X-eo:

RESEARCHING & DESIGNING FOR REBLLIOUS PLAY

APPENDICES

GRADUATION PROJECT

MSc DESIGN FOR INTERACTION

MARK KENT

Appendix B - Questionnaire responses

sdssada

(1). Could you provide an overview of what Bangerik actually is? How does the game actually work?2 responses

Bangerik is an interactive game that encourages imagination and outdoor play by a next level tagging game. The initial idea was that you need to be creative to scare someone in order to raise that persons heartbeat. Once his/her heartbeat is up you can take something (a life a light anything) from that person and add it to your own collection (that's your reward for the successful scare you did). But it offers also room to cheat! You can run around. And in that way raise someone's heart beat. Meanwhile endangering your own situation.

Bangerik is a game in which children have to raise each others heartbeat. How they do this, is totally up to them and their creativity. Once the heartbeat reaches a certain level they can steal 'lives' in a sort of Mario Kart fashion.

Bangerik is a game designed to stimulate rebellious behavior for children in a playful context. Kids need at least 2 players. Every child has a wearable which measures their heartbeat. Above a certain heartbeat the three 'lives' indicated which three LEDs become unlocked which means the child becomes vulnerable in the game. This allows children to come up with own dynamics and mechanics in the game to boost heartbeats.

(2). The metaphor of "stealing someones life " that you applied to the concept is quite interesting. What encouraged you to go with this? Did you consider reversing it around so the the less you move (the lower the heartbeat) the more "dead" you are?

Interesting thought there! I'm not sure but I thought the idea of stealing a life was added later on. In de beginning it was just lights. And you can win a rainbow of lights; different colors on your bracelet. But then we added the 'life' dimension to strengthen the concept. I can not remember us thinking to reverse the game as you mention. Very interesting!

The stealing of lives is really something we borrowed from Mario Kart (and the balloons they use in their battle mode). When it comes to the heartbeat, we decided to go for raising the heartbeat because there is a nice element of mischief in it (e.g. scaring someone else). But we never really considered to reserve it, could be nice!

The 'stealing mechanic' was copied from known games like Mario Kart balloon battle. We wanted all children to stay engaged. This means if you have a low number of lives, you still have a chance to get back up. We did not further investigate 'playing dead'. In user tests however, you saw 1 or 2 children stay completely still and calm to avoid becoming vulnerable.

(3.) Just some smaller details on the game itself. (a). With regards to the game, how many lives did each player have? (b). Can lives be regained depending on high their heartbeat is? (e.g through physical activity) (c).What happens when someone runs out of lives? Are they permanently out of the game?2 responses

A) I'm not sure if we specified that. B) Good idea! We weren't that far yet. But good thought for the 2.0 version C) then you are out of the game.

a) 3 lives. b) Nope c) Permanently out

a) 3 (b) yes (c) I would advise this to be a choice for the children. For example you get a time out. Or, you play 'deathmatch' in which you're out of the game.

(4.) Where did the Idea evolve from?(initial impression is tag, but I be wrong!) What was the first iteration of the prototype you did? Could you describe some of the iterations you went through before arriving at Bangerik.2 responses

I think the initial idea started with the scare. Later on we came to a tagging game, also because we had to prototype it and did not now how to exchange point over a longer distance. To remember the exact iterations I need to dive into the bangerik folder. But I think the initial idea arrived pretty quick and after minorwards minor alterations were made such as adding a point system, how you could steel, etc as we were trying to prototype this idea.

4. I think it all started with promoting rebellious behaviour. And one rebellious behaviour we really liked was scaring people. And it sort of evolved from there if I remember right.

The initial idea was inspired by the movie 'Monsters University' in which they have something called the Scare Olympics (or something). We built a game around that inspiration.In the first week of the project we already had a clear picture of what the game would/could be. We did not further deviate much from the concept but evolved mostly aesthetically and technically.

(5.) What technology did you integrate in the final prototype and why?2 responses

We added an nfc a heart beat sensor. To be sure you need frank or Chris. They were focusing on engineering it role was the concept.

A heartbeat sensor to measure the heart rate (the core of the concept), LED light to represent the 'lives', a capacitative touch sensor to make it possible to tag people, a XBee module so the bracelets could communicate with each other and transfer points. And of course an Arduino to connect it all :)

Arduino, LED strip, heartbeat sensor, conductive metal plate.

(6.) Can you recall any preliminary findings you had with the original prototype while testing?2 responses

Frank and Chris can tell you more about the first test they did at a school. It is too long ago sorry! But from the final test the results were pretty good. The concept was proven to work. Alterations however had to be done on the physical appearance and the way to tag. It might be difficult to actually touch the other persons bracelet in time. The heartbeat might already be down the time you actually touch it.

Mmm, it is a long time ago so I can't remember a lot haha. But one thing that I can remember is that we found that some children first do everything in their power to keep their heartbeat low (closing their eyes, breathing in and out) while all the other children scream and make noise to raise it. And the moment they succeed the child with the bracelet sprints away to escape the other children. This was something we did not expect, because we had they idea they would hide for each other and try to scare each other instead of provoking each other.

The game needed to allow creativity for the children how it was played. Instead of designing a real 'game' with rules, we thought it would be best to give children the ingredients to design their own 'play'.

(6.2) Did you test in different contexts throughout the course? Did the different contexts reflect on the behaviour provoked from the children? 2 responses

No but I remember we remodeled the whole studio into a climbing, kind of maze in a shape of a castle. I thing that also provokes making scares and physical activity (running, climbing).

We tested the concept at a kindergarden and at a self made cardboard castle we built within the faculty. At the school we noticed it became more of a 'tag' game since there was a lot of room to move. However when children played the game in our cardboard castle it was more about hiding and scaring each other since there was little space.

We tested with a preliminary school in Delft. We did not have the chance to test in many other different contexts.

(7.) What were the main pitfalls in your opinion regards to the prototype? e.g the technology used and the behavior it provoked among the children, etc.2 responses

The sensitivity of the heart rate sensor

The heartbeat sensor we used was not optimal (you had to strap it to your finger, but this often resulted in the sensor moving or not accurately reading your heartbeat).

Sturdiness, heartbeat sensors might not track due to sweat, rain.

(8.) From your own perspective, what is rebellious play?2 responses

I think children always have the natural instinct of finding and testing boundaries. I think Rebellious play is provoking in a positive way and allowing children to be wild and crazy in a way that is not harming them or anyone/ anything.

I think it is play where you know you are bending/breaking the rules.

Acting against any rules, allowing own creativity within the safe environment of a game.

(9.) How well do you think Bangerik did in terms of achieving rebellious play? Please explain why.2 responses

On a scale to 10 a 6 or 7 because in the end the product could be used even without rebellious play. If it was only the 'scare' that could get him/her points it would be more in line with rebellious play.

Honestly I don't know. I think we did not see the truly rebellious play yet because the children knew we were watching them and it was the first time playing with the device. I still have the feeling the concept could provoke rebellious play but children need to play with it a bit longer so they know how it works and where the loopholes are that you can exploit.

8.5/10. We did not have the chance to do detailed tests to verify. But I am confident the concept allows enough room and freedom for the children to become rebellious.

(10.) The form of the concept is quite distinct. Was this designed this way to cater for the components or to have a large enough touch point to enable players to steal others lives?2 responses

No it was the components. In the initial idea you'd only had to be close to receives someone's point. Not by actually touching them (which can brake the bracelet or while playing you might hurt the other)

Purely because of the components. It is rather large and in our original design it was more a thin bracelet.

Both

(11.) Continuing on the form, why did you opt for a wrist band? Did you consider utilizing other parts of the body for this?2 responses

Yes we did think of that. The wrist was the most practical place for the concept and prototype.

We did think of other body parts (mainly chest I think), but I think we chose the wrist band because of the tag element and because a wrist band is something that you can also easily remove and put on something else (for example: we would have really loved it if children would put in on their dog or something).

Wrist band seemed most accessible. Would be awesome to expand to other parts on the body!

