Breaking Down Work Hierarchy With Participatory Sensemaking: The Matching Blob Challenge

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ABSTRACT

The hierarchical structure of professions and roles often creates communication barriers between individuals of different positions, limiting the flow of valuable information and negatively impacting outcomes. This paper aims to explore strategies for facilitating effective communication and collaboration among team members, irrespective of their hierarchical positions, particularly in high-stress situations such as medical operations. In this study, strategies that can be implemented in the daily lives of surgeons and nurses have been explored, to create an intervention that stimulates better communication and reduces the negative effects of hierarchical structures. However, it was found that existing solutions focussed more on briefings and education, which does not reflect the context between surgeons and nurses in the operating room very well. Therefore, we decided to use an embodied interaction perspective to tackle the problem. We designed an interactive product called the Blob Challenge as an intervention to stimulate better communication and reduce the negative effects of hierarchical structures between surgeons and nurses in healthcare settings by participatory sensemaking. The matching Blob Challenge is placed in the breakroom, providing a daily opportunity for nurses and surgeons to engage in communication. The matching Blob Challenge intervention is designed as a challenge involving pairs of blobs with unfamiliar shapes. It consists of a box equipped with a blob sliding mechanism and a screen for each user that displays one side of the blob to be found. Each user is assigned their own blob to locate, along with a dedicated screen showing the required blob. The user's assigned blob may be positioned on the side belonging to the other user, necessitating communication and collaborative effort to slide the blobs from one side to the other to find the right one. This challenge encourages active communication, sensorimotor coupling, and sensemaking between the users to successfully identify the correct blobs. This intervention aims to foster improved communication and collaboration among healthcare professionals, addressing the challenges posed by hierarchical structures. Different iterations of the product have been made, based on feedback sessions, observations, and improv theater. The final product resembles the social practice of an operation room, which could help to transfer the behavior and sensorimotor couplings of the interactive product to daily practice. Addressing hierarchical barriers requires a cultural shift and integrating interventions into daily routines is crucial for sustained effectiveness. The Blob Challenge intervention offers a practical and engaging approach to promote better communication, reduce hierarchical barriers, and enhance collaboration in high-stress healthcare settings.

Keywords: Hierarchical structures, communication, collaboration, embodied interaction, healthcare.

INTRODUCTION

The hierarchical structure of professions and roles often leads to communication barriers between individuals working in different positions, even when their input could be valuable. In situations like a medical operation, where clear communication and collaboration are critical, the hierarchy can limit the flow of information and negatively impact patient outcomes.
Numerous studies have emphasized the influence of hierarchical structures on communication, decision-making, and outcomes in this field (Leonard et al., 2004; Edmondson, 2012; Sexton et al., 2006; Salas et al., 2010). In healthcare settings, the power gradient between physicians and nurses has

been found to contribute to communication breakdowns and compromised patient safety (Tschannen et al., 2011). Nurses often refrain from voicing concerns or sharing valuable insights due to fears of repercussions or a perceived lack of value placed on their input. Consequently, this communication gap can have profound consequences, as effective teamwork and communication are vital for positive patient outcomes (Makary and Daniel, 2016). Doctors are not always aware of this communication gap. A Dutch study from 2011 showed that surgeons think they are good at sharing information, establishing a shared understanding, and teamwork, while nurses rate this significantly lower (Wauben et al., 2011).

Given the significant implications of hierarchical structures on communication and collaboration, it is imperative to explore strategies that foster effective interaction among team members, irrespective of their positions. One approach to bridging the gap between hierarchical positions is through mentoring and coaching programs. These initiatives are specifically designed to offer support and guidance to employees at all levels of the organization (Smith, 2018). Such programs have the potential to facilitate a more inclusive and collaborative workplace culture.

Another avenue for enhancing communication and collaboration within hierarchical workplaces is the utilization of collaborative software tools. These tools serve as digital platforms that enable team members, regardless of their positions, to work together effectively (Kim et al., 2017). Project management software like Trello and Asana allows for seamless coordination and task allocation, while communication tools such as Slack and Microsoft Teams facilitate real-time communication and information sharing. By utilizing these tools, organizations promote collaboration and minimize the barriers imposed by hierarchical structures.

