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Eggventures

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Eggventures: Strengthening Connectedness through Coop-Play

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ABSTRACT

Cooperative play has been shown to increase connectedness and enjoyment. We developed Eggventures, a platforming game for two players, to investigate how movement mechanics influence connectedness. In one version of the game, the two players are tied together with a rubber band and have to make use of it to catapult each other through the levels. In a between-subjects study, we compare this to a version with only jumping. We find that both versions offer an enjoyable experience, but that the rubber band version increased player communication. A likely contributor to this is the increased level of challenge and frustration that forced players to engage more with each other to succeed.

CCS CONCEPTS

• **Applied computing → Computer games**; • **Software and its engineering → Interactive games**; • **Human-centered computing → Collaborative interaction**.

KEYWORDS

cooperative game, platformer, connectedness

Figure 1: In one version of our *Eggventures* game, a rubber band ties together the two player characters. Players have to make use of it to catapult each other through the levels.

1 INTRODUCTION

Playing games together is a social activity that can strengthen feelings of connectedness [10]. Some ways games do so are by enabling players to have shared experiences, overcome challenges together, and getting to know each other better. We investigate how input mechanics influence connectedness through a study of a cooperative platforming game. In our *Eggventures* game (shown in Figure 1), pairs of players could either independently traverse the levels or were tied together with a rubber band and then needed to make use of a catapulting mechanic during play. We compare the two variants in a between-subjects study and find that the rubber band mechanic was more challenging for the players, but in turn increased how much they communicated and consequently also their feeling of connectedness.

2 RELATED WORK

Stepanova et al. recently surveyed how the feeling of connectedness is influenced by different kinds of technologies [10]. One strategy they identified is *play* which also encompasses cooperative games. As they point out, such games also foster connectedness through other channels, such as *shared embodied experience* and *touch*, especially when players are co-located and directly engaging with each other.

Several previous works have investigated co-located games. Harris and Hancock's *Beam Me 'Round, Scotty!*, for example, is an asymmetric game where the resulting interdependence between players resulted in enjoyment [4]. With a follow-up version of the game, connectedness was explored explicitly and a significant effect of

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symmetry on connectedness was found [3]. Taking on complementary roles resulted in an increased feeling of being connected to the other player. Results from Wehbe and Nacke suggest that the influence of cooperation in co-located play might be complicated, though, and that it does not necessarily result in more pleasurable or arousing experiences [12]. As Kappen et al. noted, the notion of social connectedness can also include bystanders and not just the players themselves [5]. Using their *In the Same Boat* game, Robinson et al. demonstrated that remote cooperative play can also increase feelings of social closeness, especially where the controls used embodied interactions [9].

Eggventures is a co-located game, but also has both players sit on the same computer and use a shared keyboard for input. This facilitates closeness and touch, as described in previous work around game input. Garner et al.'s *intangle* game, for example, is designed around shared controllers and gameplay that strongly facilitates physical closeness [2]. Similarly, *Touchomatic* by Marshall and Tennent is an arcade that incorporates physical touch between players as a game input [6].

3 EGGVENTURES

Eggventures (shown in Figures 1 & 2) is a 2D platformer for two players, one controlling a chicken and the other an owl, who then together have to make it to the end of each level. On their way, they need traverse static and moving platforms, collect a key to open the exit, and can also collect eggs to increase their score. The players also need to avoid spikes and pits with a cat clawing at them. A level ends once one of the characters has made it to the end: a birdhouse inhabited by both birds.

The game is designed to be played on a shared computer and both players share the same keyboard for input. They control the two birds with the arrow and WASD keys respectively (see Figure 3). Aside from moving left/right and jumping, they can also employ a rubber band that binds the two characters together. When one player is crouching, the other can press the jump key to catapult themselves up and in the direction of the former. While they can control their character during a regular jump, players cannot steer while getting flung by the rubber band. The rubber band also prevents the two players from splitting up and pulls them back towards each other should they separate too much. This function kicks in once the characters are about 7.5 character widths apart.