(12.) And finally, if you had another attempt at this project, is there anything that you would of done differently?2 responses

No I think we were all pleased with the final result. If there was more time of course more iterations would have been taken place. Regards; how to steal and the physical appearance Good questions! I wish the best of luck with your project! Regards, Avital

I think it would have been nice if we did more testing with children with really low tech prototypes just to optimise the game.

Nope

Appendix C - Design criteria

Primary stakeholder/target group

- The primary stakeholders are children between the ages of 8 -10 years old, ranging in different genders and personality types.

Environment/context of use.

- Home (Indoor & outdoor)
- School (Indoor & outdoor)
- General public.(Indoor & outdoor)
- The device should be “showerproof”.

Ergonomic

- Should feel comfortable by the child when wearing it.
- Should securely fit participants and not detach during play and while moving.
- Tagging areas on upper arms should measure no more than 66mm x 156 mm (Dined)
- Tagging area on chest should measure no more than 300mm x 180mm
- Tagging areas on laterals of upper body should measure no more than 200mm x 75mm.
- The device should ideally seamlessly fit the children.
- The device should accommodate for chest size 25" to 28". (635mm - 711.2 mm).
- The device should weigh no more than 150 grams.

Game dynamics

- The game should accommodate for movement play.
- The game should accommodate for success and team play.
- There should be more than one player participating in the game at all times.
- The rules during game play should remain limited.
- The game should remain open to let children to get creative with their thoughts and actions during play.
- The game should keep all the children involved for the entire duration of play.(e.g not permanently out when all lives exhausted.)

Technical

Heartbeat

- The sensors should fit securely body area/part to record pulse.
- The sensor should not need to be adhesively attached to skin.
- The sensor should be able to record pulse and process the data while in motion.
- The sensor should be able to withstand sweat & moisture for accurate pulse measurements.
- The high heartbeat threshold should be calibrated to each individual child playing game (measure with smartphone app, wear device for a continuous period to get an average calculation of their bpm).

Tagging

- The tagging areas should only be triggered by human touch.
- The tagging areas should not be triggered by coming into contact with other materials during play.
- The tagging areas should be behave consistently with it's reaction to touch.
- The tagging area materials should be able to wrap/sculpt around the form of body parts.
- The tagging areas should have a resistive threshold of …… on the tagging areas to avoid inconsistencies.

Communication

- Should be able to connect to a smartphone.
- Should be ables to transfer data (lives) over a short distance (1- 2 metres)
- Should not need the assistance of a wifi or cellular network.

Visual Communication
- Live status' should be visible and obvious in bright and dark conditions.
- Tagging areas should be highlighted.
- Stolen lives should be highlighted and indicated and other players in the surrounding areas.
- Live transferal should be exhibited to both tagging

Power

- The device should be rechargeable via standard mini usb.
- The device should ideally hold its charge for at least 14 hours.
- The Battery should way less than 100 grams.
- The battery should measure less than 65mm x 50mm x 15mm
- The battery should be removable for maintenance or replacement.

Micro controller

- The microcontroller should be compatible with all components within the device.
- The microcontroller should be no bigger than 45mm x 45mm x 7mm thick.
- The microcontroller should not inflict discomfort on the wearer.
- The microcontroller should be removable for maintenance purposes.

Providing feedback

Heartbeat

- The device should indicate the live status of every individual player.
- The device should indicate personally to each player when their lives are vulnerable to be stolen.

Tagging

- The device should indicate to the player when they have been tagged and lost a life.
- The device should indicate to the player when they have successfully stolen someone life.

Rebellious potential

- The game should not contain any serious or enduring consequences during the play frame.
- The game should be able to be operated without any adult supervision.
- The game should provide the players with continuous dilemmas throughout the game play.
- The game should entail and provoke some form of competitiveness throughout the game play.
- The game should be able to be played in any environment the children find themselves in.
- The game should allow children to explore their full behavioural boundaries.

Safety/ Ethical

- The game should not encourage the children to physically hurt each other.
- The game should not force the children to do something they do not want to do or against their will.
- The game should not require the child to remove their clothing to apply it to them.
- The device should not inflict pain, while being worn.
- Parts and components must not be exposed or loose.
- The components (sensors, cables ,etc) must not make contact with exposed skin of the child.