There are also solutions specifically directed towards hierarchical problems in healthcare. A systematic review looked at 47 studies that researched the effectiveness of briefings, debriefings, team-building exercises, educational campaigns and checklists on improving culture in healthcare settings (Sacks et al., 2015). Most of the studies reported an improvement in surgical culture, which led to better patient outcomes. However, there are few design solutions that try to solve this problem. We identified this research gap and aim to fill this with an embodied interaction design solution. The aim of this paper is to address the problem of hierarchical structures between surgeons and nurses in operation rooms and find ways to train effective communication and collaboration among team members, regardless of their positions. For this, we will use embodied interaction theories, which can help to design an interactive product that fits the situated practice.

THEORY

There are a few embodied interaction theories that are relevant to this project, with the most important one being participatory sensemaking. The participatory, embodied sensemaking theory proposes for example that a physical object can become a 'shareable object of thought', which supports participatory and embodied sensemaking; non-physical tools are less likely to do so (Smit, et al., 2022; Kirsh, 2010). As we engage in embodied sensemaking activities in social situations, we have the opportunity to contribute to each other's sensemaking processes, thus establishing intersubjectivity, or shared meaning (Smit, et al., 2022). In a team exercise that promotes communication, participatory sensemaking could be used to create shared meaning and understanding, which might show that both the nurse and the surgeon can give valuable input in different situations which could further reduce the feeling of hierarchy.

Next to this, Djajadiningrat, et al., 2007, have suggested that there is an increased neglect of the body and suggested methods to reverse it. Sensorimotor couplings could improve usability while also

providing a more aesthetically rewarding experience (Djajadiningrat, et al., 2007). Using hands to make these sensorimotor couplings could be a good start (Klemmer et al., 2006). Hands are very good at detecting shapes and identifying objects. Surgeons and nurses also rely very heavily on their hands to operate in an operation room. The designed embodied exercise could therefore implement this principle to use the embodied skills that nurses and surgeons already have. Thus, designing a team activity that uses hands for sensemaking could fit the target group of surgeons and nurses quite well.

Furthermore, Gaver, W. W. (1993) proposes using multi-modal feedback, which engages multiple senses to provide feedback and information. Along with visual cues, incorporating auditory or haptic feedback could provide additional information or reinforcement. Using multi-modal feedback in the embodied design exercise can enhance the nurse's and the surgeon's perception and understanding of such an exercise. Besides, affordances and constraints need to be taken into account when designing an embodied experience (Norman, 2013; Gibson, 1986). The embodied exercise should have clear affordances, in order for users to understand it and interact with it as we intended. It should also be taken into account what affordances are present that are not deliberately designed. This helps to see how users will make sense of the product.

RELATED WORK

In the pursuit of improving communication and collaboration within hierarchical workplaces, various products, and services have been developed. This chapter explores a range of examples that aim to address the challenges posed by hierarchical structures through embodied exercises.

Problems with hierarchical structures in operation rooms are currently often tackled by team building exercises (Sacks et al., 2015). One company that offers exercises based on embodied interaction is Embodied Learning (Lana, 2023). Exercises include balancing games where people have to help balance one person on ropes, throwing and catching objects, and exploring different materials together. Embodied Learning claims that their team building exercises improve collaboration and communication between employees, and create more awareness of each other's values.

As an additional intervention, a game called "The Marshmallow Challenge" could be employed to promote teamwork and reduce hierarchy in a physical, interactive manner. The Marshmallow Challenge, developed by Tom Wujec (2010), is a simple activity where teams are tasked with building the tallest free-standing structure using spaghetti, tape, string, and a marshmallow. This game encourages participants to collaborate, communicate, and think creatively while working under time pressure. By engaging in this hands-on challenge, team members are encouraged to step out of their traditional roles and contribute ideas and insights on an equal footing, thereby fostering a more inclusive and collaborative environment.

While the aforementioned products and services are not all specifically designed to address hierarchy-related issues in a healthcare setting, they have the potential to cultivate a more inclusive and collaborative workplace culture. Nevertheless, the aforementioned exercises are still team building exercises organized by an external party. These solutions do not play a role in the daily lives of surgeons and nurses. There is an opportunity to design an embodied challenge that could be incorporated into the daily lives of surgeons and nurses, in order to break the habit of poor communication and make a lasting change. It is essential to recognize that addressing hierarchical structures necessitates a cultural shift within organizations. Ultimately, a comprehensive approach that combines these products and services with a commitment to fostering a culture of inclusivity and collaboration is crucial in overcoming the challenges posed by hierarchical workplaces.

