Matchmaker: Interpersonal Touch in Gaming

Cody Watts
University of Calgary
2500 University Drive NW
Calgary, AB, Canada
wattsc@cpsc.ucalgary.ca

Ehud Sharlin
University of Calgary
2500 University Drive NW
Calgary, AB, Canada
ehud@cpsc.ucalgary.ca

Peter Woytiuk
BioWare Corp.
200, 4445 Calgary Trail
Edmonton, AB, Canada
woytiuk@bioware.com

ABSTRACT

Interpersonal touch – a shared touch between two people – is both significant and common in human social interaction. In this paper we argue that interpersonal touch should play a role in interaction between people in computer-mediated social activities, such as video games.

To support this notion, we have designed *Matchmaker*; a two-player cooperative tabletop video game themed on the concepts of love and romance. *Matchmaker*'s gameplay is directly controlled by a set of collaborative tabletop interaction techniques, as well as by interpersonal touch between its players.

In this paper we present the philosophy behind *Matchmaker*'s design and describe in details the game implementation. We also include the results of an exploratory user study designed to gauge players' responses to *Matchmaker* and to its unique interpersonal interaction technique. Our results suggest that not only is *Matchmaker* a highly enjoyable game, but that its integration of interpersonal touch is a strong contributor to players' enjoyment.

ACM Classification: H5.2 [Information interfaces and presentation]: User Interfaces – Input devices and strategies, interaction styles.

K.8.0 [Personal Computing]: General – Games.

General terms: Design

Keywords: Games, gaming, interpersonal touch, tabletop, love, *Matchmaker*, interaction, DiamondTouch

INTRODUCTION

> *Though mother may be short on arms,*
> *Her skin is full of warmth and charms.*
> *And mother's touch on baby's skin,*
> *Endears the heart that beats within.*
>
> --Harry F. Harlow, "The Elephant" [5]

The above poem comes from psychologist Harry Harlow's seminal 1958 paper, "The Nature of Love" [5]. This paper

presented the results of a study in which day-old macaque monkeys were separated from their parents and placed in the care of two surrogate mothers. In actuality, these mothers were little more than stationary dolls, outfitted with a nipple for bottle-feeding. One of these dolls was constructed of wire mesh, while the other was made of soft rubber, and covered with a terrycloth "skin". Aside from this, the two mothers were identical. The baby monkeys were observed over a period of 165 days to determine how they would relate to their two mothers.

The results of the study were dramatic and profound: baby monkeys overwhelming preferred to spend their time on and around the terrycloth mother; they would sleep on her chest and cling to her when scared. Even in situations where only the wire mother was able to provide milk, babies chose to spend the significant majority of their time with the cloth mother. Harlow's work demonstrated that a comforting touch is profoundly important to the healthy psychology of developing baby monkeys, with direct implications to humans.

And why shouldn't touch be important? Touching is one of the most emotionally-significant ways in which social creatures interact. Whether it is a baby kitten nuzzling its sibling, a young couple sharing a hug, or a father resting his hand softly on his daughter's shoulders, the merest act of interpersonal touch represents a significant emotional connection between participants.

Yet, in spite of touch's importance to human interaction, the notion of using interpersonal touch as a technique for human-computer interaction has not been extensively explored. This is especially relevant in light of recent trends towards pervasive computing: as interfaces become increasingly transparent, simple and natural methods of interaction between users will become increasingly necessary. We see potential benefits in examining the suitability of interpersonal touch for this purpose.

Granted, interfaces which rely on interpersonal touch are not ideal for every application; the act of touching another person can be inefficient, socially uncomfortable, and possibly even offensive. But in spite of these potential drawbacks, we believe that there are also interaction scenarios where interpersonal touch is not only appropriate, but even desirable.

One instance where interpersonal touch can be especially appropriate is within the context of a video game. Video

games offer optional, consequence-free environments which are capable of evoking strong emotions from their players [6]. By couching interpersonal touch in a game, we allow the act to remain light-hearted and unthreatening by implicitly giving players permission to touch. Games such as *Dance Dance Revolution* and *SingStar* have demonstrated how players will gladly participate in ordinarily embarrassing activities (such as dancing or singing) when the action is tied to the outcome of an enjoyable game. Video games allow players the option to participate or abstain without consequence, ensuring, in our case, that they will never be forced to touch or be touched against their will. But more importantly than this, games allows us to create an environment where the act of touch makes sense. By tying touch to the theme and mechanics of the game, we can create a situation that moves touch from an arbitrary interaction technique to a sensible extension of the gameplay itself.

To demonstrate this idea, we created *Matchmaker*: a cooperative, two-player tabletop video game which utilizes interpersonal touch between players (Figure 1). In the following pages, we present an in-depth description of *Matchmaker*: its story, game mechanics and implementation. We also examine the results of an exploratory user study, conducted to evaluate how enjoyable *Matchmaker* is to play, and to reflect on how the inclusion of interpersonal touch contributes to *Matchmaker*'s gameplay.