Appendix D -How to's Brainstorm

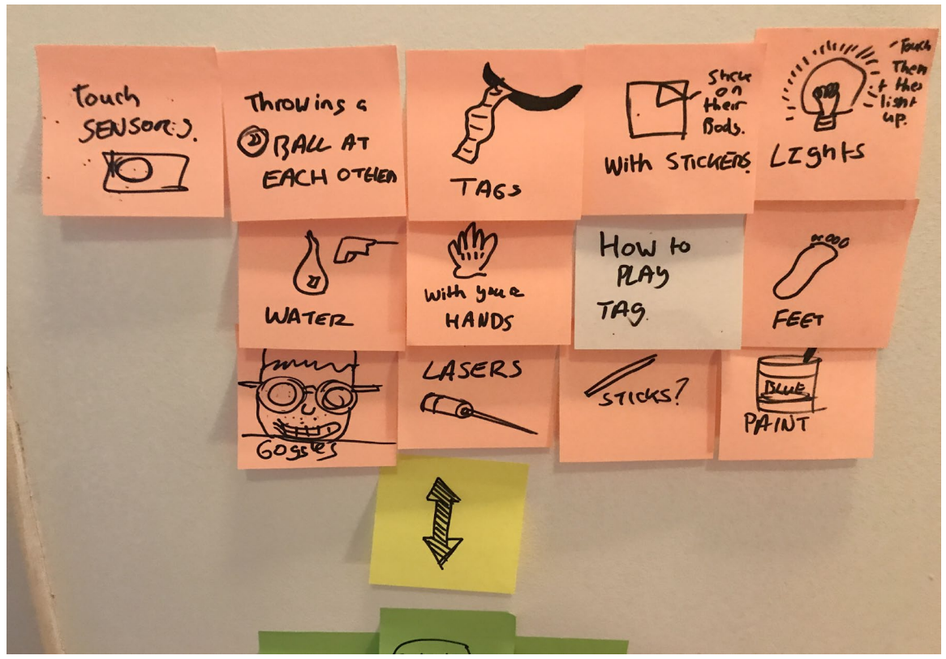


Figure 1- How to play tag brainstorm outcomes

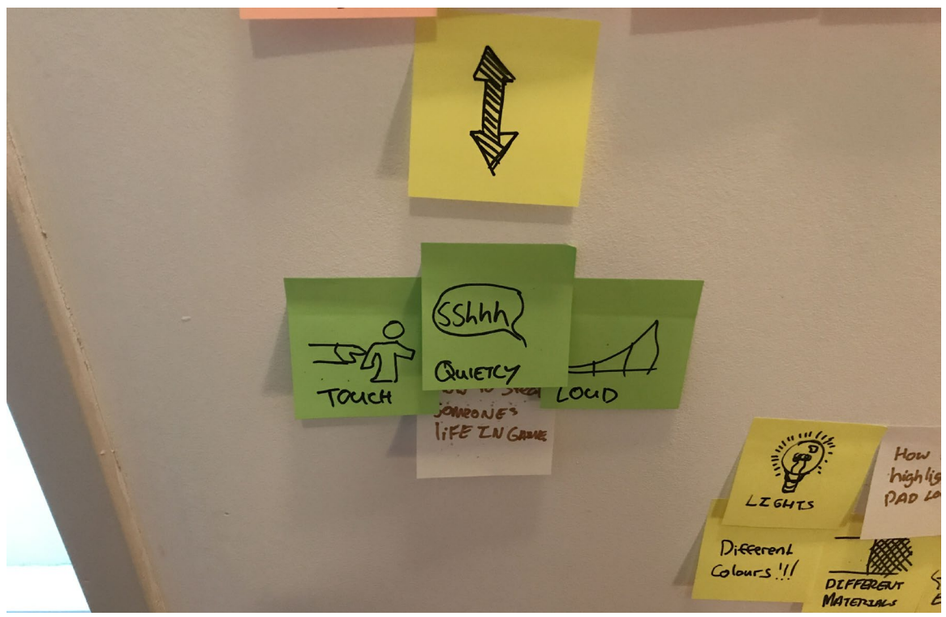


Figure 2- How to steal lives outcomes

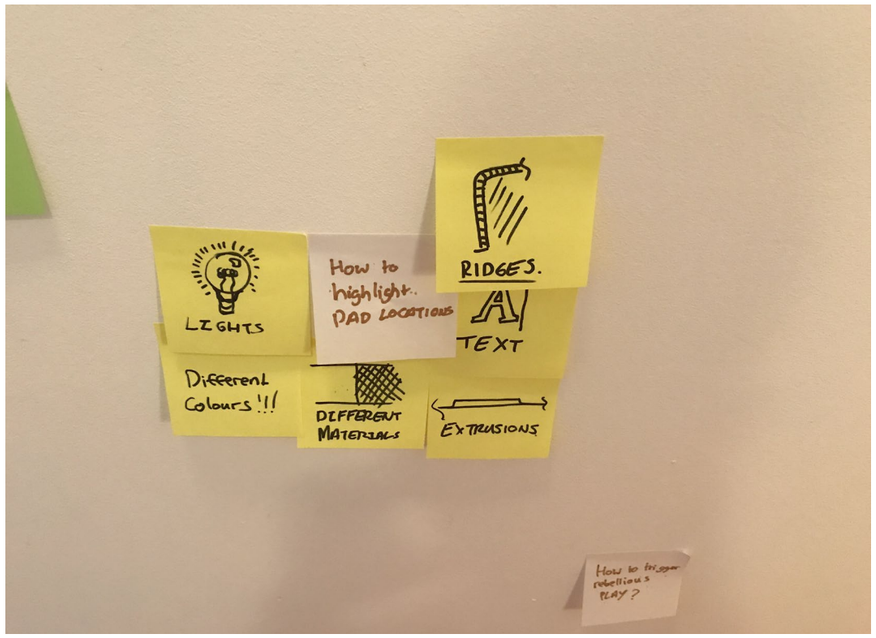


Figure 3- How to highlight touch pad location outcomes

Figure 4- How to raise heart rate outcomes

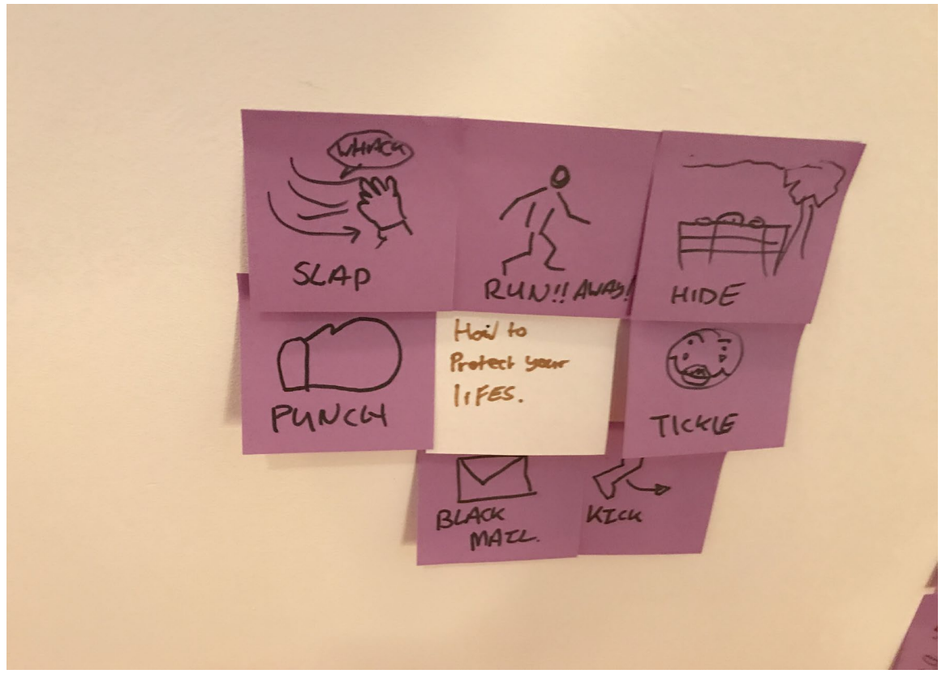


Figure 5 - How to protect lives outcomes

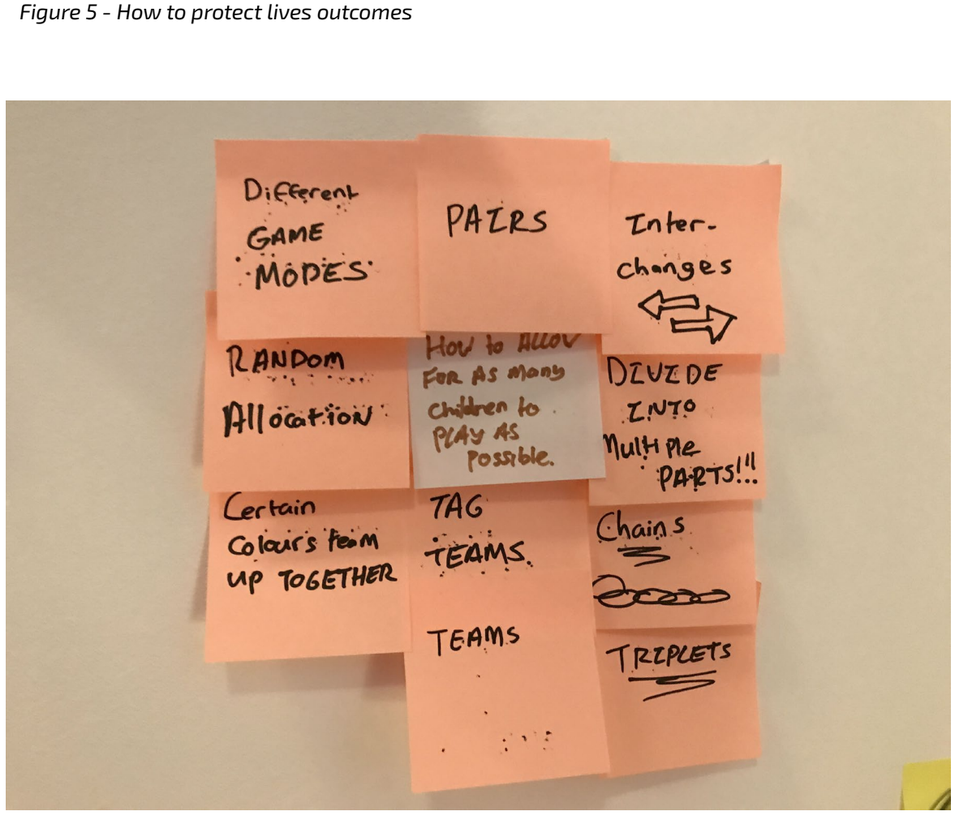


Figure 6 - How to accommodate as many children possible.