METHODS

Embodied design ideation methods (EDI) can be used to design products that have a good relation

between body, materials, and context (Wilde et al., 2017). The fundamental theory behind embodied interaction is phenomenology, a philosophical method by Merleau-Ponty (1946). Phenomenology is a mindset where lived experiences are central. It is a way to re-learn how to look at the world, which allows people to experience things while bracketing away their previous knowledge. This concept in EDI is also called estrangement (Wilde et al., 2017). There are several EDI methods that follow this concept.

One of these methods that we will use to design the embodied challenge is "Material props in context". This method was developed by Oscar Tomico at the Eindhoven University of Technology (TU/e) and asks the designer to explore materials in a certain context by draping your body in a material and then moving around in that context (Tomico & Wilde, 2016). This allows designers to use their body to understand and experience the materials in the context and to use this information to make design decisions.We can use this method as an ideation method for finding original design solutions while immediately thinking about the embodied interaction that takes place.

Another method is called "Object theater", developed by Jacob Buur and Preben Friis at the University of Southern Denmark (Buur & Friis, 2015). For this method, designers have to make a performance around everyday objects. The designers will act out all the different perspectives, including the perspective of the object, to experience all the relationships between stakeholders (Wilde et al., 2017). The described methods could be used in this project to get a better sense of how participatory sensemaking would be stimulated. It also allows for understanding the perspectives and experiences of different users. We will use this method in an improv theater session, where our prototype will be shown to new users. We can use this method to observe how people interact with our product for the first time and understand the affordances and constraints of our product better.

In addition to these embodied design methods, we will also conduct observations employing the principles of Observing Socially Situated Practices and Ethnography (Ingold, 2014; Pollard, 2009). These observations will focus on various aspects, including the roles of individuals, relationships between people, the role of the material environment, and the interplay between people, objects, and technologies. Our aim is to gather a rich, detailed understanding of the nature of the nurse's and the surgeon's relationship during the operation, including habits, behavioral patterns, ways of doing things, temporal patterns, contextual patterns, implicit norms, and affective impacts (Ingold, 2014; Pollard, 2009).

THE DESIGN

Challenge design

A team building exercise was designed that motivates communication between two players (Figure 1). The "Blob Challenge" will be placed in the breakroom of nurses and surgeons where they will be motivated to do the challenge together. In contrast with existing solutions, the challenge will be incorporated into the daily work-life of nurses and surgeons, with the intention of maintaining good communication. To see an example interaction between two users and the matching Blob Challenge intervention, please see this YouTube video - https://www.youtube.com/watch?v=d9eoXDcUhfA. See Spread 2.2 for a visualization of the communication between the doctor and a nurse by using the Blob Challenge. In the operation room, the situated practice of nurses and surgeons includes cognitive distribution, where the nurse and doctor each have their own cognitive processes. They use different sensorimotor couplings to operate, where the surgeon operates on the person, and the nurse hands the surgeon tools. In the design of the Blob Challenge, the nurse and surgeon are seated next to each other in a similar position as in the operation room. In front of them is a screen with the blob that they are looking for, which corresponds to one of the blobs that is on the side of the other player. Through participatory sensemaking, the two players have to help each other find the corresponding blobs. They have to describe the blobs to each other, feel them, and finally slide them over to the other player

where they will evaluate their choice. The goal of this team building exercise is to practice participatory sensemaking in a similar situated practice as the operation room, in order to improve communication and collaboration.

Figure 1: The final design of the matching Blob Challenge prototype.

Blob design

The blob was designed in such a way that the first initiative is to explore the blob by fingers and hands (Spread 1.5). It is smooth and has different polygons to it, which makes the blob somewhat useless for other applications than just touching it. Users are shown a different perspective on the blob and have to communicate to find the blobs on the board. Each user searches for the blob on their half of the board and has to communicate to the other player what they see and what they feel. This requires active participatory sensemaking. Other affordances are to slide the blobs to each other, which also imitates the situated practice in the operating room, where the surgeon and nurse have to pass each other tools.