We built Eggventures with the Unity game engine and made use of its 2D physics system to implement the movement and rubber band mechanics. A spring joint connects the two characters together, pulling them back once extended too much. When crouching, a character's mass is massively increased to anchor it in the world and also counteracting the rubber band. If the other character then initiates a jump, this triggers a catapult action with the force proportional to the distance between the two characters.

Eggventures starts with a tutorial level that introduces players to the movement mechanics. Afterwards, there are twelve levels that players can traverse, each one designed to be a bit more difficult than the previous. Later levels have increased complexity, as we gradually introduce game elements and increase the need to utilize the catapulting mechanic.

4 EVALUATION

We ran a between-subjects study to evaluate how playing Eggventures influences players' feelings of connectedness. For this we also created a second variant of the game with the rubber band mechanic removed. To still allow players to complete the levels, we instead made the individual jump more powerful.

4.1 Measures

We used a questionnaire with twelve questions (in Danish, but shown here in English), each measured on a five-point Likert scale:

Q1 I know my teammate better now
Q2 I enjoyed playing the game
Q3 My teammate and I were good at navigating the game
Q4 Our communication during the game was great
Q5 I got frustrated with my partner during the game
Q6 It was easy to find out how to solve the game
Q7 We had to cooperate when playing the game
Q8 I could rely on my teammate
Q9 It would have been easier to play the game on my own
Q10 It was stressful to play the game
Q11 Our communication improved the longer we played the game
Q12 I felt like we were a team

We also collected comments, took notes during the participants' play, and recorded the screen and audio from the players. We subsequently analyzed the latter data to determine: (1) instances of communication between the players, (2) how many times a player died, (3) for how long they played, and (4) how many levels they completed. We define communication instances as gameplay-related utterances and exchanges broken up by pauses.

4.2 Procedure

After establishing informed consent pairs of participants sat down and played the game for 10–15 minutes. We stopped once players had finished a level at some point close to the ten minute mark. We randomly assigned pairs to play the version with or without the rubber band. After they were done playing, participants filled out our questionnaire individually. Participants received no remuneration for participating in this study.

4.3 Participants

We recruited participants in the lobby of a university building and hence all our participants were students. Participants were recruited as pairs of people already knowing each other. Overall, 24 people participated (15 male, 8 female, 1 non-binary), 20 of them between the ages of 20–25 (as well as three aged 26–30 and one aged 31–35). In the rubber band group there were 5 male and 7 female participants while the group that played without the rubber band had 10 male, 1 female, and 1 non-binary participant.

5 RESULTS

We first normalized the number of times participants communicated and died as well as their level progression. Note that we had to exclude one group from this part of the analysis due to technical

Figure 2: A screenshot of the fourth level of Eggventures. It shows all elements of the game: static and moving platforms, pits and spikes, a key and eggs to collect, and the birdhouse that marks the exit. Players control the two birds and have to jump and catapult each other via a connecting rubber band to traverse the level.

Figure 3: Players shared the same keyboard for input and had dedicated keys on either side. A core mechanic of the game is a catapulting action that is triggered by one player jumping while the other is crouching.

difficulties with their game recording. Figure 4 shows the differences in those measures between the two versions of the game. Statistical analysis with t-tests showed significant differences for communication ($t(6.99) = 2.53, p < 0.05$), and level progression ($t(9) = -3.86, p < 0.01$), but not for deaths ($t(8.97) = -0.52, p = 0.6$). Teams playing the version with the rubber band mechanic communicated about twice as much as those playing without. However, we can also see that they only advanced through the levels at about half the speed of the other group. This was not because they died a lot (in fact, they died about the same number of times than the group without the rubber band), but because they were more cautious and slower to move in the first place.

Differences also show up in the questionnaire responses given by participants (see Figure 5). The largest differences between the two groups were with respect to the necessity to cooperate, how frustrated they got with their partner, and the quality of their communication. The rubber band version required more cooperation, led to more frustration, and also resulted in a lower rated quality of communication. How much they had to rely on their partner and how stressful the game was in general also were rated substantially different. When playing with the rubber band, the game was more stressful and players could rely less on their teammate. However, they also responded that they cooperated much more than in the version without the rubber band. With respect to knowing their teammate, enjoying the game overall, improving their communication during play, and feeling like a team there were no differences between the two versions. The latter three all had high ratings across the board, independent of game version.