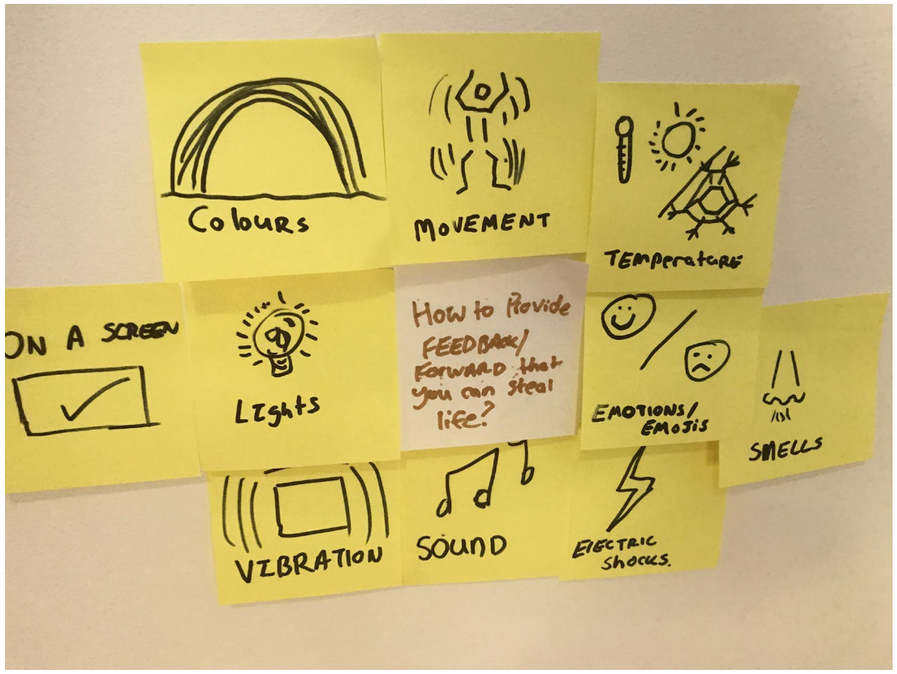


Figure 7- How to provide feedback/forward that you can steal a life.