RELATED WORK

To the best of our knowledge, no previous video game has made use of interpersonal touch. In this regard, we believe *Matchmaker* to be quite unique. However techniques for detecting interpersonal touch over tabletop interactions have been previously studied and implemented using the Mitsubishi Electric Research Laboratories (MERL) DiamondTouch. DiamondTouch is a front-projected, touch-sensitive tabletop computing surface which uses an electrical capacitance system to detect touches from up to four unique users simultaneously. These events are detected using a mesh of conductive metal antennae which lie just below the surface of the tabletop. Each of these antennae conducts a unique electrical signal; when a user touches the surface of the table she too begins to conduct the electric signals carried on the antennae that she touched [3].

Each DiamondTouch user sits on a conductive pad connected to the host PC. These pads act as receivers for the signals coming from the table's subsurface antennae. When a user touches the table, a circuit is formed between the tabletop, the user's body and the conductive pad. By analyzing the signals coming from a particular pad the DiamondTouch software can identify exactly which antennae the user has touched and, consequently, where on the table each user is touching.

Although the DiamondTouch was not explicitly designed to sense when two users are touching each other, it can be adapted to perform this task with minimal difficulty. When two users make skin-on-skin contact, they will begin to
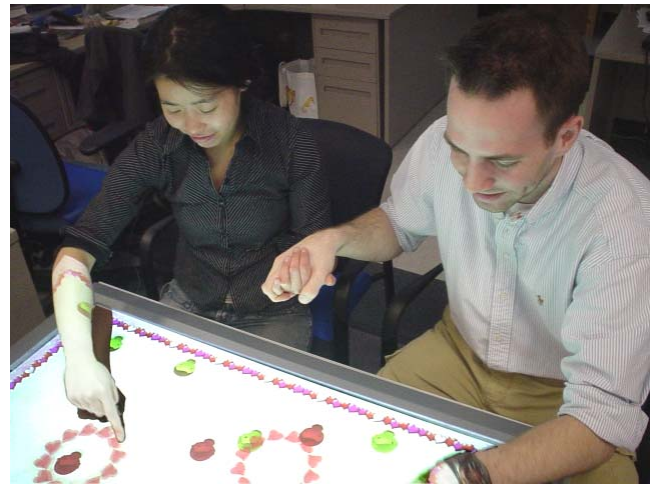

Figure 1: *Matchmaker:* a cooperative, two-player tabletop video game utilizing interpersonal touch.

"share" the electronic signals coming from the table and each user's pad will receive a nearly-identical set of input. Now, when either user touches the surface of the DiamondTouch it will appear as though both users are touching that point on the table simultaneously. Since this is a physical impossibility, such events can easily be recognized as a consequence of interpersonal touch. This technique was first suggested in [3] and is the method we use to detect interpersonal touch in *Matchmaker*. There are some limitations to this method; most significantly, it requires at least one of the participating users to touch the surface of the table. If two users hold hands but neither one touches the tabletop, the system will be unaware of the interaction taking place.

CollabDraw is a tabletop drawing application which used the DiamondTouch to allow up to four people to collaborate simultaneously on a single illustration [8]. As a part of its collaborative toolset, CollabDraw employed two "cooperative gestures" which made use of interpersonal touch in some way. The first of these was the "partner" gesture, in which two participants held hands, allowing one participant to dynamically control the width of the other's pen stroke. The second was the "quit" gesture, which required participants to hold hands with their neighbors before one user finally touched the table, ensuring that the drawing session could not be terminated without the unanimous consent of all users involved.

Acts of interpersonal touch in CollabDraw were not well received by the co-workers who were selected to test the system. Participants cited problems such as "sweaty hands" and general awkwardness as having detracted from their experience. Though CollabDraw users found hand-holding unpleasant, this does not necessarily preclude the usefulness of interpersonal touch in other applications; the authors concluded that while their study points to handholding being unpleasant in formal tasks, interpersonal touch may still be valuable for other purposes, such as entrainment applications.

In [9], Zimmerman proposes a novel view of interpersonal touch interaction, by using the human body as a "biological conductor" for the transmission of modulated electric signals produced by on-body devices. When two people touch, signals sent by an emitter on one person's body can be transmitted freely to a receiver on the other's, allowing digital data to be exchanged through the act of touch. To demonstrate the concept, a prototype system was created which would allow one person to transmit an electronic business card to another merely by shaking hands [9].

Research in tangible user interaction is also aimed at exploring and expanding the value of touch in HCI. For example, in the PSyBench and inTouch projects [1] physical objects are used to facilitate interaction between remote collaborators, creating an illusion that the interface is shared between users, allowing them to touch and to simultaneously sense others touching the objects. However, research in tangible interaction is limited to exploring touch as it is being mediated through physical objects, and stops short of exploring interpersonal interaction via unmediated skin-to-skin contact.

