*

One subject who played the game at work offered an interesting explanation during the focus group interviews:

> *Since I have a habit of immediately answering all SMSs I get, I played the game at work and at*

home. It's interesting in a way, since I normally don't play the games at work, but I considered the game SMSs to be like any other SMS I get, so I just answered them.
—Subject D

In the questionnaire, the respondents estimated at what times they played most often. Their responses reveal that they played the game mostly between 1 p.m. and midnight (nine subjects played mostly between 1 and 5 p.m.; 13 subjects played mostly between 5 p.m. and midnight). The SMS activity log data (in this case, the time of each player's peak activity) supports these estimates. The following quotations illustrate the main reason for choosing this part of the day:

I just had most of my available time at nights, and I also think that night is the time of day when you feel like you want to relax, play games, and have fun. *—Subject A*

This time of day is the normal time for communication with your friends, after work. *—Subject E*

Evenings and nights were the natural times of the day to play, since I'm not working then. *—Subject F*

Combining the results regarding where and when the participants played the game, we conclude that they played the game mainly at evenings and nights at home during their leisure time.

The deep cultural division between work and recreation contexts[9] might explain this observation. The participants relate computer games to recreational or leisure time, so they use the game at home because they normally spend a lot of their recreational time at home. The players' lack of mobility would then be a consequence of this attitude.

Considering the two subjects who stated that they played the game mostly at work, the picture becomes somewhat more problematic. Both subjects stated in the focus group interviews that they normally don't play computer games at work but that they considered the SMS game activities in SupaFly as different from traditional computer game playing. They explained that they normally and regularly respond instantly to all the SMS messages they get on their mobile phones and that they always carry their mobile phones with them throughout the day. So, they didn't consider the SMS messages from other players as different from any other SMS messages they receive. Because the time to respond to these messages is short, they claimed, the game's intrusion during work hours was so limited that it didn't become an issue. Another factor limiting the intrusion was that the two respondents received most of their game SMS messages during evenings and very few during work, which could be due to how most other participants played the game. Because all game actions are player initiated and most participants played the game in the afternoon and evening, game traffic during regular office hours was generally low.

Those two subjects' decision to play the game during what they classify as work time seems to run contrary to how people generally separate activities into work and recreation, pursued at separate times. This observation calls for further research considering pervasive gaming's anytime, anywhere aspect to clarify to what extent pervasive games might challenge people's conception of social contexts and related activities.

The empirical results lead to a design implication: the "mobile, place-independent game play" idea might benefit from being turned inside out. That is, we should consider place- or location-dependent game design in which players must move around at a specific location (instead of being able to play the game "anywhere," which in our study was realized in most cases through "sofa gaming").

How about the integration of the physical and the virtual?

Analysis of the focus group data reveals that the game's integration of the physical and virtual worlds was of limited importance to the players. The general opinion of this specific part of the game design was that the integration was somewhat "cool" but of limited or no significance for the overall game play. Only one subject commented on the integration as positive and enriching:

The triangulation and place independency adds an interesting dimension to the game. *—Subject E*

The following quotations better reflect most players' opinions:

Some functions were completely irrelevant, such as the ability to pick up virtual objects in my nearby environment. It costs me real money in terms of SMS charges; one for finding an item and then another charge for picking it up. Why would I do this? I can buy items in the magazine without spending hard cash!
—Subject A

I think the integration between the physical place of yourself and the virtual place of your character was somewhat unclear. I think this aspect would be more meaningful and fun if there actually were more players in the game. As it was now, the connection between my physical place and the game was totally unimportant; I just talked to the characters that had names I could remember. Maybe this would be different if there were more players in my surroundings.
—Subject F

From our evaluation, we conclude that the implemented integration of the physical and the virtual, based on location of players and virtual objects, was insufficient to be a meaningful and enriching part of the game. However, as Subject F mentioned, the perception of this particular implementation might be different if more people were playing the game. If the critical mass of players

needed to make this game design successful is higher than the 42 active players in this evaluation, our observations concerning this dimension of pervasive gaming might be misleading.

So, the most important conclusion regarding this dimension might be that we must explore it further to better understand how to meaningfully integrate these worlds in pervasive-game designs. It's still somewhat unclear whether location is sufficient to successfully implement this integration.

This vision of tight integration has so far been about accessing the virtual part of the game anywhere, anytime. This integration can become much more interdependent so that players must perform actions in both the real world and virtual worlds to keep the game going. On a general level, this is about finding and placing appropriate game-playing rules and constraints on pervasive gaming instead of focusing on just the enabling components. This is similar to managing brainstorming sessions, where putting constraints on the brainstorming process is important—for example, telling participants that they must tackle a specific problem and that they may not use the most obvious means to reach a solution (as opposed to just bringing together a group of people and asking them to discuss smart ideas on any topic they prefer).