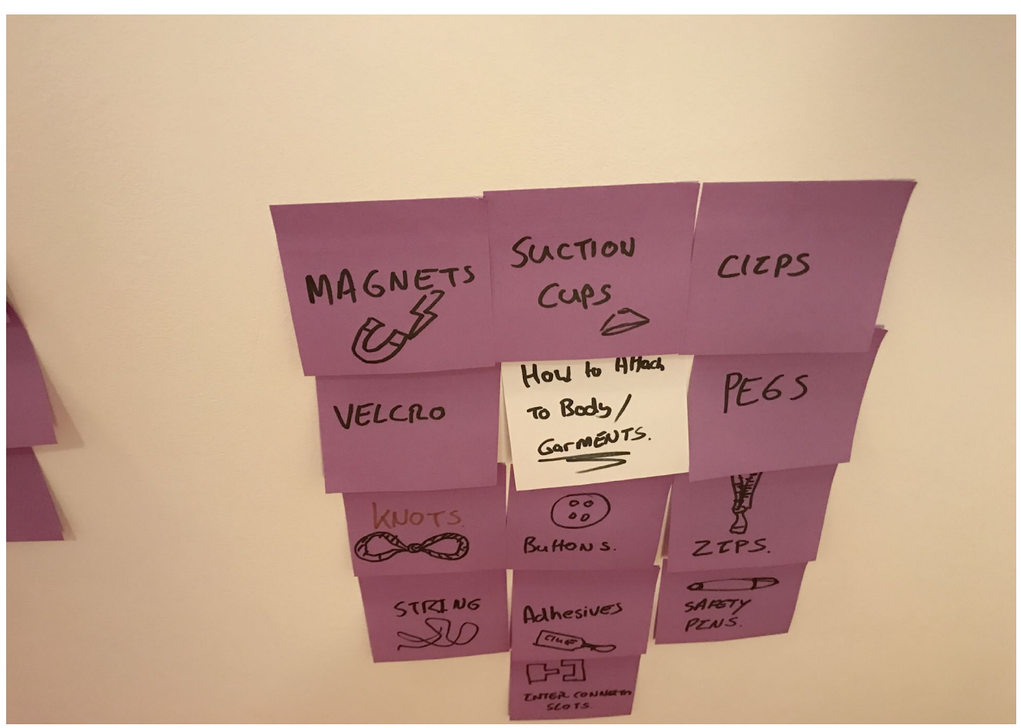


Figure 8- How to attach to body outcomes

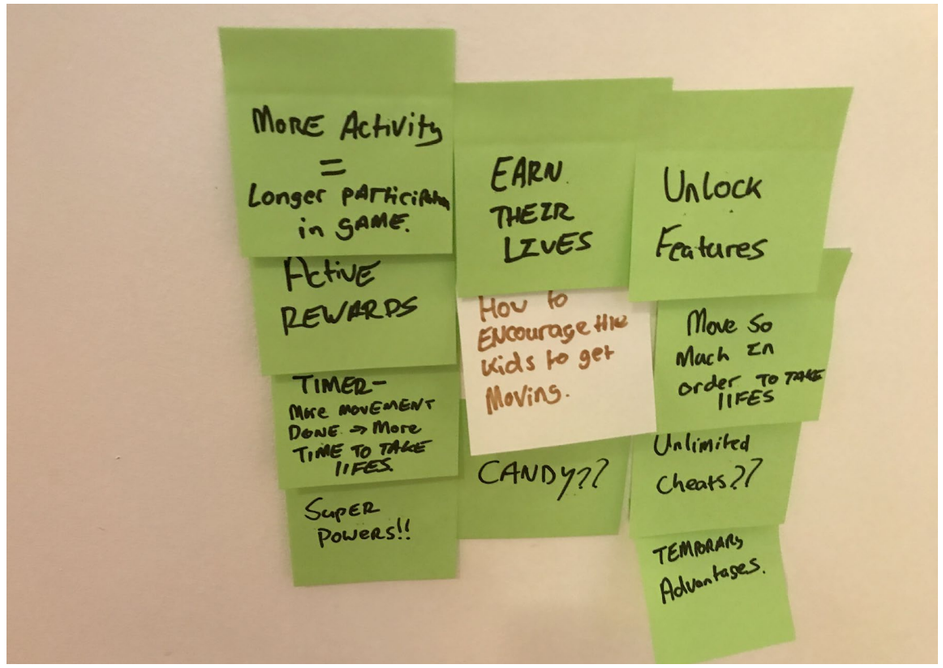


Figure 9- How to encourage children to get moving outcomes

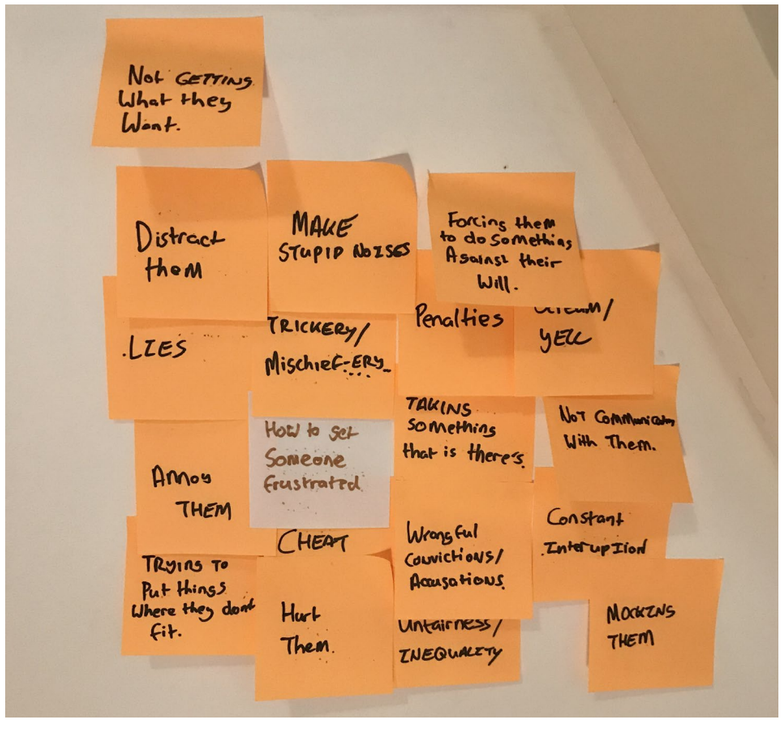
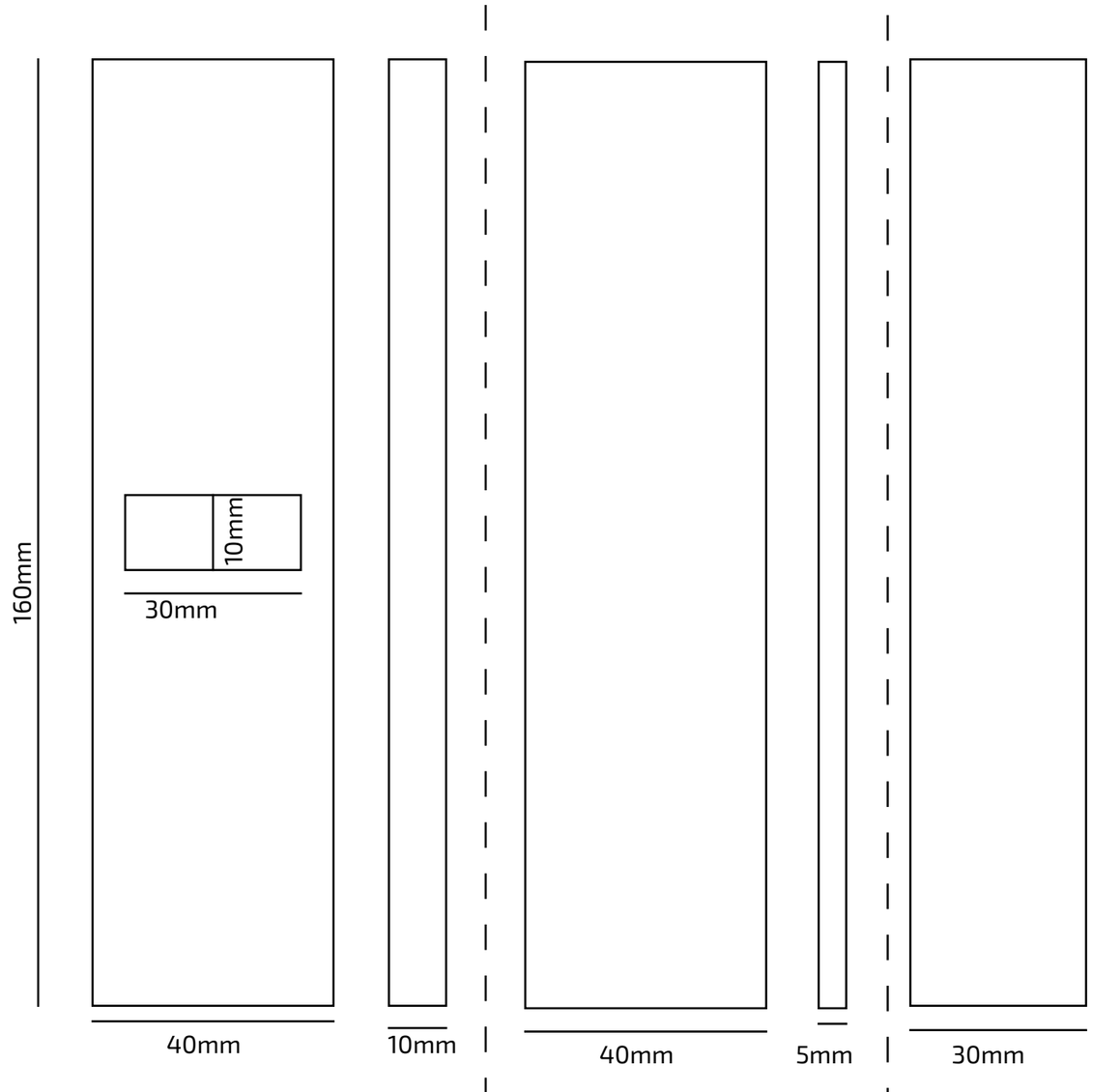


Figure 10- How to frustrate outcomes.

Appendix E - Prototype
Round 1 details



3D printed shell dimensions
(Wall thickness = 4mm)

Foamboard base dimensions

Fabric tag
dimensions

Child shoulder to mid hand length- 568mm
(Dined)
Estimated length from mid hand to elbow-
284mm

Appendix F - Round 1 testing setup.

The research for this phase undertook a qualitative and explorative. Qualitative through the use of observation and explorative in the sense of letting the play unfold with the prototypes as it happens to gather unexpected insights that could provide answers to the other knowledge gaps previously stated.

The testing session was conducted with 11 participants aged between 8 to 9 years at a local school. This school was chosen due to the ties it holds to the TU Delft and their previous experiences of collaborating with the chair of this assignment's Co-design with children and Design for children's play courses within the faculty of Industrial design engineering.

The testing session was conducted within the confines of the school gymnasium located within the school building where the participants attend class. (see fig 34). This decision was taken based on the teacher's preference due to the inclement weather conditions outside and for the safety of their pupils as the Christmas vacation approached. The 11 participants were divided into groups: first group consisting of six (three male and three female) and five (three male and two female) respectively.

The division was created by their teacher on request, to ensure there was a balance based in terms of the children's personality types, how comfortable and friendly they are with each other, their physical activity level and their ability to communicate to each other and the facilitator through the English language.

The observations sessions consisted of 3 rounds of play where the children would wear the prototypes on various locations on their upper body and participate in play for a predefined amount of time.

The first round of play consisted of wearing the prototype on the wrist of their non dominant hand, similar to the original bangerik concept. For the second round, it was placed on their upper arm. For the final round it was placed on the chest in combination with another previously tested body part depending on how many prototypes were still functioning at this point.

The testing was approximately 25 mins in duration, and both groups followed the same sequence of events outlined below:

- Pre-test arrangements- Gathering consent forms and collecting children from the classroom: 3 mins
- Introduction and outlined instructions: 1 - 2 mins
- Fitting children with prototypes: 3 mins
- 7-10 mins of play and continuous resetting of prototype if required. (per round)
- 2 mins for children to ask the facilitator questions with regards to the task at hand.
- Reset prototypes and recording equipment and attach prototypes to children for next round of testing. (per round)

The children were given instructions before each session with regards to the goal of that specific test and how it would be further utilised in the research. The goal for each child was to get as many tags as possible and knock their opponents out of the game. The rules were kept to the bare minimum to let the children be creative in coming up with their own strategies for tagging each other (and in some cases protecting their tags). The single rule of the session was that they could do whatever they wanted on the condition that they do not try to hurt each other physically.

They were free to ask the facilitator questions before the start of the session, during a demonstration and at the start of each round. The participants were informed that if they felt uncomfortable or did not want to participate at any stage during the session they were free to leave if they wished to do so.

The primary data gathered from the observation session were video and audio recordings of the children during the predefined testing rounds. A bridge camera and a Go-pro were utilised to capture footage of the children during the session. Both cameras were allocated different locations within the gymnasium. The GoPro captured footage from a tripod set at a height to capture the full environs of the gymnasium, while the second camera was hidden out of view at the eye height of the children to capture activity from their perspective. A voice recorder app on a smartphone was used to take voice notes throughout the session. This was accompanied by notes taken during and after each round of testing. The footage and audio were then analysed after the session with regards to the research goals previously mentioned in this chapter.