Several psychological studies suggest that the mere act of interpersonal touch creates a positive affect in those involved. In [2] an experiment was performed wherein restaurant waitresses would briefly touch the hands of clients as they were returning the clients' change. Their tips were then compared to the tips received by a control group, who did not make physical contact with their clients. The results showed that both male and female diners who made physical contact with their waitress tipped higher than those who had not. A similar result was reported in [4], where library clerks (both male and female) were instructed to subtly touch patrons' hands as they returned the patrons' library cards. After checking out, these patrons were approached by the research team (posing as library workers) and asked to fill-out a questionnaire rating their satisfaction with the library and its clerks. This data was compared to satisfaction data for a control group of non-touching clerks. After analyzing the data, the authors concluded that the addition of touch had significantly increased female satisfaction ratings, regardless of the gender of the clerk. Differences in males' responses were less marked, showing only a small increase in satisfaction.

Can the positive effect of interpersonal touch carry over to video games as well? In "Why we play games: Four keys to more emotion without story" Lazzaro presents the results of a study designed to identify and categorize the positive emotions that players experience while playing video games [7]. Lazzaro encapsulated her findings into four keys, which she calls "the four most important pathways to emotion in games." One of these keys is the People Factor – the social interaction that occurs in and around games. Similarly, we believe that encouraging players to interact through the medium of interpersonal touch can create tangible social connections which can serve to heighten players' enjoyment.

MATCHMAKER
Design Goals
In designing *Matchmaker*, our goal was straightforward: to create a game which made an effective use of interpersonal touch. But this left us with a difficult problem: how could we design a game where the use of interpersonal touch would make sense both thematically and mechanically?

Although any form of interpersonal touch would have suited our purposes, hand-holding naturally emerged as the preferred mode of operation. Hand-holding has the added benefit that it is essentially a cooperative gesture – both parties must take some action in order for it to occur. Generally speaking, holding hands is seen as a symbol of affection between couples and so, our minds quickly turned to thoughts of affection. We seized upon a plan to create a game whose themes of love and romance would mirror the romantic appearance of its hand-holding players. But, to keep the experience light-hearted we decided to go over the top with *Matchmaker*'s presentation: to create a cutesy, garishly-pink game filled with heart iconography designed so players would feel both amused and vaguely silly playing it.

Matchmaker does not condone polyamory; in order to support our themes of partnership and romantic love, *Matchmaker* was designed to be played with exactly two players.

Storyline
The universe of *Matchmaker* is a microcosm of our own; it is a world filled with adorable, round-headed people called Peeps (Figure 2) whose only goal in life is to love, and be

Figure 2: Peeps of different colors.

loved in return. Unfortunately the Peeps are also a little bit clueless; they need the help of some benevolent *Matchmaker*s to speed the process along. That is where the players come in. Players must work together to match up compatible Peeps and spread love throughout the land. But they will have to act quickly; if a Peep remains single for too long, he or she will become depressed and lovelorn (Figure 3). Only one thing can restore a lovelorn Peep's hope: it's

Figure 3: Lovelorn Peeps.

Figure 4: *Matchmaker*'s main game screen.

Figure 6: When a player holds their partner's hand and touches the table, the Power of Love is activated.

up to the players to join hands, and share the Power of Love!

Game Mechanics

In *Matchmaker*, a Peep is defined by two characteristics: its color (red, orange, yellow, green, blue or purple) and its gender (male or female). Aside from these characteristics, Peeps are otherwise identical.

Matchmaker's game screen is presented as a window to the world of the Peeps; (Figure 4) a heart-covered border surrounds the game's playing field. When the game begins, Peeps will begin to stream into the field from off-screen, wandering in and out in a disorderly, ambling fashion. The players must use these onscreen Peeps to create their matches.

Making matches is simple. Players can "grab" a Peep by touching it with their finger as it wanders by. When a Peep has been selected, a colored halo surrounds it, indicating that it is now under the player's control. Selecting a Peep gives the player the power to drag it to any place on the screen. When two players drag their selected Peeps to the same location, a match will be created if the two Peeps are "compatible" (Figure 5). Two Peeps are compatible if and only if they have the same colors and opposite genders. That is to say, red boys are compatible with red girls, green boys with green girls, and so on. Each player is allowed to select only one Peep at a time; this prevents players from being able to match Peeps alone, and forces them to work together with their partner.