DISCUSSION

Collaborative social sensemaking is the main aim of the matching Blob Challenge. In our design, the participant is making sense of the blob by feeling its details; hearing the details but making sense of them by touch. The participants perceive the blobs and what is said by physically interacting with them. So, the participants have to work in a team to make sense of the object together, which gives very little space for one of the participants to take the upper hand, which again would display the hierarchical structure. By working in a team and being dependent on the information that the other person has to finish the task, which requires collaborative sensemaking, both participants have to have the same role. This goes hand in hand with the theory of sensorimotor couplings and socially situated practices, which were discussed before.

The matching Blob Challenge focuses on the aesthetics of actions, where products are designed for the particular user, task, and context, which strengthens the action (Buur, et al., 2004). In this case, the aesthetic of actions is the tangible interaction. The matching Blob Challenge requires active exploratory touch that permits both the grasping of an object and a grasp of its meaning. The blobs are made tangible by having different shapes, dimensions, proportions, curves, and edges. The blob design is similar to one designed by James Jerome Gibson (Gibson, 1966). He created sculptured

objects for studying the haptic perception of shape. In his study, he found out that when presented to a pair of hands behind a curtain, familiar objects and utensils proved so easy to identify that they did not challenge perception. Despite familiar solids like the sphere, ellipsoid, and cube, the subject encountered difficulty in tracing the edges and corners of unfamiliar polygons. The blob design is made to be an unfamiliar shape with different curves and edges that do not represent an existing and recognizable object.

The first prototype (Spread 1.2) consisted of a transparent plastic box with a metal spring placed in the middle. Users were required to use two sticks with magnets attached at the ends to retrieve an object from the box using only one hand. It was evident that our focus was on teamwork to solve the hierarchy. After developing the initial prototype, we delved into further literature and discovered that nurses often feel uncomfortable expressing their opinions when they have a different view from doctors. This led us to contemplate how we could incorporate different viewpoints into this team activity, where each perspective is vital to solving the task.

As a result, we devised the matching Blob Challenge (Spread 1.3), where each participant receives a picture representing a different view of the blob that needs to be found inside a box. Additionally, we began implementing various embodied interaction theories, as discussed earlier. We ensured the blobs were highly tangible, emphasizing the significance of social sensemaking in completing the task. Hence, the blobs were designed to have unfamiliar shapes that are challenging to recognize. However, we realized it was essential not only to focus on the design but also to consider how this product would be used. Others questioned us about when the Blob Challenge would be played - would it be in the operating room, the break room, or during nurse and doctor training sessions? We were uncertain about this aspect. To gain insights into the social practices of doctors and nurses, we observed YouTube videos. We learned more about the physical position of each person in the operation room, but also about their roles. One nurse would be standing next to the surgeon and handing them tools. There was almost no verbal communication. You could say that the nurse that handed the tools to the surgeon could be seen as a tool in the eyes of the surgeon, instead of a co-worker. This habit needed to be broken by facilitating better communication.

Moreover, we gained valuable insights from improv theater and theory. During the improv theater sessions, the actors were inclined to throw the blobs into the box, utilizing the box's holes as targets. The actors seemed to compete against each other, aiming to place their blobs inside the holes first. We realized that the product needed to fit more in the situated practice. Inspired by this, we aimed to create a design that prioritizes the aesthetics of actions, ensuring products are tailored to the specific user, task, and context, thereby enhancing the overall experience (Buur et al., 2004). In essence, we aimed to design the prototype in a way that discourages the immediate inclination to throw the blobs, but instead has other affordances, such as grabbing or feeling the blobs. Based on this, an idealization board was created, which can be seen in Spread 1.1. Multiple ideas were brainstormed, where the aspects in question were whether to enhance the urge to throw the blob and create an extension of the prototype, or rather make the design in a way that makes it less appealing to throw the blobs inside the blob compartment.

This resulted in the idea that is visualized in Spread 1.4, where there are spaces for all blobs to be placed in, a bigger space for the placement of the chosen final blob, a recognition system to recognize if the correct blob is placed, a sound indication whether the blob is the correct one or not, a curtain to cover the sides of the box for the hands to be placed in (not shown in the spread).
However, we realized that in this design, feeling the hidden blobs and sitting across from each other did not match the situated practice of the operation room. Since, during the operation, nurses have to hand the tools to the doctor that are required and then collect the tools, perhaps the prototype could represent this action by also including more input and communication from the doctor. Based on this

realization, an ideation sketch was made (Spread 2.1).