Appendix H - Round 2, Heart rate prototype code

```
 #define USE_ARDUINO_INTERRUPTS true    // Set-up low-level interrupts for most acurate BPM math.
#include <PulseSensorPlayground.h>     // Includes the PulseSensorPlayground Library.

//  Variables
const int PulseWire = 11;      // PulseSensor PURPLE WIRE connected to ANALOG PIN 0
const int LED7 = 7;
const int sound = 9;// The on-board Arduino LED, close to PIN 13.
int Threshold = 550;          // Determine which Signal to “count as a beat” and which to ignore.
int kidactive = 30;                     // Use the “Gettting Started Project” to fine-tune Threshold Value beyond default setting.
                        // Otherwise leave the default “550” value.

PulseSensorPlayground pulseSensor;  // Creates an instance of the PulseSensorPlayground object called “pulseSensor”


void setup() {

 Serial.begin(9600);         // For Serial Monitor

  // Configure the PulseSensor object, by assigning our variables to it.
  pulseSensor.analogInput(PulseWire);
  pulseSensor.blinkOnPulse(LED7);       //auto-magically blink Arduino's LED with heartbeat.
  pulseSensor.setThreshold(Threshold);



  // Double-check the “pulseSensor” object was created and “began” seeing a signal.
   if (pulseSensor.begin()) {
    Serial.println(“We created a pulseSensor Object !”);  //This prints one time at Arduino power-up,  or on Arduino reset.
  }
}


void loop() {

 int myBPM = pulseSensor.getBeatsPerMinute();  // Calls function on our pulseSensor object that returns BPM as an “int”.
                                  // “myBPM” hold this BPM value now.

if (pulseSensor.sawStartOfBeat()) {           // Constantly test to see if “a beat happened”.
 Serial.println(“    A HeartBeat Happened ! “); // If test is “true”, print a message “a heartbeat happened”.
 Serial.print(“BPM: “);                        // Print phrase “BPM: “
 Serial.println(myBPM);                        // Print the value inside of myBPM.

}

if (myBPM > kidactive)
 {digitalWrite(sound,HIGH);
 }else
 {digitalWrite(sound,LOW);
 }

 if (myBPM > kidactive)
 {digitalWrite(LED7,HIGH);
 }

 if (pulseSensor.sawStartOfBeat()) {
   pulseSensor.outputBeat();
   tone(sound,1670);             // tone(pin,frequency)
 }

 /*
   The Pulse variable is true only for a short time after the heartbeat is detected
   Use this to time the duration of the beep
 */
  if(pulseSensor.isInsideBeat() == false){
   noTone(sound);
  }

 delay(20);                 // considered best practice in a simple sketch.

}
```

Appendix I - Round 1 testing setup.

```
 #include <Wire.h>
#include <Seeed_QTouch.h>

#define led  3
#define buzzer 2
#define key0 0
int lastKeySignal = 0;
char nthr = 0;

void setup()
{
  pinMode(led,OUTPUT);
  digitalWrite(led,LOW);
  pinMode(buzzer,OUTPUT);
  digitalWrite(buzzer,LOW);
  Wire.begin();
  Serial.begin(9600);

 //the value determines how long any
key can be in touch before it recalibrates
itself.160ms * 62 = 9.92s.
  QTouch.setMaxDuration(62);

 //set the threshold value for key0 to register
a detection.If the hit pan is bigger, you should
increase this Value.This Value should not be
less than 20.
  QTouch.setNTHRForKey(60,key0);
}

void loop()
{

  if(QTouch.isTouch(0)) {
    digitalWrite(led, HIGH);
    delay(100);//wait for half a second
digitalWrite(led, LOW);// led off
delay(100);//wait for half a second
digitalWrite(led, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(led, LOW);// led off
delay(100);//wait for half a second
digitalWrite(led, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(led, LOW);// led off
delay(100);//wait for half a second
digitalWrite(led, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(led, LOW);// led off
delay(100);//wait for half a second
digitalWrite(led, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(led, LOW);// led off
delay(100);//wait for half a second
digitalWrite(led, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(led, LOW);// led off
delay(100);//wait for half a second
digitalWrite(led, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(led, LOW);// led off
delay(100);//wait for half a second
digitalWrite(led, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(led, LOW);// led off
delay(100);//wait for half a second
digitalWrite(led, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(led, LOW);// led off
delay(100);//wait for half a second
digitalWrite(led, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(led, LOW);// led off
delay(100);//wait for half a second
  }
  else {    digitalWrite(led,LOW);


  }



 if(QTouch.isTouch(0)) {
    digitalWrite(buzzer, HIGH);
    delay(100);//wait for half a second
digitalWrite(buzzer, LOW);// led off
delay(100);//wait for half a second
digitalWrite(buzzer, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(buzzer, LOW);// led off
delay(100);//wait for half a second
digitalWrite(buzzer, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(buzzer, LOW);// led off
delay(100);//wait for half a second
digitalWrite(buzzer, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(buzzer, LOW);// led off
delay(100);//wait for half a second
digitalWrite(buzzer, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(buzzer, LOW);// led off
delay(100);//wait for half a second
digitalWrite(buzzer, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(buzzer, LOW);// led off
delay(100);//wait for half a second
digitalWrite(buzzer, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(buzzer, LOW);// led off
delay(100);//wait for half a second
digitalWrite(buzzer, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(buzzer, LOW);// led off
delay(100);//wait for half a second
digitalWrite(buzzer, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(buzzer, LOW);// led off
delay(100);//wait for half a second
digitalWrite(buzzer, HIGH); //Led on.
delay(100);//wait for half a second
digitalWrite(buzzer, LOW);// led off
delay(100);//wait for half a second
```

Appendix J- Round 2 testing setup.

The testing was conducted with the same participants that participated in the 1st round of testing, with the addition of one new participant with full permission and consent from their guardians.

The testing session was conducted with 11 participants aged between 8 to 9 years old at the International School Delft at Jaffalaan 60, Delft. The context for this test was an empty classroom in the newly renovated 2nd floor of the school. Once again this was agreed between the facilitator and the respective teacher of the participants based on required supervision, the inclement weather conditions forecasted and the technical operations of the prototypes utilised for the session.Unfortunately, the classroom was free of a mass of furniture and other props that are typically found in such an environment. 2 small chairs were the only props to be found in the room.

The children were accompanied to the test location in two groups of six and five respectively, determined by their teacher for the sake of convenience and the limited timing allocated for the test. The notable difference for this test compared to the 1st Ideate testing session is the division of participants into pairs for each test. This was decided due to the number of prototypes available to test and for the convenience of analysing the data. The previous session involved the whole group of children participating at the same time, and this brought about many challenges in terms of having a strict research focus and concisely analysing the data.

The testing was approximately 38 minutes in duration per group and took the following schedule:

-Introduction (5 mins)
-Fitting children with Heart beat prototype- (3 mins)
-Pair 1 (3 mins) and interchange prototype
-Pair 2 (3 mins) and interchange prototype
-Pair 3(3 mins) and interchange prototype
-Short Q&A and insights 2 mins
-Fitting children with garment prototype- (5 mins)
-Pair 1 (4- mins)
-Pair 2(4-mins)
-Pair 3 (4 mins)
-Short Q&A and insights 2 mins
-Bring children back to classroom and collect next group.

The children were provided with an overview of the planned activities of the testing session and how they were going to influence the research being conducted. At this point, they were also free to ask any questions in regards to the research and the proposed activities. The participants were also informed that if they felt uncomfortable or did not want to participate at any stage during the session they were free to leave if they wished to do so. Before each testing, they were introduced to the specific prototype by a demonstration and the goal of the test they were about to participate in was outlined. The rules were kept to a minimum to ensure that the children were free to come up with creative strategies towards reaching the goals outlined for both tests.

The primary data gathered from the observation session were video and audio recordings of the children during the predefined testing rounds. A bridge camera and a GoPro were utilised to capture footage of the children during the session. Both cameras were allocated different locations within the classroom.