Figure 5: Two players create a match by dragging their selected Peeps together.
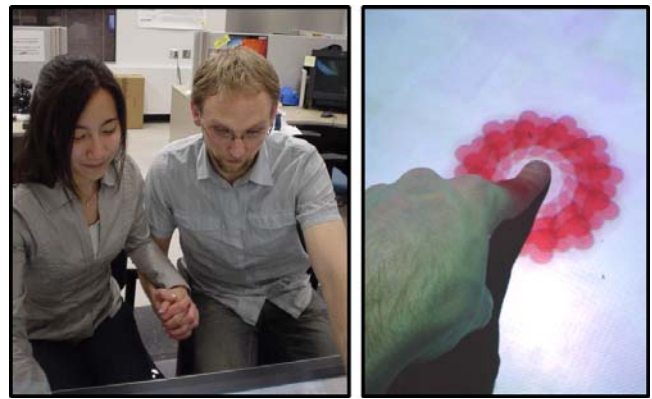
When a match is successfully made a pleasing chime will play and the matched Peeps will disappear from the playing field. Two new Peeps will be created (off-screen) to take their place; this ensures that the total number of Peeps in the world stays constant. If two incompatible Peeps are dragged together, no match occurs. Instead, a small buzzer will sound, and the affected Peeps will simply wander away.

If a Peep is not matched up within a certain period of time it will become lovelorn. When a Peep becomes lovelorn, it will start to cry and lose its color, becoming grey. While lovelorn, a Peep cannot be matched up, even with other lovelorn Peeps. Although players can afford to ignore lovelorn Peeps for a short amount of time, eventually more and more of the Peep population will become lovelorn, making it extremely difficult to create further matches. The only way to "cure" a lovelorn Peep is with a technique we have dubbed the "Power of Love". Players can activate the Power of Love by making physical, skin-on-skin contact with their partner, typically through holding hands, and having either player tap the affected Peep(s) (Figure 6). This will "cure" the Peep, restoring its original color and permitting it to be matched up once again. Peeps which have been cured in this way are still susceptible to become lovelorn again if enough time elapses.

While players are holding hands, they cannot perform normal operations such as selecting, dragging and matching Peeps; they can only cure lovelorn Peeps through the Power of Love. Though this may seem punitive, we designed this limitation to give the game strategic depth. If the Power of Love was not mutually exclusive with other game actions, players could simply choose to hold hands for the entire game, and in so doing, rob the act of its significance to gameplay.

Themes

Matchmaker's design and mechanics reflect three intertwined themes. These themes are:

1. Love & Romance: At its core *Matchmaker* is a game about finding love. The game even takes its name from the practice of arranging a romantic coupling between

two people. "Love" is also a visual motif in *Match-maker*; hearts, and red colors (which connote love and passion) are sprinkled liberally throughout the game. But we also see this theme as extending beyond the game itself; *Matchmaker* provides a social setting where hand-holding is permitted and even encouraged. Our goal is for players to bond with their partners as they hold hands and play together.

2. Touch: In *Matchmaker*, all interaction is accomplished through some form of touch. Whether it is a player touching a Peep to select it, or two players holding hands to activate the Power of Love, touch provides an easy, natural way for players to interact with the environment and with each other.

3. Cooperation: In *Matchmaker*, a single player is powerless to act. Players must work together with their partners in order to match up Peeps and to invoke the Power of Love. The most successful *Matchmaker* players are the ones who have learned to communicate with their partner, and anticipate their partner's actions. This ties back into the game's romantic theme; alone, you are powerless, but with your partner, you can accomplish anything.

Game Flow

Matchmaker is divided into a series of six stages, each of which is ostensibly harder than the last (Table 1). The goal of each stage is to make a set number of matches within a specified time limit. Players advance through the stages in a linear fashion; when one stage is completed, they move to the next. If the players fail a stage, they are given the opportunity to restart the game from the beginning of that stage.

As stages introduce more and more colors of Peeps, they become increasingly difficult. In the first stage, Peeps come in only two colors – red and green. This lack of diversity ensures that opportunities for matching compatible Peeps are plentiful. By stage five, there are six distinct colors of Peeps, which significantly lowers the chance of two compatible Peeps appearing onscreen simultaneously. As the scarcity of compatible Peeps increases, players must act faster, and tightly coordinate their actions with their partner

if they hope to succeed.

Each stage controls the rate at which Peeps become lovelorn (Table 1). In the first two stages, Peeps cannot become lovelorn at all. This minimizes the early complexity of the game, and allows players to practice the game's fundamental mechanics (such as selecting and matching Peeps) before we introduce more complicated techniques. In stages three through five Peeps will become lovelorn if they are not matched up within approximately 25 seconds. In the final stage, stage six, all newly created Peeps begin their lives as lovelorn.

IMPLEMENTATION

Matchmaker was implemented in C++ and uses the GLUT library to perform OpenGL rendering. The game itself was developed for the MERL DiamondTouch. Our Diamond-Touch is powered by a desktop PC running Windows XP, with an Intel Pentium D 940 3.2GHz Dual Core Processor, an NVIDIA GeForce 7800 GTX graphics card, and 2 gigabytes of RAM.