We then used Wilcoxon signed-rank tests for a statistical analysis of the questionnaire responses. As shown in Table 1, the responses to several questions significantly differed between the games with and without the rubber band. In particular, Q5 and Q7 (frustration and cooperation respectively) stood out and the rubber band version was rated higher in both.
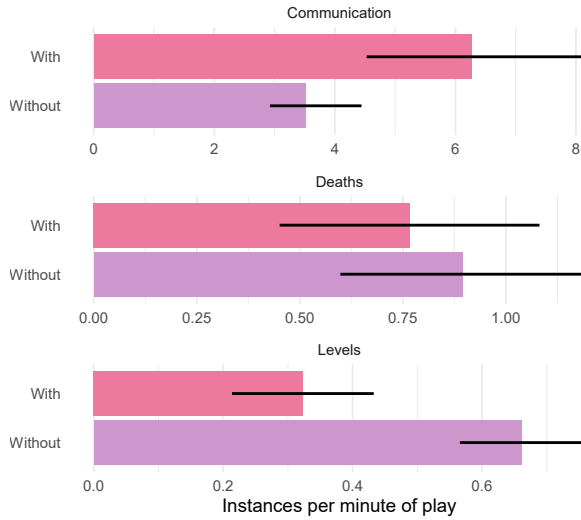
Figure 4: We analyzed the screen recordings to determine instances of communication and deaths as well as how many levels players completed. Players with the rubber band communicated almost twice as much, but also made it less far into the game. Error bars show 95% confidence intervals.

Table 1: We used Wilcoxon signed-rank tests to investigate whether there are differences between the game with the rubber band mechanic and the version without.

Question	W	p-value		Effect size	
Q1	63	0.61		0.11	small
Q2	87	0.35		0.20	small
Q3	24	0.0035	**	0.60	large
Q4	28	0.0060	**	0.67	large
Q5	130	0.0005	***	0.72	large
Q6	34	0.0204	*	0.48	moderate
Q7	132	< 0.0001	***	0.80	large
Q8	28	0.0090	**	0.54	large
Q9	106	0.0358	*	0.44	moderate
Q10	116	0.0085	**	0.54	large
Q11	83	0.47		0.16	small
Q12	87.5	0.31		0.22	small

6 DISCUSSION

Across both versions of the game, we find overall positive responses for enjoyment and feeling like being part of a team. While enjoyment is a complex construct [7], Eggventures seems to provide the right amount of challenge and control.