Appendix K - Embodiment- Weighted Objectives and Harris profile outcomes

Separate	Score	Total
Rebellious potential-35	8	280
Balance-30	7	150
Movement-15	5	75
Set-up-10	4	40
Duration-5	6	30
Safety-5	5	25
Total		610

Garment	Score	Total
Rebellious potential-35	6	210
Balance-30	5	150
Movement-15	9	135
Set-up-10	8	80
Duration-5	4	20
Safety-5	9	45
Total		640

Combo	Score	Total
Rebellious potential-35	8	280
Balance-30	8	240
Movement-15	9	135
Set-up-10	8	80
Duration-5	5	25
Safety-5	9	45
Total		805

Figure 3 - Weighted objectives outcomes

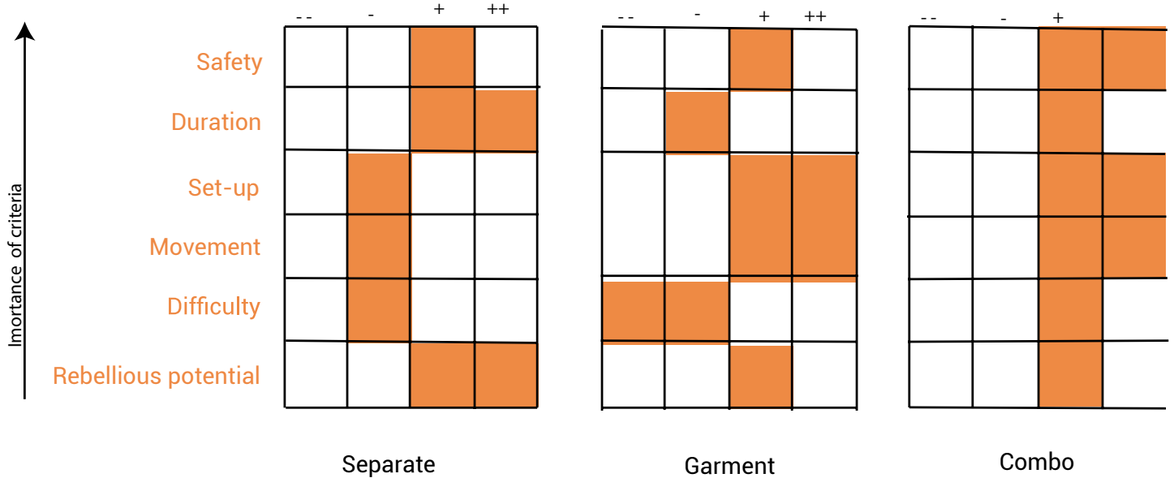


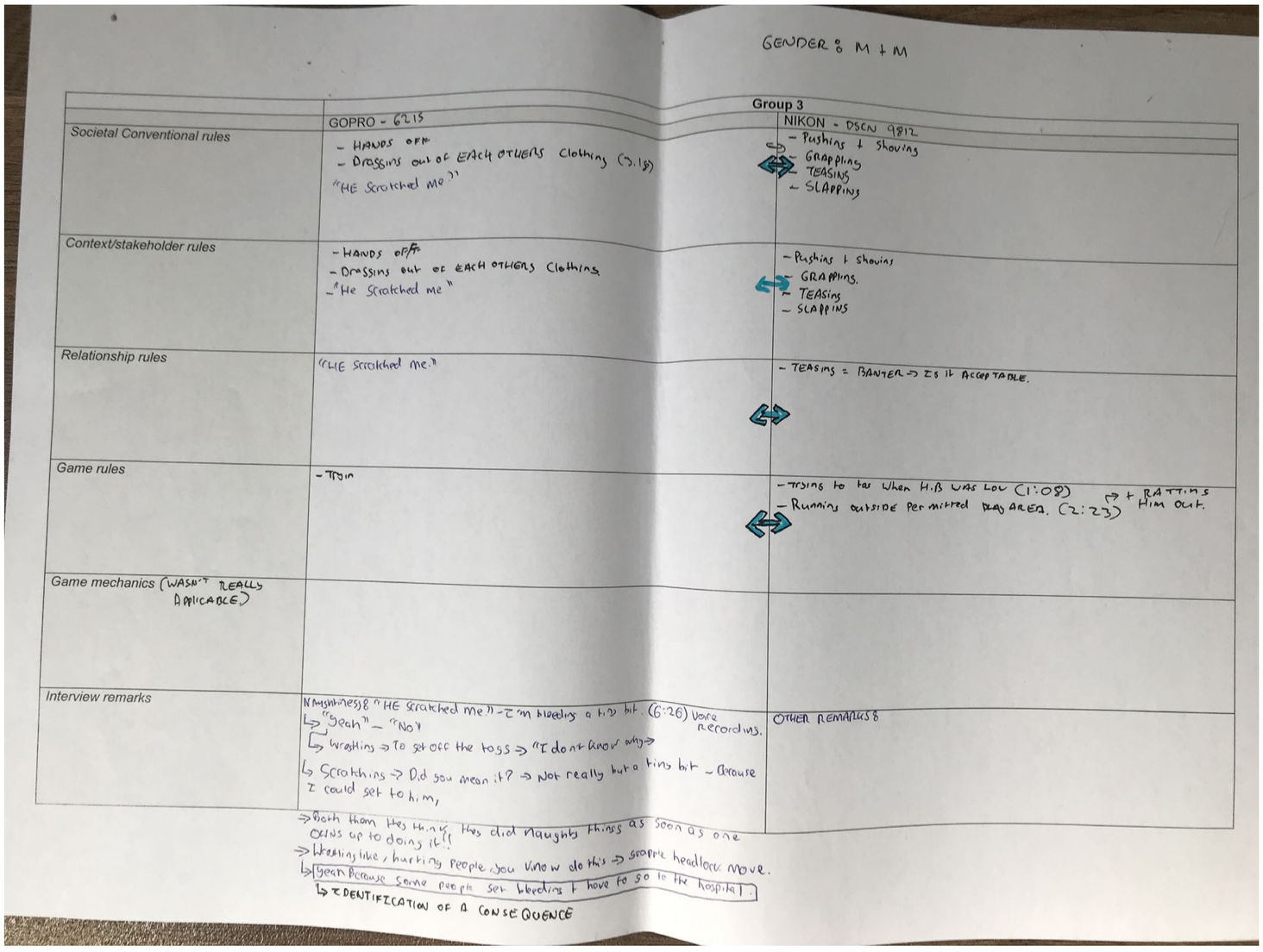
Figure 4 - Harris Profile outcomes

Appendix L - Pilot study prototype code

```
#define USE_ARDUINO_INTERRUPTS false
#include “MillisTimer.h”  // Brett Hagman’s MillisTimer Library
#include <CapacitiveSensor.h>
#include “Adafruit_FloraPixel.h”
#include <Wire.h>

const int PIN_RUNLED = 7;
const int PIN_HEARTRATE = 11;
const int PIN_CAPSENSE_SEND = 9;
const int PIN_CAPSENSE_RECEIVE = 10;
const int PIN_NEOPIXEL = 6;

const int TOTALHIT_TIME = 2000;
const int HIT_INTERVAL = 100;

const int NUMLEDS = 3;
const int CAPSENSE_THRESHOLD = 40;
const int HEARTRATE_THRESHOLD = 80; // in BPM

MillisTimer glHitAnimation = MillisTimer();
MillisTimer glReadyAnimation = MillisTimer();
MillisTimer glChargeInitiation = MillisTimer();
MillisTimer glChargeAnimation = MillisTimer();

RGBPixel Color(byte, byte, byte);

RGBPixel glColourValue[4] = {Color(255, 0, 0), Color(74, 181, 0), Color(0, 255, 0), Color(0, 0, 0)};

CapacitiveSensor glCapSense = CapacitiveSensor(PIN_CAPSENSE_SEND, PIN_CAPSENSE_RECEIVE);      // 10M resistor between pins 4 & 2, pin 2 is sensor pin, add a wire and or foil if desiredPulseSensorPlayground glPulseSensor;  // Creates an instance of the PulseSensorPlayground object called “pulseSensor”
Adafruit_FloraPixel glLedStrip = Adafruit_FloraPixel(NUMLEDS);

void setup() {
  // put your setup code here, to run once:
  pinMode(PIN_HEARTRATE, INPUT);

  Serial.begin(9600);
  Wire.begin();

  glLedStrip.begin();
  glLedStrip.show();
  //glPulseSensor.analogInput(PIN_HEARTRATE);
  glCapSense.set_CS_AutocaL_Millis(0xFFFFFFFF);     // turn off autocalibrate on channel 1 - just as an example

  glHitAnimation.setInterval(HIT_INTERVAL);
  glHitAnimation.expiredHandler(hitAnimation);
  glHitAnimation.setRepeats(round(TOTALHIT_TIME / HIT_INTERVAL));

  glReadyAnimation.setInterval(10);
  glReadyAnimation.expiredHandler(readyAnimation);
  glReadyAnimation.setRepeats(0);

  glChargeInitiation.setInterval(5000);
  glChargeInitiation.expiredHandler(chargeInitiation);
  glChargeInitiation.setRepeats(1);

  glChargeAnimation.setInterval(15);
  glChargeAnimation.expiredHandler(chargeAnimation);
  glChargeAnimation.setRepeats(1000);

  Serial.println(“Starting program...”);
}

int glHitcounter = 0;
bool glReadyForHit = false;
bool recoverFromBlackout = false;

void loop()
{
  glHitAnimation.run();
  glReadyAnimation.run();
  glChargeInitiation.run();
  glChargeAnimation.run();

  glReadyForHit = (checkHeartRate() > HEARTRATE_THRESHOLD); // evaluates to true or false

  if (glReadyForHit) {
    digitalWrite(PIN_RUNLED, HIGH);
  }
  else {
    digitalWrite(PIN_RUNLED, LOW);
  }

  if (!glHitAnimation.isRunning() && !glChargeAnimation.isRunning() && !glChargeInitiation.isRunning()) {
    if (glReadyForHit) {
      if (!glReadyAnimation.isRunning())
        glReadyAnimation.start();

      if ((checkForHits() == true)) {
        glHitcounter++;

        glReadyAnimation.stop();
        glHitAnimation.reset();
        glHitAnimation.start();

        if (glHitcounter >= 3) {
          glChargeInitiation.reset();
          glChargeInitiation.start();
        }

        Serial.print(“WE GOT HIT!: “);
        Serial.println(glHitcounter);
      }
    }
    else {
      glReadyAnimation.stop();
      ledsSolid();
    }
  }
}

uint8_t checkHeartRate()
{
  static unsigned long hrMillis;
  static unsigned long prev_hrMillis;
  static uint8_t val = 0;

  hrMillis = millis();
  if (hrMillis - prev_hrMillis > 500) {
    prev_hrMillis = hrMillis;
    Wire.requestFrom(0xA0 >> 1, 1);    // request 1 bytes from slave device
    while (Wire.available()) {          // slave may send less than requested
      val = Wire.read();// receive heart rate value (a byte)
    }
    Serial.println(val);
  }
  return val;
}

bool checkForHits()
{
  static bool detection = false;
  static bool prev_detection = false;
  static unsigned long capmillis = 0;
  static unsigned long prev_capmillis = 0;