As can be seen, Spread 2.1 shows different shapes of the intervention. The shape of the Blob Challenge intervention can influence embodied interaction by affecting the physical actions and gestures involved (Johnson, 2007). Different shapes can afford different interaction possibilities and can evoke distinct sensorimotor experiences. In the case of the Blob Challenge, the design of the traces and the manipulation of the blobs can provide opportunities for various gestures and tactile interactions. The shape of the challenge should be carefully considered to support the desired embodied actions, promote engagement, and facilitate effective communication between the users. To find out which is a suitable shape for the matching Blob Challenge intervention, there were a couple of aspects to consider, which are discussed further below.

We wanted to explore what advantage there is if the participants are able to see each other's hands rather than hiding them in a box. In embodied interaction, the visibility of hands can have different effects on the interaction dynamics (Dourish, 2001). It depends on the specific goals and context of the challenge. If the goal is to emphasize communication and collaboration between the nurse and doctor, allowing them to see each other's hands and gestures can facilitate non-verbal communication cues, such as pointing or indicating specific features of the blob. This visual feedback can enhance the sense of shared understanding and coordination. On the other hand, if the goal is to create a more challenging experience, where verbal communication is emphasized, hiding the hands and relying solely on verbal descriptions can increase the difficulty level. Allowing the visibility of hands can be beneficial in this context. When the nurse and doctor can see each other's hands, it promotes non-verbal communication cues such as pointing, gesturing, or indicating specific features of the blobs. These gestures can enhance the shared understanding between the players and facilitate coordination. Visible hands also allow for the observation of each other's actions, which can help build trust and mutual respect.

Another detail to consider was the spatial arrangement of the users, which can significantly impact the embodied interaction (Lindley, et al. 2010). When sitting face-to-face, users can establish direct eye contact, enhancing social presence and the perception of engagement. This arrangement can promote a stronger sense of shared agency and mutual focus. On the other hand, sitting side-by-side promotes a shared perspective and joint attention towards the task at hand. It can foster a collaborative mindset, as both users need to work together to achieve a common goal. Sitting face-to-face can be a preferable spatial arrangement to decrease hierarchy and promote effective communication. Face-to-face interaction allows for direct eye contact, which enhances social presence and engagement. It supports a stronger sense of shared agency and fosters a collaborative mindset. This arrangement encourages active listening, observing facial expressions, and promoting open dialogue between the nurse and surgeon. However, we argue that in the case of surgeons and nurses, a side-by-side sitting arrangement is more suitable, because this reflects the real situated practices of being in the operating room better than sitting face-to-face.

It was decided for the final prototype to have slots for the blobs to be slidden from one side to the other. Implementing sliding rails for the blobs can indeed enhance the aesthetics of actions and make the matching Blob Challenge more intuitive, aligning with the principles of embodied interaction. This suggests designing the challenge elements and interactions to provide clear affordances (perceived possibilities for action) and constraints (limitations on possible actions). For example, the sliding rails could have stoppers or markers that indicate the valid range of motion for the blobs. This helps in guiding the user’s actions and ensuring they stay within the intended challenge mechanics. Grounded in James J. Gibson's (1986) work, ecological perception focuses on the perception of affordances and the relationship between perception and action. Designing the matching blob challenge with attention to the affordances of the blobs, sliding rails, and other elements can facilitate

intuitive interaction and support the users perception-action coupling. Sliding mechanisms can provide a tactile and kinesthetic experience, engaging the user's motor skills and creating a more immersive interaction. The physical manipulation of the blobs through sliding can further strengthen the embodiment of the user's within the matching Blob Challenge.

In the end, we believe that the Blob Challenge incorporates two kinds of embodiment: A designed tangible interaction exercise and a natural embodiment of the social interaction between the surgeon and nurse. The designed embodiment is part of the challenge, where users have to use their body and sensorimotor skills to make sense of the blobs. The natural embodiment is caused by the placement of the users who are seated next to each other in the same space. This natural embodiment is comparable to the socially situated practice of nurses and surgeons in the operation room. However, when playing the Blob Challenge, the natural embodiment is influenced by the designed embodiment. Because users have to use participatory sensemaking to play the game, communication between the doctor and nurse is necessary. This could break the habit of poor communication in the operation room.

