

# Rainmaking on Mars – a social musical instrument for the journey to Mars

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## Abstract

In this paper, we describe Rainmaking on Mars, a device developed as a social musical instrument for the 7-month journey to the planet Mars. The instrument was designed to facilitate and enhance social interaction between the travellers of the Mars One community. Using methodologies in design, ethnographic research and physical computing, we produced prototypes that reflect the need for the imagined environment. We interviewed and worked with some of the community members using empathic design. The instrument enables learning and sharing, requiring hands-on interaction with multiple players. The crew members would encounter spontaneity and fun through discovery. Travelling to Mars would challenge the human condition. The instrument would have to be adaptive to constraints, such as space, gravity and limitation of sound. This paper discusses the experimentation with sensors and sounds for the imagined environment of the spaceship.

*Keywords: interaction design, physical computing, haptic, empathic design, musical instrument*

## 1 Introduction

Rainmaking on Mars is a spherical musical instrument designed as a social activity for the Mars One crew members while on their journey to Mars. The instrument is presented as a very simple object, a ball that carries multiple haptic sensors. We created shapes on the object that seem familiar in their materiability but foreign in their specific use and the sound generated.

Candidates must discover the haptic features to understand what their limitations and abilities are. At the beginning of our research, we interviewed three potential astronauts on their reasons for going to Mars. We found that most of the logistics were well researched, however there was no cultural questioning beyond the scientific exploit. After this initial research, we interviewed Alison Rigby (Figure 1), one of five Britons, and 100 worldwide, selected to join the Mars One mission in 2015 (Smith, 2015). While the Mars One mission is very controversial (Laroche, 2015; Do, Ho, Schreiner, Owens, & de Weck, 2014), it synthesizes well the human desire to go to Mars. Compared to the plans made by NASA and the SpaceX program, the project is more open to global applicants from diverse backgrounds. It gambles on the notion of global citizenship, which can be defined as ‘a politics of mobilization, expressed by transnational militancy, and centring on the conviction that it is important to make “the impossible” happen by dedicated action that is motivated by what is desirable, and not discouraged by calculations of what seems likely’ (Falk, 1994). This notion of making the ‘impossible’ happen is one that can be found in other transnational organizations such as Amnesty International. The members of Mars One feel they can take responsibility for their lives and eventually contribute to extending humanity. Rigby said in an interview: ‘You have to have a good reason to go, and to do it for humanity is a really good motivator towards a step into the future’ (Rigby, 2017).



**Figure 1. Skype interview with Alison Rigby, one of the 100 selected worldwide to join Mars One.**

This project is an example of research through design. On the interrelated subject of design and innovation, there are two schools of thought, social innovation and design-driven innovation. On one hand, the ethnographic approach prevails and is well represented by companies such as IDEO and designers such as Victor Papanek or academics such as Ezio Manzini (Manzini, 2013). On the other hand, the approach of the designer as an author can be seen in companies such as Alesì or Apple, backed by academics such as Roberto Verganti (Verganti, 2008). We have been inspired

by Manzini's bottom-up approach, and have made the object from the perspective of a personal experience in the context of a wider issue. Research through design pushes us to look at the wider picture, allowing a comparison that goes beyond the aesthetic or function of a product: 'the design practice is brought to bear on situations chosen for their topical and theoretical potential' (Gaver, Blythe, Boucher, Jarvis, Bowers and Wright, 2010). This constitutes the deeper features of the object, which creates a network with other similar objects based on their ability to actively mediate and question the world around us. As part of this research, we also took careful consideration to design the learning aspect so the instrument would be easy to use for the beginner and introduce a level of progression through social interaction as a collaborative element. The ludic aspect of the instrument was important in its development. Finally, and this is possibly the most important contribution, the instrument is thought to work in a context of uncertainty. No human has yet travelled to Mars and the object should be able to evolve with the users.