  capmillis = millis();
  if (capmillis - prev_capmillis > 10) {
    prev_capmillis = capmillis;

    detection = (glCapSense.capacitiveSensor(30) > CAPSENSE_THRESHOLD);

    if ((prev_detection == true) && (detection == true)) {
      prev_detection = detection;
      return true;
    }
  }

  prev_detection = detection;
  return false;
}

// Create a 24 bit color value from R,G,B
RGBPixel Color(byte r, byte g, byte b)
{
  RGBPixel p;

  p.red = r;
  p.green = g;
  p.blue = b;

  return p;
}

void ledsSolid()
{
  for (int i = 0 ; i < NUMLEDS; i++) {
    glLedStrip.setPixelColor(i, glColourValue[glHitcounter]);
  }
  glLedStrip.show();
}

void readyAnimation(MillisTimer &t)
{
  static int ramp_counter = 254;
  static int ramp_direction = -1;
  RGBPixel calculatedColour;
```

```
  ramp_counter += ramp_direction;

  if (ramp_counter == 255 || ramp_counter ==
0) {
    ramp_direction = -ramp_direction;
  }

  switch (glHitcounter) {
    case 3:
      calculatedColour = Color(0, 0, 0);
      break;
    case 0:
      calculatedColour = Color(ramp_counter,
0, 0);
      break;
    case 1:
      calculatedColour = Color(map(ramp_
counter, 0, 255, 0, 74), map(ramp_counter, 0,
255, 0, 181), 0);
      break;
    case 2:
      calculatedColour = Color(0, ramp_counter
* 255, 0);
      break;
  }

  for (int i = 0 ; i < NUMLEDS; i++) {
    glLedStrip.setPixelColor(i,
calculatedColour);
  }
  glLedStrip.show();
}

void hitAnimation(MillisTimer &t)
{
  static int blinkflag = 0;
  RGBPixel calculatedColour;

  glReadyAnimation.stop();

  switch (glHitcounter) {
    case 0:
      calculatedColour = Color(0, 0, 0);
      break;
    case 1:
      calculatedColour = Color(blinkflag * 255,
0, 0);
      break;
    case 2:
      calculatedColour = Color(blinkflag * 74,
blinkflag * 181, 0);
      break;
    case 3:
      calculatedColour = Color(0, blinkflag *
255, 0);
      break;
  }

  for (int i = 0 ; i < NUMLEDS; i++) {
    glLedStrip.setPixelColor(i,
calculatedColour);
  }
  glLedStrip.show();

  if (blinkflag == 1)
    blinkflag = 0;
  else if (blinkflag == 0)
    blinkflag = 1;

  if ((t.getRemainingRepeats() == 0) ) {
    if (glHitcounter < 3) {
      if (glReadyForHit) {
        if (!glReadyAnimation.isRunning())
          glReadyAnimation.start();
      }
      else {
        glReadyAnimation.stop();
        ledsSolid();
      }
    }
    else { // Going to blackout state next
      for (int i = 0 ; i < NUMLEDS; i++) {
        glLedStrip.setPixelColor(i, 0, 0, 0);
      }
      glLedStrip.show();
    }
  }
}

void chargeInitiation(MillisTimer &t)
{
  glHitcounter = 0;
  glChargeAnimation.reset();
  glChargeAnimation.start();
}

void chargeAnimation(MillisTimer &t)
{
  static int ramp_counter = 254;
  static int ramp_direction = -1;
  RGBPixel calculatedColour;

  ramp_counter += ramp_direction;

  if (ramp_counter == 255 || ramp_counter ==
0)
    ramp_direction = -ramp_direction;

  calculatedColour = Color(0, 0, ramp_
counter * 255);

  for (int i = 0 ; i < NUMLEDS; i++) {
    glLedStrip.setPixelColor(i,
calculatedColour);
  }
  glLedStrip.show();

  if (t.getRemainingRepeats() == 0) {
    if (glReadyForHit) {
      if (!glReadyAnimation.isRunning())
        glReadyAnimation.start();
    }
    else {
      glReadyAnimation.stop();
      ledsSolid();
    }
  }
}
```

Appendix M - Hierarchy grid sheet example



GENDER: M + M

	Group 3	
	GOPRO - 6215	NIKON - DSCN 9812
Societal Conventional rules	- HANDS OFF - DRESSING OUT OF EACH OTHERS Clothing (7:15) "HE Scratched ME"	- Pushing + Shoving - GRAPPLING - TEASING - SLAPPING
Context/stakeholder rules	- HANDS OFF - DRESSING OUT OF EACH OTHERS Clothing - "He Scratched me"	- Pushing + Shoving - GRAPPLING. - TEASing - SLAPPING
Relationship rules	"HE Scratched me"	- TEASING = BANTER → IS it ACCEPTABLE.
Game rules	- TOUCH	- trying to tag when H.B was Low (1:08) - Running outside Permitted PLAY AREA. (2:23) → + RATTING HIM OUT.
Game mechanics (WASN'T REALLY APPLICABLE)		
Interview remarks	NAUGHTINESS? "HE Scratched me" - I'm bleeding a tiny bit. (6:26) More recordings. ↳ "yeah" - "No" ↳ wrestling → To set off the toss → "I don't know why" ↳ Scratching → Did you mean it? → Not really but a tiny bit - because I could see to him, → Both them they think they did Naughty things as soon as one owns up to doing it! → Wrestling like, hurting people, you know do this → grapple headlock move. ↳ [yeah because some people see bleeding + have to go to the hospital]. ↳ IDENTIFICATION OF A CONSEQUENCE	OTHER REMARKS?