CONCLUSIONS

This project aimed to enhance communication and collaboration in hierarchical healthcare workplaces by using embodied interaction theories. The hierarchical structure in professions like medicine and nursing often hinders effective communication, compromising patient safety. While interventions like mentoring programs, software tools, training, and development opportunities contribute to a more inclusive culture, they are not fully integrated into daily routines, diminishing their impact over time.
To address this limitation, the study proposed the Blob Challenge, a daily design intervention placed in the breakroom to stimulate communication between surgeons and nurses. By actively participating in the matching Blob Challenge and engaging in sensemaking activities together, healthcare professionals can establish shared meaning and foster improved collaboration.

The Blob Challenge makes use of two main embodied interaction theories: participatory sensemaking and sensorimotor couplings. Because the nurse and surgeon have to use good communication to solve the challenge, hierarchical barriers could be broken. The design of the challenge simulates the socially situated practice of the operation room, which could help to transfer the learned communication skills from the challenge to real practice.

In summary, addressing hierarchical barriers requires a cultural shift, and integrating interventions into daily routines is crucial for sustained effectiveness. The Blob Challenge intervention offers a practical and engaging approach to promote better communication, reduce hierarchical barriers, and enhance collaboration in high-stress healthcare settings. By combining strategies like the Blob Challenge with other interventions, organizations can cultivate a more inclusive, communicative, and collaborative workplace culture, ultimately improving patient outcomes and overall performance.

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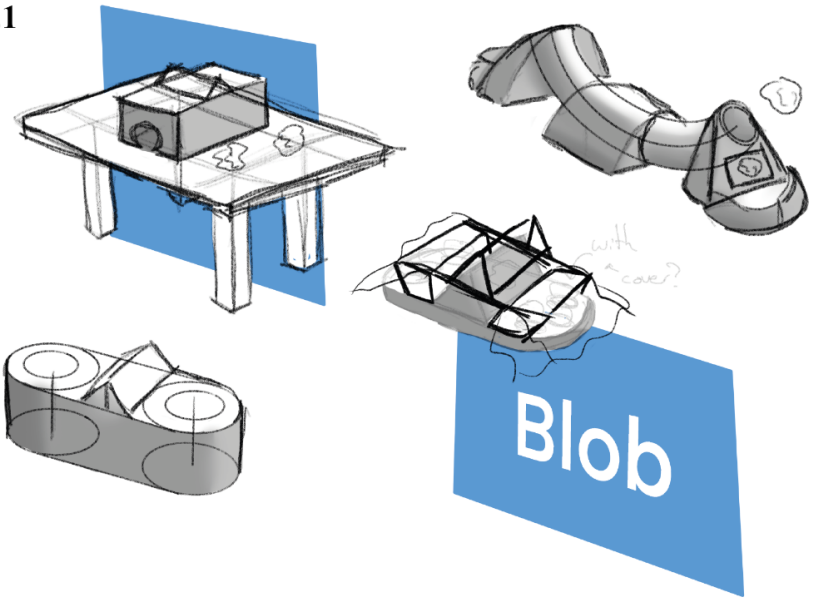
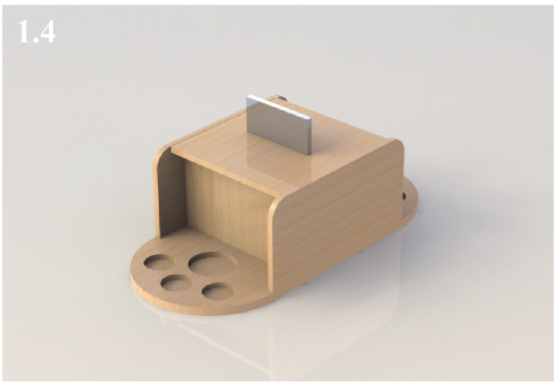
SPREAD ONE - BLOB IN BOX IDEATION