## **2 Designing for Neotribes**

To design for interaction is to look at 'how human beings relate to other human beings through the mediating influence of products' (Buchanan, 2001). We are interested in the social interaction aspect of design, but what is the size of the group and what is their bond? Too often, designers use personae (archetypal character) as a shortcut, or a societal issue (such as aging) as a general topic, but we looked for an approach between these two, that would be neither too narrow nor too wide. The French sociologist Michel Mafessoli, who looks at the concept of tribes in contemporary societies, came up with the concept of neotribes (Mafessoli, 1996). While ancient tribes were about the structure of the group, neotribes are about the bonds and the purposes of the group. A neotribe, according to Mafessoli, is a small entity of people with a purpose (Mafessoli, 1996). This approach permits us to look at groups of people regardless of age, gender or social position, based on their social activity (a purpose) or even activism (a stronger purpose). The Mars One travellers are scientist or technicians, concerned with uncertainty but in a way that includes them. They are individually committed as global citizens, with the specific purpose of going to Mars.

The global citizen reflects on the motivation and the ideal of joining the group, but what about the way they function as a group? We found the concept of 'serious leisure' to be a good fit. The Mars One training is serious, but it does not have the years of experience of a world respected institution such as NASA. According to Stebbings, serious leisure is a systematic pursuit by an amateur, that is highly substantial, interesting and fulfilling (Stebbing, 1992). Serious leisure doesn't question its own implications, ideals or desires, but reflects the ability of the organization to do more than planning. To Richard Buchanan, 'design is the human power of conceiving, planning and making products that serve human beings in the accomplishment of their individual and collective purposes' (Buchanan, 2001). Mars One has conceived a plan to go to Mars and is making a tangible reality out of the community of people who feel empowered by it. We feel that our purpose as designers is to give them a prototype, a technology that they may never use but which we take as seriously as their desire to go to Mars.

### 3 Living in Space

When designing an object, we need to consider not only the users but the circumstances of its use. There will be years of training for the final candidates prior to embarking on the journey. Simulators on earth are created to train them for the constrained environment. Astronauts are currently reliant on Earth during space missions and must learn about living and working in space for long periods in order to understand the physiology of the human body in space. By the 2020s, NASA hopes to send astronauts on a year-long mission into deep space in order to verify habitation and prepare to become earth independent (NASA, n.d.). The spaceship will be a workplace as well as a living space. As the ship hasn't yet been built, it is not easy to tell how the space will be divided, but we can look at decisions made on the design of the International Space Station (ISS) for guiding principles. The ISS is a habitable space station put into orbit in 1998. It has already helped the journey to Mars by researching delays in communication, isolation, confinement, food, exercise and habitability (Hobson, 2017). Habitability is the most interesting to us, as it includes the environment, equipment, activities and group interactions. A video shows astronaut Samantha Cristoforetti (ESA, 2015) making red rice and turmeric chicken. By European Space Agency (ESA) standards, this is 'bonus food', and shows a recognition that food plays a role that goes beyond basic needs. The space for the astronaut is slowly changing from a technical space to one where the users make a cultural impact. Samantha Cristoforetti was key to the development of the first espresso machine in the ISS (ISSpresso, 2018). An equivalent to the ISS has yet to be built to carry travellers to Mars. While the habitability of a space is a first step, Alain Findeli looks at *habitating* space as a main concern of the design project. To Findeli, *habitating* looks 'at the relationship between people and their environment (in all its dimensions: physical, psychical and spiritual)' (Findeli, Brouillet, Martin, Moineau, & Tarrago, 2008). This is, for us, a key element of the success of the mission, as it requires a new type of creative activity that can enhance the group socialization by creating new types of interaction and finding ways to keep a meaningful attachment to Earth via the natural sounds of Earth.