In *Matchmaker*, all gameplay functions are performed through the DiamondTouch tabletop; no other peripherals are required to play. Users select Peeps by touching them with their fingers, and drag them by moving their fingers over the surface of the table. As stated in the Related Work section, *Matchmaker* detects interpersonal touch through the DiamondTouch using the method described in [3]. Although the DiamondTouch can only recognize interpersonal touch when one participant also touches the surface of the table, this does not limit *Matchmaker*, where interpersonal touch is only used in conjunction with the Power of Love.

EVALUATION

An exploratory experiment was conducted in which we invited four couples to play *Matchmaker*. Following these play-sessions, questionnaires and interviews were administered to help us understand how players feel while playing the game.

Aims

In evaluating *Matchmaker*, we sought to explore two general topics. The first of these topics deals with *Matchmaker*'s capability as a game. This forced us to ask ques-

Stage	Peep Colors	Time Limit (min)	Matches Required	Special Conditions
1	2	1:30	20	Peeps will never become lovelorn.
2	3	1:30	20	Peeps will never become lovelorn.
3	4	2:00	25	Peeps become lovelorn after 25 ± 15 seconds.
4	5	2:00	25	Peeps become lovelorn after 25 ± 15 seconds.
5	6	2:00	25	Peeps become lovelorn after 25 ± 15 seconds.
6	6	3:00	25	All new Peeps spawn as lovelorn. Peeps become lovelorn after 35 ± 15 seconds.

Table 1: *Matchmaker*'s stages.

tions such as: is *Matchmaker* playable? Is it fun? What do players find enjoyable about the game and what about it do they dislike? How can we make *Matchmaker* more enjoyable? Though these questions may seem trivial, we believe them to be of the utmost importance; if *Matchmaker* is inherently unenjoyable, then it is a poor case-study for examining the value of interpersonal touch in games.

Our second area of inquiry was: how does the inclusion of interpersonal touch contribute or detract from the experience of playing *Matchmaker*? Is interpersonal touch a valuable component of *Matchmaker*, or would the game be equally enjoyable if it was removed? What about interpersonal touch to players like or dislike?

Participants
Matchmaker was designed to be played by partners who were familiar with each other, and who were comfortable holding hands for brief periods of time – in short, *Matchmaker* was mainly designed for couples. Accordingly, when recruiting we sought out participants with a preexisting romantic relationship, i.e. those who were dating or married. In total, four couples were recruited; three heterosexual couples, and one homosexual male couple, making for a total of three female and five male participants. Participants were either lab members, or associated with lab members and varied in age from 18 to 37. Seven out of the eight participants had spent at least one hour playing some form of digital game (console, cellphone, PC or online games) in the past week and four out of eight participants had used a tabletop computer at least once prior to this experiment.

Procedures
Before starting the experiment, the administrator would introduce himself to the participants, and outline the purpose and requirements of the study. Special attention was paid to ensure participants understood that they would be required to hold hands during the experiment. Participants were also informed of their rights, particularly the right to terminate the study at any time if they felt uncomfortable. Participants were then asked to complete a pre-test questionnaire designed to reveal their past experience with the skills they would be using during the experiment – playing video games, interacting with a tabletop computer, and engaging in interpersonal touch.

Once the questionnaires were completed participants were seated side-by-side in chairs at the head of the Diamond-Touch and informed that they would now play a game of *Matchmaker*. Participants were instructed to play to the best of their abilities and as though the observer was not present. In order to replicate a natural playing experience, the administrator would not address the participants past this point until the experiment had concluded. Instead, in-game instructions were used to provide players with information on how to play the game and how to proceed (Figure 7). As the participants played through the game, the observer was responsible for noting any interesting occur-
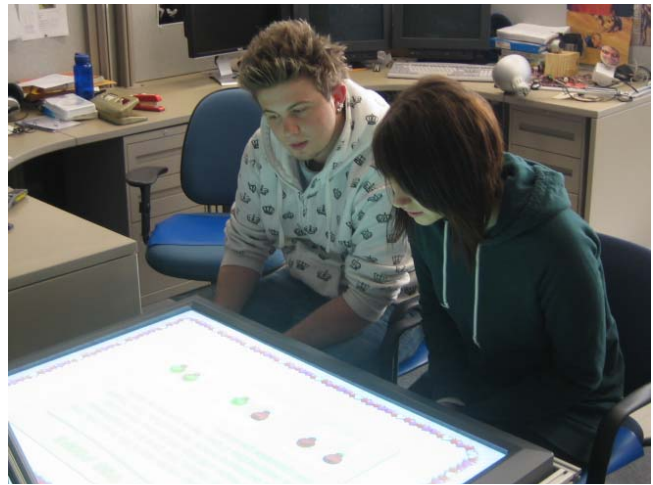

Figure 7: Two participants learn to play *Matchmaker* via onscreen instruction.

rences, patterns or behaviors that he witnessed from the players.