1.1

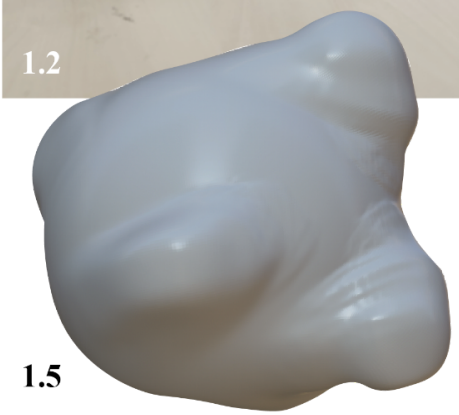


1.2

1.3

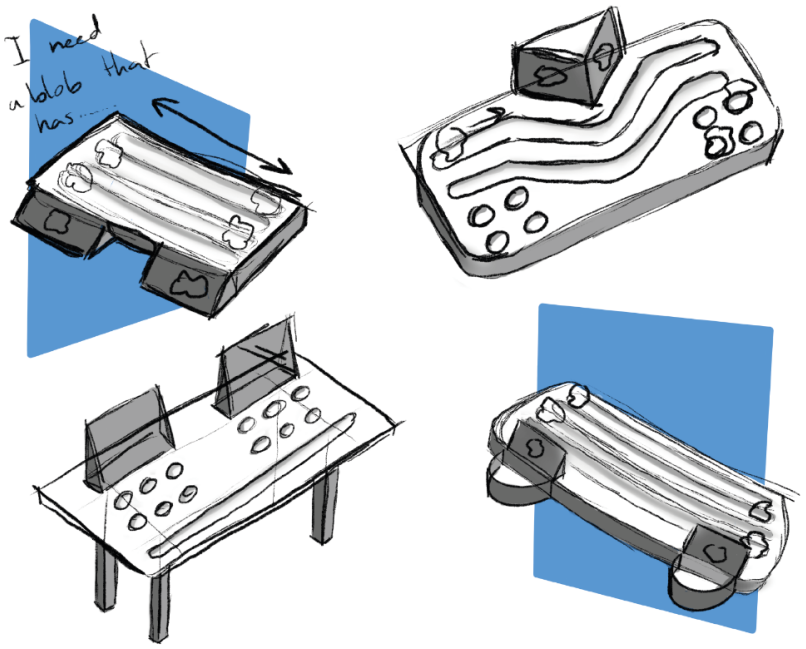


1.4

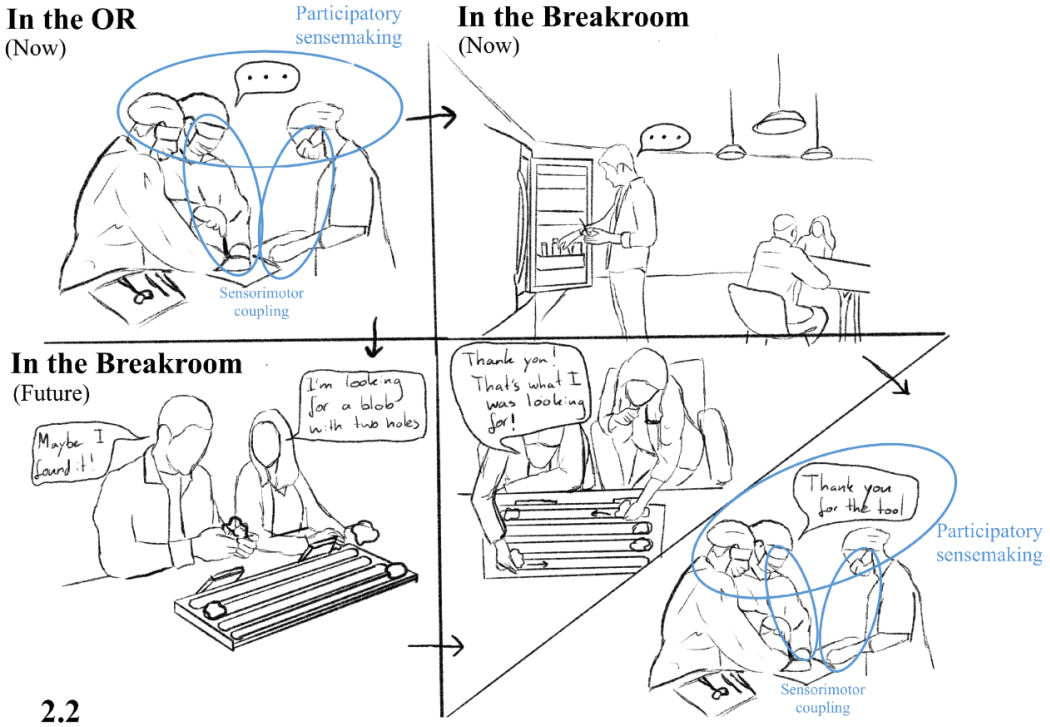


1.5

SPREAD TWO - SLIDING CONCEPT



2.1



2.2