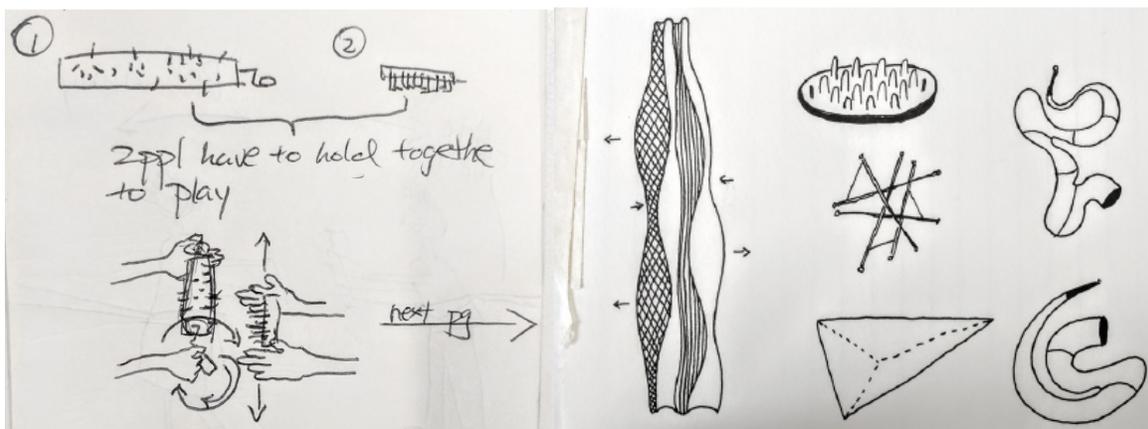
### 4 A Musical Instrument as a Social Object

We interviewed various candidates for the mission prior to deciding what kind of object would be designed. The reason for researching, and joining, the candidates interviewed is that we, as designers, should empathize with the subjects we design for. Two months was also spent just researching Mars One and how the mission to Mars is being planned. We specifically left the problem of identification until after interviewing the candidates in person and seeing their current living and working environment. This is to mitigate any assumptions we may have based on what we know prior to personally meeting the candidates and broaden our perspectives through field research. We met Ryan MacDonald in Cambridge (UK) so he could take us to where he studies, works and lives. This approach to design research treats the design discipline as something far beyond producing objects, with aims of producing new forms of life. Herbert Simon distinguishes between 'natural sciences' and 'sciences of the artificial' and introduces the concept of a satisfied

solution as opposed to a true solution (Simon 1969). This is a way of constructing new knowledge from a design perspective that puts prominence on the user, in our case the crew members of Mars One. This means that perspectives constantly shift from the designer to the user, and the designed object is heavily based on the system it lives within.

After a few interviews, Alison Rigby suggested that natural sounds such as rain would be a major element she would miss from earth, and that an object which could evoke a natural earthly environment may help with psychological health. To address the element of uncertainty in our design, we looked further than the ludic aspect of the instrument. Music and the sounds of nature have been used in human mental therapy since prehistoric times. As early as 400BC, Asclepius applied music as therapy to conquer ‘passion’ (Conrad, 1980). In this project, we used this therapeutic approach to reduce the psychological risks of the journey. As the design and prototyping process evolved, we learned more about the candidates through collaborative making. We developed an iteration and feedback approach to designing the object. One common instrument used in sound therapy is the *rainmaker*, but this would not function without gravity. Therefore, we decided to take on the challenge of reimagining the rainmaker.

We found that most of the candidates interviewed had no background in playing musical instruments and were new to the idea of a sound-making object as a social interaction. We started researching sound-making in space, with the limitations of an imagined environment. For example, the gravity would change how the crew would be oriented and make the traditional function of a rainmaker completely impossible.



**Figure 2. Sketches of how people can interact with haptic and kinetic parts.**

Early sketches (Figure 2) imagined the ways people could move and interact with haptic objects, and how the instrument could look, feel and act. People move differently in space without gravity, and even everyday tasks such as going to the washroom change habitually. We imagined in the space ship, that the crew could float freely when playing the object, allowing it to float between them. We designed the object with this idea in mind.