As mentioned previously, *Matchmaker* is broken into six stages, each of which is more difficult than the last. Participants were allowed to play until one of two conditions was met: either all six stages were completed and the game was won or the participants failed to complete a single stage three times in a row.

Once gameplay had concluded, each participant was issued a post-test Likert-scale and open-response questionnaire. The purpose of these questionnaires was to determine the participants' feelings and reactions to *Matchmaker*, while the experience of playing was still fresh. Participants were instructed to fill out their post-test questionnaires silently and independently of one another, to protect their responses from possible conformity biases.

Following the post-test questionnaires, the experimenter would conduct a debriefing and an unstructured discussion with the participants in order to explore any questions which arose during the testing period.

RESULTS AND DISCUSSION
Having run only eight participants, we must be cautious about drawing any general conclusions; with a sample of this size, we view our study as strictly exploratory. Nevertheless, we were strongly encouraged by the results we obtained.

Most encouraging was our participants' demonstrated affinity towards *Matchmaker*, as evidenced by their response to the statement "Overall, I enjoyed playing *Matchmaker*" ($\mu = 6.5$, $\sigma = 0.53$, Figure 8). Observations of players' behaviors seem to support this data; smiling and laughing during gameplay was a common occurrence amongst all couples. This positive response is especially surprising when one considers how few couples made it through the entire game; of our four participating couples, only one managed to complete all six levels. The remaining couples became stuck on stages three, three, and five, respectively.
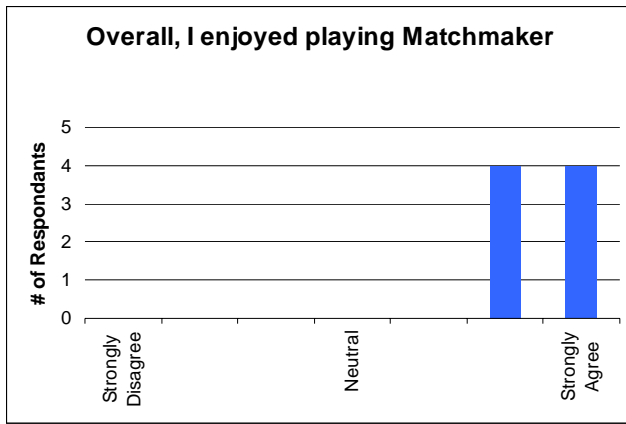
Overall, I enjoyed playing Matchmaker

Figure 8: Participant response to "Overall, I enjoyed playing *Matchmaker*."

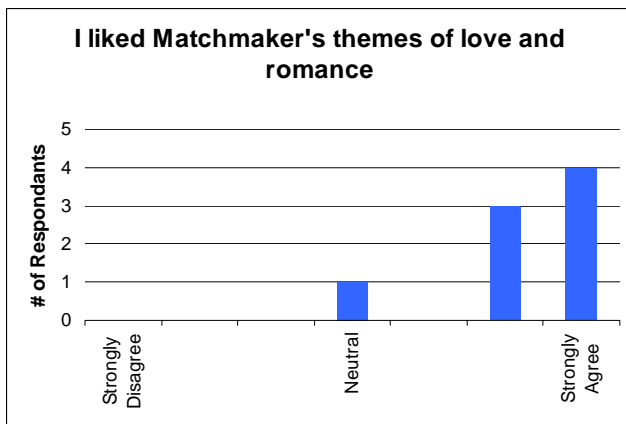**I liked Matchmaker's themes of love and romance**

Figure 9: Participant response to "I liked *Matchmaker*'s themes of love and romance."

In fact, the game's difficulty was a popular topic in our players' post-test questionnaires. When asked what he disliked about *Matchmaker*, a male participant wrote: "[It gets] too difficult too quickly." Considering that the game was designed to be relatively easy for first-time players, this represents a real problem with the game's balance. A few players managed to hit on why this was so. Two players commented that the Peeps moved "too fast", while other participants wrote that Peeps became lovelorn too quickly, or that the stages ended too soon. In truth, the game's excessive difficulty can be attributed to a combination of all of three of these factors.

The participants' enthusiastic response towards *Matchmaker* is likely due at least in part to *Matchmaker*'s themes and presentation style. Not only did participants agree strongly with the statement "I liked *Matchmaker*'s themes of love and romance" ($\mu = 6.25$, $\sigma = 1.03$, Figure 9), but many participants commented favorably on *Matchmaker*'s polished and "professional" appearance. One participant compared the Peeps to the iconic Miis used in the popular Nintendo title *Wii Sports*, while another praised the game for its "cutsey feel". Spontaneous expressions of delight uttered by players (such as "awww!" and "oh, wow!") also added the impression that *Matchmaker* was engaging its

I found Matchmaker difficult to play

Figure 10: Participant response to "I found *Matchmaker* difficult to play."

players. In fact, even after their respective experiments had concluded, two separate couples voiced a desire to keep playing. In these authors' opinions, this strongly suggests that *Matchmaker* is an enjoyable game to play.