The rubber band version led to an increase in the amount of communication between players and players also felt that they cooperated more. For example, players talked to each other about how to move together such as: (1) "We just have to get close to the edge and then you have to say when you jump, and then I jump", (2) "If I push down then maybe you can jump higher", and (3) "I
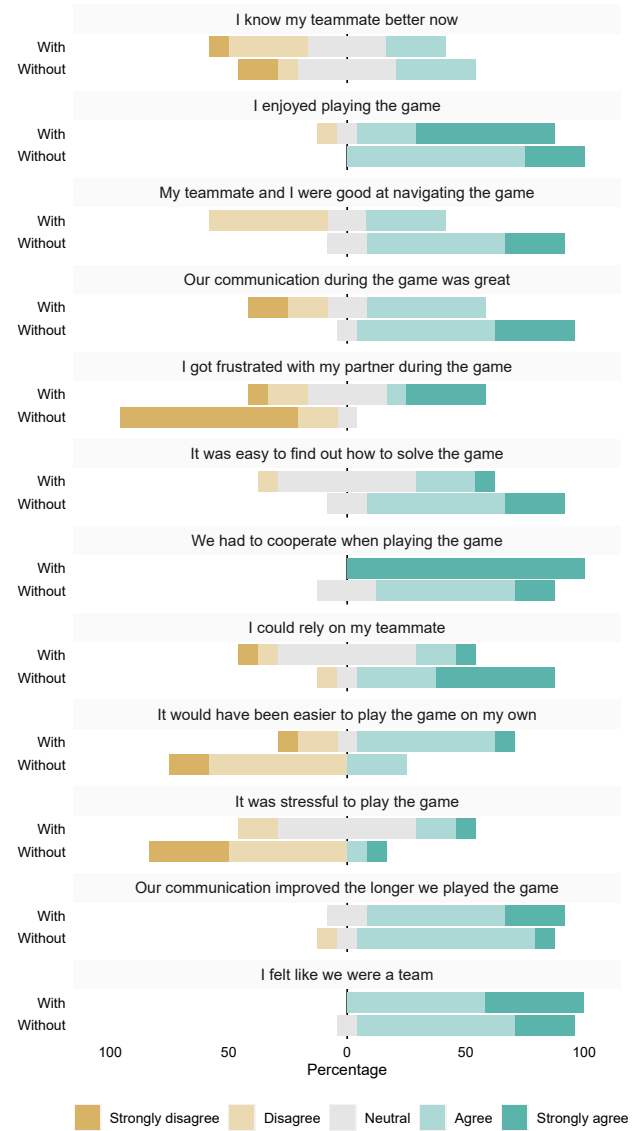

Figure 5: Likert scale responses for our post-game questionnaire show that the game with the rubber band differed from the version without in several aspects. Large differences, for example, are found with respect to the quality of communication, reliance on teammates, and frustration with teammates.

crouch, then you jump over me". This is in contrast to the version without the rubber band where players just tried movements but did not engage in planning-focused communication.

The need to coordinate also could be a challenge and the communication of players of the rubber band version also reflected that, such as: (1) "It's stressing me a lot when you just walk" (move without telling the player), (2) "Stop crouching!" (other player only wanted to move, not catapult), and (3) "Jump, god damnit!". As each

player's movement was inherently tied to their partner's, uncoordinated input resulted in surprising movements and frustrated the players.

Our results showed that having more challenging movement mechanics makes players cooperate and communicate more. In our case, the mechanic itself directly required coordinated input and thus forced players to communicate. Players had to coordinate their movements in order to successfully traverse the levels. The rubber band version was *harder to play*, as also reflected in the progress differences, but this extra challenge can have positive effects. On this point, one participant remarked, when asked whether it would be easier to play alone, that "Yes, it would be easier, but not more fun".

These findings are in line with previous work around cooperation and connectedness. For example, Harris and Hancock also showed that increasing interdepence between players resulted in more connectedness [3]. In their case, "players would need to coordinate closely on timing and positioning", which is similar to the mechanics in Eggventures. Earlier, Harris et al. already demonstrated that, as players have to rely more on each other, this results in increased enjoyment [4]. In Eggventures, we saw that higher degrees of reliance can also lead to frustration and challenge. As Depping and Mandryk also pointed out, "Cooperation facilitated trust development better than competition and interdependence facilitated trust better than independence" [1]. In contrast to this, we saw that players could rely *less* on their partners when they had to coordinate their movements in the rubber band version. Just as Depping and Mandryk, we also saw an increase in communication (in their case conversational turns), where players are dependent on each other.

6.1 Limitations

One confound in our study is that we did not balance groups by gender. Hence, the players of the version without rubber band were predominantly male while the other group contained slightly more female participants. As gender significantly influences how much [8] and what [11] games people play, it is possible it could also influence how they experience our game mechanics.

7 CONCLUSION

With Eggventures, we have implemented a cooperative game with a rubber band movement mechanic. Because players are now tied together and have to coordinate their movement, this does increase the difficulty of movement overall. Players had a harder time picking up the game and did not progress as fast as players in the version without the rubber band mechanic. On the other hand, this also forced players to communicate more with each other. Their enjoyment of the game was only slightly higher, but this forced level of engagement did result in higher ratings of cooperation.

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