To design the sounds that would be made by the object, we explored the art of music concrète, experimental music that exploits acousmatic listening. Using rain recordings by sound composer, Hildegard Westerkamp, we created a rainforest-like environment of sound. We made connections between the haptic from each sensor point and the sounds made by interacting with that point (Figure 3). Some examples are, squeezing a furry ball on the object making the sound of the rain turn on, while a light touch on a sensor point results in a subtle change of volume in the rain sound. This lets the object carry its own essence of sound instead of forcing interaction. In traditional instrument playing, musicians act like dancers in the way they move, something that requires a tap or soft sliding motion can create richness in the language of body movement. Haptic surfaces can provoke various modes of movement, pressures and gestures.



**Figure 3. In a newer version of the object, this tentacle-like touch-point changes the pitch of the rain as users run their fingers through it.**

The instrument has no resemblance to any other conventional instrument, nor is it expected to sound conventional, putting no pressure on anyone inexperienced in playing musical instruments. Therefore, we refer to it as a social object rather than a musical instrument. Using haptic sensory touch-points (Figure 4), the players are encouraged to discover and learn what sounds are triggered by interacting with these touch-points over the duration of the journey to Mars. Contrary to most instruments, the object needs participation from multiple players to diversify the composition possible, which creates an interactive environment for the crew.