Tabletop Interaction

Players' feelings towards interacting with the Diamond-Touch were mixed. On one hand, many players made a note of how easy it was to interact with the touch-sensitive surface. In the words of one male participant: "The multi-touch surface made it easy to play; [you] just drag the Peeps together." A female participant commented that *Matchmaker* was very "accessible" because it requires mastery of only simple everyday skills like touching and dragging, in contrast to the complex, multi-button control layouts required by many commercial games.

Yet, these quotations seem incongruous with the participants' ambivalent response to the statement "I found *Matchmaker* difficult to play" ($\mu = 3.875$, $\sigma = 0.99$, Figure 10). In hindsight, we suspect that our question did not properly distinguish between the escalating challenge of gameplay as players advance in levels and the challenges of working with *Matchmaker's* tabletop interface.

Matchmaker's tabletop interaction also came with a very tangible drawback; two of our eight participants wrote that the experience of playing *Matchmaker* had hurt their fingers. The cause of this pain was apparent from observation; many players were "stabbing" at the board with their fingers, rather than using a gentle touch. This phenomenon is likely related to the Peep's excessive movement speed. Although a firm touch is no more accurate than a soft touch, most participants did not seem to recognize this and, in their excitement to select Peeps, they were prone to these hurtful stabbing gestures.

Interpersonal Touch

Of all the Likert-scale statements we posed to participants, "I feel that *Matchmaker* made use of interpersonal touch in a significant way (i.e. the game would not be the same without it)" received the most highly varied responses ($\mu = 5.875$, $\sigma = 1.12$, Figure 11). The graph reveals an overall
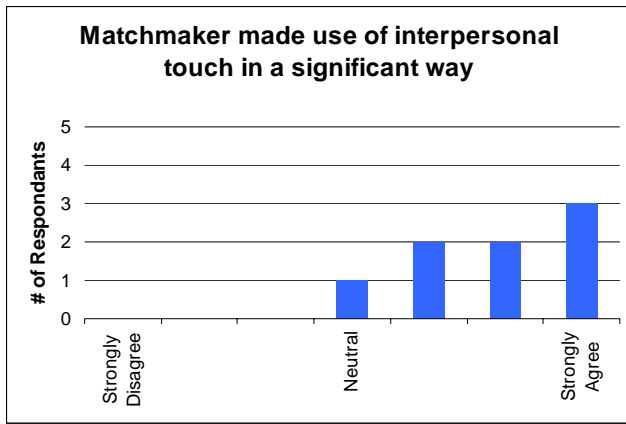
Matchmaker made use of interpersonal touch in a significant way

Figure 11: Participant response to "*Matchmaker* made use of interpersonal touch in a significant way."

Matchmaker made use of interpersonal touch in a significant way

Figure 12: Participant response to the statement "*Matchmaker* made use of interpersonal touch in a significant way" as a function of stages completed.

trend towards agreement, but no clear consensus on the issue. Interestingly, a participant's response to this question seems to be positively correlated with how far he or she was able to progress into the game (Figure). The two couples that became stuck on stage three – the stage in which the mechanic of interpersonal touch is first introduced – responded to this statement with a mean value of 5.25. In contrast, the couples who progressed to level five or higher responded with a mean value of 6.5. A probable explanation for this disparity is that players who progressed farther into the game – and thus ended up spending more time using interpersonal touch than those who did not – became more appreciative towards the use of this interaction technique as time went on.

When asked how the use of interpersonal touch affected their perceptions of *Matchmaker*, participants were largely positive in their responses. In the words of one participant: "I felt like I was sharing my love in a [silly] but fun [kind of] way." Another participant responded: "[Interpersonal touch] really made the game more collaborative. Both players really needed to work together to be successful."

However, the use of interpersonal touch in *Matchmaker* was not an unqualified success. One couple did not immediately understand that matches could not be made during periods of interpersonal touch. A member of this couple conveyed his displeasure in the post-test questionnaire, saying: "It's counter-intuitive to have to let go [of my partner's hand] to match up couples." Another couple encountered similar problems. In this case, the female partner would often touch her partner without any forewarning, preventing him from selecting Peeps until she let go. In his post-test questionnaire, he wrote: "It was frustrating trying to coordinate touches when you notice a pair [of compatible Peeps] and your partner doesn't."