What kind of social interaction actually occurred?

We noticed that the players seemed to use the game to facilitate existing social interaction in groups that they belonged to before they played the game:

> *I think I am expected to meet new friends in the game, but I mainly communicated with people I already knew when I played the game.*
> *— Subject F*

A possible explanation for this common phenomenon could be that the game lacks activities that trigger new social interactions:

> *There should be more shared activities in the game, like for instance different tasks, quests, and team competitions. Those kind of activities would give you [the players] a common point to gather around, and something to actually discuss when you interact in the game, instead of just SMS the usual "Hey, how are you" to as many players as possible to earn points.*
> *—Subject G*

> *I think the game should have more features that make it easier to start talking to other players. There could be some kind of bulletin board or some kind of contests that you could start to discuss. As it is now, you don't have anything in common to discuss if you don't already know the other player.* *—Subject A*

Considering the subjects' opinions, we conclude that the game's design doesn't sufficiently support meaningful social interaction between players who don't know each other. Even though the game gives the players a shared forum (*Hype*) for keeping track of the community's activities and a reward system that promotes interaction, the players require something more to experience meaningful social interaction. This observation points to the need for further research on social interaction in pervasive games. We need to further elaborate on different solutions for supporting social interaction and to further explore the requirements and social behaviors of people in pervasive-gaming situations.

One implication of these observations is that the vision of a "general platform for social interaction between players" might benefit from being narrowed to a communication platform tightly coupled to the events and actions in the game (for example, "you can't send a message to or talk to the princess before you have beaten the monster and made it to level 3"). This should cause the game itself to trigger social interaction.

Although the threefold vision for pervasive gaming hardly became a reality for the users in our study, it still might be a good catalyst for developing ideas for future pervasive-gaming platforms. Our findings related to the three dimensions lead to questions such as these:

- Where do people play the game?
- In what situations do people choose to enter the game?
- Do people play alone or when they get together?
- Is there any learning effect (for example, do people internalize the SMS commands over time)?
- Does the cost of sending SMS messages create a barrier to long-term playing of the game?

To address these questions, we plan to use a longitudinal, ethnographically inspired approach to further explore the social and technical dimensions of everyday pervasive gaming. With such an approach we hope to address the questions within people's everyday contexts and environments, thereby offering an understanding of the complex nature of pervasive gaming as an everyday activity. P

REFERENCES

1. G.D. Abowd and E.D. Mynatt, "Charting Past, Present, and Future Research in Ubiquitous Computing," *ACM Trans. Computer-Human Interaction*, vol. 7, no. 1, 2000, pp. 29–58.
2. S. Benford, C. Magerkurth, and P. Ljungstrand, "Bridging the Physical and Digital in Pervasive Gaming," *Comm. ACM*, vol. 48, no. 3, 2005, pp. 54–57.
3. S. Björk et al., "Designing Ubiquitous Computer Games—A Report from a Workshop Exploring Ubiquitous Computing Entertainment," *Personal and Ubiquitous Com-*

puting, vol. 6, nos. 5–6, 2002, pp. 443–458.

4. A.D. Cheok et al., "Touch-Space: Mixed Reality Game Space Based on Ubiquitous, Tangible, and Social Computing," *Personal and Ubiquitous Computing*, vol. 6, nos. 5–6, 2002, pp. 430–442.
5. T. Manninen, "Contextual Virtual Interaction as Part of Ubiquitous Game Design and Development," *Personal and Ubiquitous Computing*, vol. 6, nos. 5–6, 2002, pp. 390–406.
6. F. Flintham et al., "Where On-Line Meets on the Streets: Experiences with Mobile Mixed Reality Games," *CHI Letters*, vol. 5, no. 1, 2003, pp. 569–576.
7. A.D. Cheok et al., "Human Pacman: A Mobile, Wide-Area Entertainment System Based on Physical, Social and Ubiquitous Computing," *Personal and Ubiquitous Computing*, vol. 8, no. 2, 2004, pp. 71–81.
8. P. Lankoski et al., "A Case Study in Pervasive Game Design: The Songs of North," *Proc. 3rd Nordic Conf. Computer-Human Interaction* (NordiCHI 2004), ACM Press, 2004, pp. 413–416.
9. P. Thomas and R. Macredie, "Games and the Design of Human-Computer Interfaces," *Educational & Training Technology Int'l*, vol. 31, no. 3, 1994, pp. 134–142.

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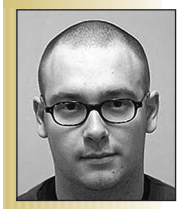

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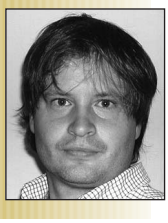

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