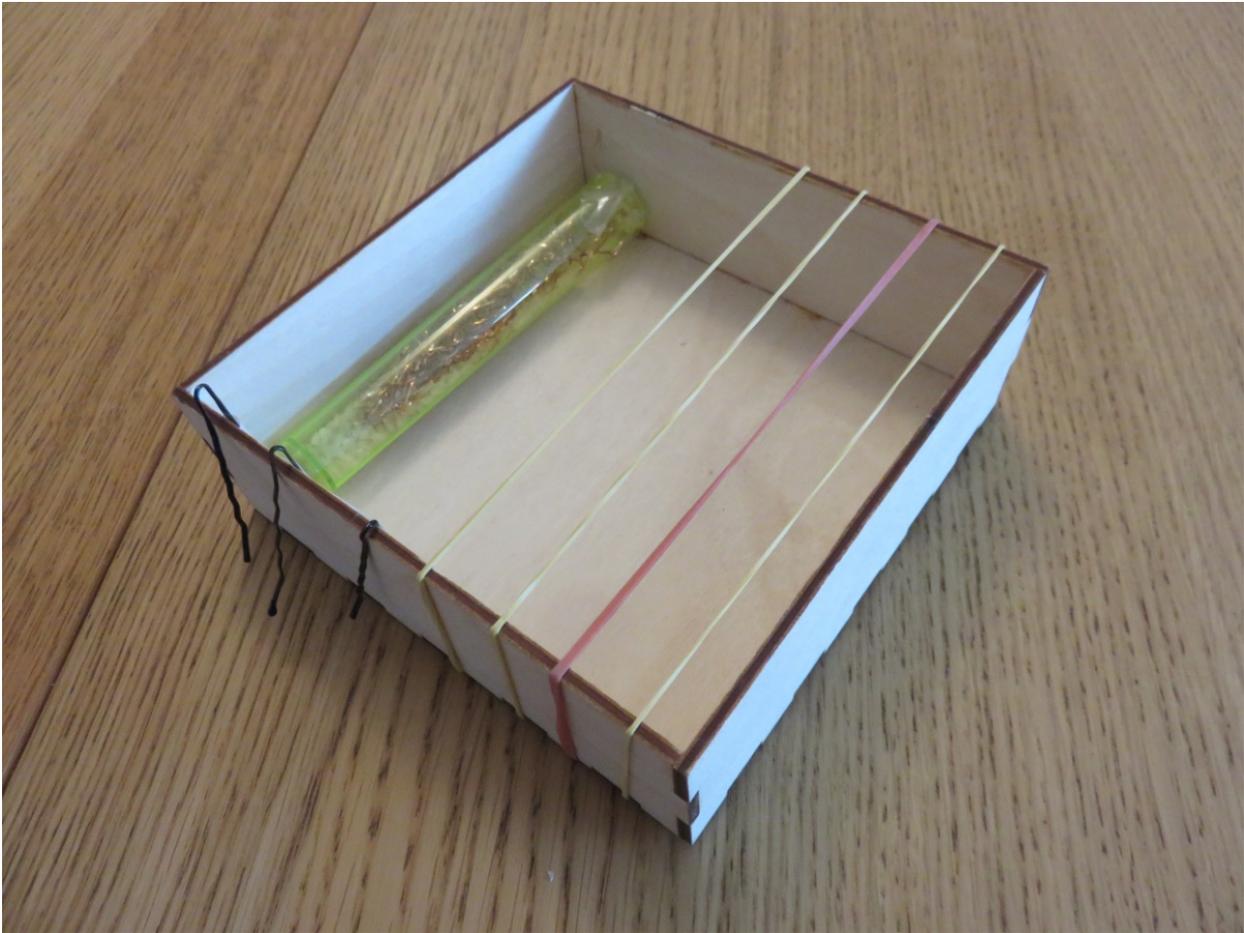


**Figure 4. Users interact with the haptic touch-points of the social object creating variations of sound.**

Alison Rigby's reaction to the playful nature of the final design showed that she felt the object empathized with her psychological well-being, as well as the conditions of the physical environment: 'I can easily imagine that sphere floating around the Mars Transfer Vehicle emitting calming rain sounds. It will certainly help me sleep soundly' (Rigby, 2017).

## **5 Prototyping**

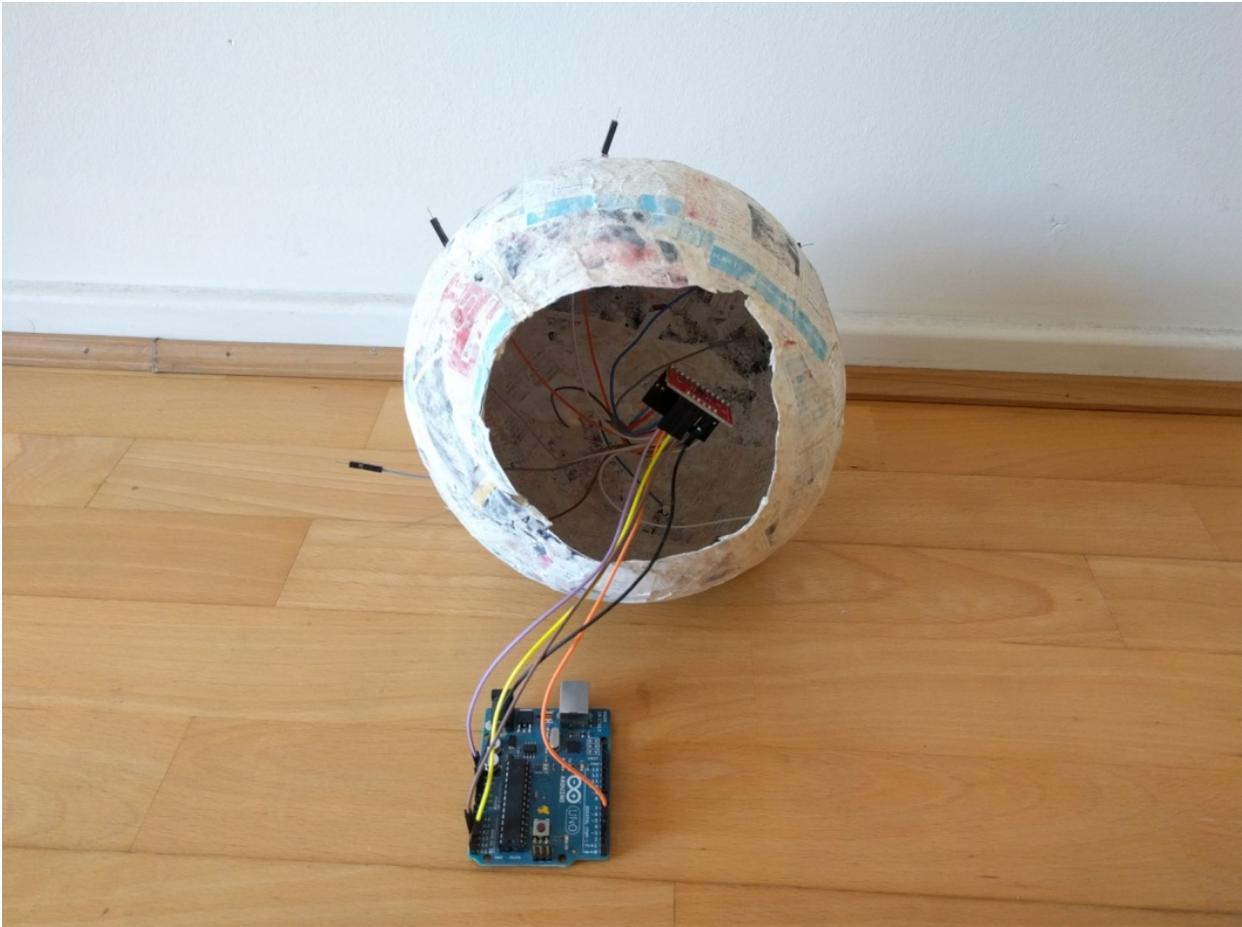
The prototyping process began with making non-digital DIY instruments from found objects such as rubber bands stretched across a wooden box to create a sound much like a guitar (Figure 5). They combined to create a collage of sounds of various pitch and tone. This helped us relate materials to the sounds they can create and understand that 'melodic' sounds can be created with objects never considered to be musical instruments before.