Although we are mindful of such concerns, cooperation among partners is central to succeeding at *Matchmaker* and communicating when and how interpersonal touch will be used is a significant aspect of this cooperation. In the words of one insightful participant: "[Interpersonal touch]
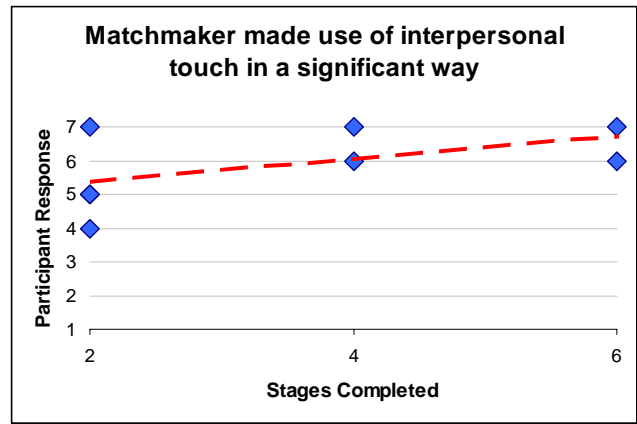
made the game more challenging in an interesting way. It was less about the actual act of contact, and more about the coordination challenge."

Implications

Within the past decade, the field of commercial game development has seen a groundswell in the popularity of novel interaction techniques. Consider *Dance Dance Revolution* which revolutionized the games industry in 1999 when its dance-pad-based gameplay first appeared in North America. *Dance Dance Revolution* proved so popular that it revitalized the entire genre of rhythm-based games – the effect of which can be seen today in the success of modern rhythm games like *Guitar Hero* and *Rock Band*.

The Nintendo Wii has proved similarly successful, largely because of the popularity of its innovative motion-sensing controls. Nintendo's "wiimotes" have given game designers the ability to explore entirely new methods of play, and opened the door to games which would have otherwise been impossible.

We view interpersonal touch and its inclusion in *Matchmaker* as an extension of this philosophy. Interpersonal touch should not be viewed as a surrogate of existing interaction techniques but rather as a new interactive medium. Existing games would not benefit from the inclusion of interpersonal touch any more than they would benefit from the introduction of a dance pad. We suggest that game developers and HCI practitioners view interpersonal touch not as a way of improving existing interaction techniques but rather as a concept that affords entirely new and heretofore unexplored HCI experiences.

FUTURE WORK

Both *Matchmaker* and the broader notion of using interpersonal touch in games are ripe for future exploration. In the immediate future we plan to revise *Matchmaker* to make it less difficult for first time players, in accordance with the findings we have presented here. Subsequently, we intend to revisit our original study with a greater number of participating couples so that we can better understand how

players feel about *Matchmaker* and its use of interpersonal touch.

Beyond this, possibilities for further inquiry are vast. One avenue for future exploration would be to study how *Matchmaker* plays with non-romantic couplings. Such a study could examine anything from parent-child partnerships, all the way to partnerships of randomly selected strangers. This study would also permit us to examine the role that gender plays in touch interactions; we think it would be very enlightening to observe how the experience of two randomly selected male participants would differ from that of a random male-female or female-female pairing.

Another avenue of study would be to attempt and formally quantify how interpersonal touch contributes to *Matchmaker*. To this end, we may perform a controlled study with separate touch and no-touch conditions to see how interpersonal touch specifically contributes to players' overall enjoyment of *Matchmaker*.

One of the limitations of interpersonal touch in *Matchmaker* is that it is essentially binary – either it is on, or it is off. This limited possibility-space reduces the amount of decisions players have to make surrounding interpersonal touch. We are planning to explore a game which allows three or more players to play simultaneously, exponentially raising the potential for touch interactions. In such a game, the decision to touch would not only be a question of when, but also, with whom. If designed correctly, we believe that a multiplayer touch-based game could help us to explore complex and interesting game scenarios and while offering players increased freedom to strategize and collaborate through touch.

CONCLUSION

Interpersonal gestures are a common sight in human socialization. Every day, important messages are exchanged from person-to-person using simple, familiar actions such as handshakes, hugs, and hand-holding. In this paper we have presented Matchmaker: a two-player, cooperative tabletop game which detects interpersonal touch between its players and integrates these events in its gameplay. Matchmaker leverages the idea of touch as a romantic gesture to create an environment themed on the twin notions of love and romance; an environment where touch is not just accepted, but also encouraged. This theme is reinforced in-game through the use of cute characters, and heart-iconography.

With the aid of participant couples, we performed an exploratory user study to determine how players respond to Matchmaker. Data gathered from observation, questionnaires, and verbal interviews suggests that participants genuinely enjoyed playing Matchmaker, due to its themes, attractive presentation, and its use of interpersonal touch. In Matchmaker touch acts not only as a physical manifestation of the game's theme of love, but also as a tangible action by which players cooperate as they struggle to bring love to the Peeps. We believe Matchmaker successfully demonstrates the potential of interpersonal touch in game interaction and motivates further explorations of this interaction approach.

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