**Figure 5. The rubber bands vibrate to create sounds; as the tube with rice rolls inside the box it creates 2 variations of sound.**

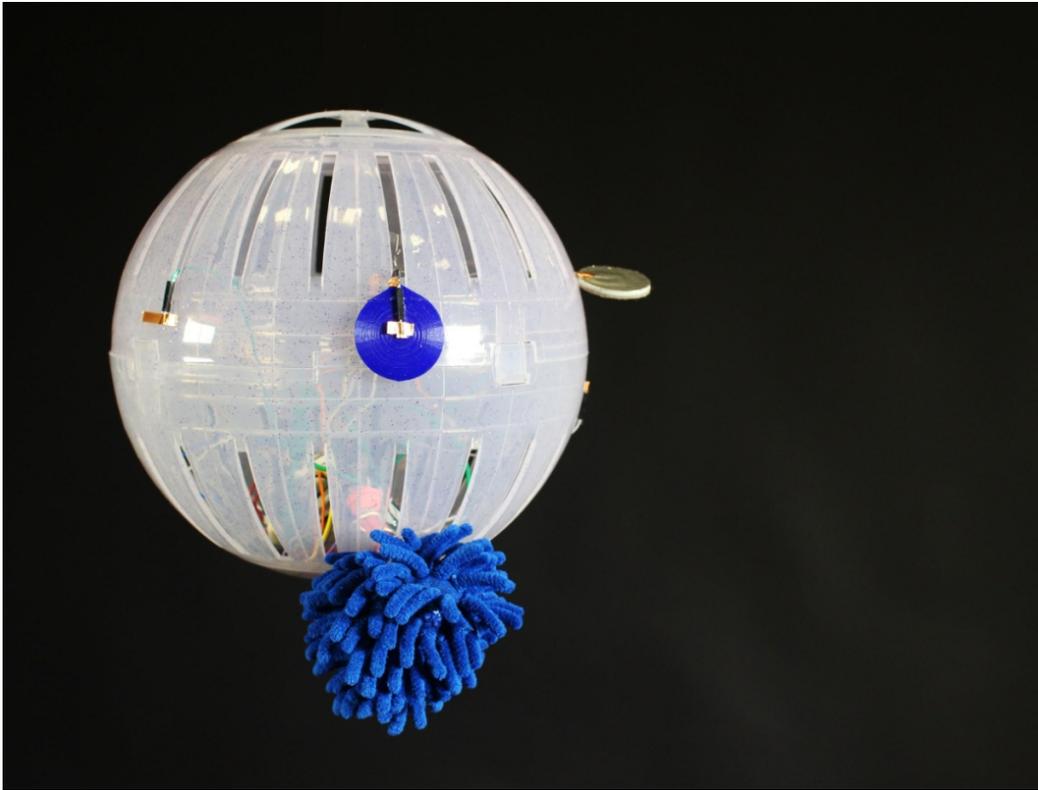
We tested digital prototypes by using proximity sensors to make a Theremin using piezoelectric and light sensors with Arduino. The pitch changed based on the distance from the piezoelectric sensor to the player's hand. We imagine it would be interesting to have bodies floating in space, creating sounds through body movement.

Thus we moved on to creating sounds completely digitally. We focused on sound selection, testing recordings of rain, simulating a natural earthly environment, and accompanying those sounds with other melodies. An Arduino was used to interface with a capacitive sensor and we used the software Max to prototype quickly. For example, to alter the intonation, pitch, volume and mix with other audio recordings (Figure 6). The first prototype used touch-points as on/off triggers for the sounds however we adjusted this to create ranges controlled by the level of proximity communicated by the capacitive sensor. At the end, we arrived at enough variable affordances and results to create a diversified object (Figure 7).



**Figure 6. Prototype with a capacitive sensor and touch-points that turn sounds on and off.**

Different objects provoke different actions from their materiality. Looking at haptic toys, we played with various materials in order to give different affordances. Ultimately, we decided that a spherical overall silhouette of the object would be better than a hard-edged shape floating in space. It would be safer in case of any unplanned interaction, and less rigid in terms of surface plains. The object and its affordance is significant to triggering behaviour, as we saw from testing with visitors at the Ars Electronica Festival 2017 in Linz, Austria (Figure 8). People were generally wary of approaching the object, but once they familiarized themselves with it, they quickly opened up to discovering what they could do with it. The goal of spontaneity and fun were evident in their reactions and the object provoked conversation about the mission and awareness of the psychological risks for astronauts.



**Figure 7.** A more refined prototype using a plastic ball covered with haptic interactive sensor points.



**Figure 8.** In September 2017, the instrument was exhibited at the Ars Electronica Festival. One boy spent quite a long time after his friends had left figuring out what he could do with the ball.

In another exhibition, at the Ontario Science Centre in Canada, the object was hung in the air to simulate floating, and people were asked to walk around while interacting with it (Figure 9). Some of the sound was altered for this version to make clear distinctions when the various sensors were activated.



**Figure 9.** In February 2018, the instrument was exhibited at the Ontario Science Centre in Canada with speakers spread out around the room to create a larger sonic experience than the previous exhibit.

## **6 Conclusion**

Travelling to Mars is now a plausible scenario of science and technology. With the Mars One mission as our neotribe, we looked at making an object to fill the gap between the present and the future but also between a group of people and their desired future. We looked at the tribe, their motivations as global citizens, and their function as a group practicing serious leisure. We also looked at existing spaces orbiting our planet such as the ISS, anticipating on the *habitability* of future transport to Mars. The environment, reactions and limitations of this social object were speculated on, based on current space experiments such as the ISS or space training programme results conducted in simulations. There is no real environment within reach to test these prototypes or the final result. The object serves as a diegetic prototype, an object that allows the user to live

in their desired future by means of a narrative. According to David Kirby, the prototype is created by the producers (Kirby, 2011). However, our perspective on the diegetic prototype does not entirely align with Kirby's view; we see it as a hybrid between empathic design and design fiction, a shared construction between the designer and the user with the hope to convince others to help realise this future. The object's role is not to make anyone believe in the future but to act as a prop connecting a group of people with their own desire and ambitions. We propose that a social object such as ours displays a design approach through collaboration with possible candidates to achieve this goal. We also hope that this design will trigger more research on the social aspects of space travel. Once more, in the history of science and technology, we are faced with a technical situation that obscures the human and social implications, design has the ability to reflect and propose other solutions.

### **Acknowledgement**

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