Towards an Initial Understanding of the Design of Playful Water Experiences Through Flotation

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Human-Computer Interaction (HCI) researchers are increasingly captivated by water interactions and hence explored interactive devices to support aquatic activities in different settings (e.g., mixed realities in water parks). However, our understanding of the user experience in interacting with water and technology is still underdeveloped. To begin closing this gap, we explore flotation tanks as a water setting for playful interactive experiences. The goal of the associated somaesthetic design approach was to sensitize the body of the designer (the first author) by engaging with her experiences interacting with water and create meaningful interactions. This preliminary work presents four different user experiences that can facilitate play through a defamiliarization analysis of water interaction with the body mediated by technology. We offer HCI insights for design researchers interested in creating playful experiences in water settings, while also providing industry with initial strategies on how to enrich flotation tank sessions.

CCS Concepts: • **Human-centered computing** → *Human computer interaction (HCI)*; Interaction paradigms;

Additional Key Words and Phrases: Flotation tank, playful experience, soma design, water interaction.

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1 INTRODUCTION

Advancements in interactive technology have led to several devices used in water settings. For example, surfers can use smartwatches to remain alert to weather changes [14], divers can use robots to assist exploration tasks [40] and water park attendees can enrich their visit with virtual reality (VR) [3] have proposed interfaces made of water [17]. We note that the design of these devices has focused on supporting instrumental tasks, while their use for experiential purposes

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such as aquatic play has rarely been explored. This is surprising, as HCI researchers are increasingly interested in understanding how people experience technology in water settings [15, 16, 45, 48]. As such, we find that in interaction design research there appears to be limited understanding of the coming together of technology, water, and humans, interacting as synergetic agents to enrich the user experience (UX) through play. In particular, we are interested in understanding how to design playful interactions in water settings hence aim to understand what the associated UXs are in playful water interactions. To further such understanding, we begin by exploring playful experiences in a flotation tank. Also known as a sensory deprivation tank, this is a spa bath where people can, without much effort, float in water with a high salt concentration (approx. 20% Epsom salts) [34] The water is heated to skin temperature (35 degrees Celsius) and the tank is isolated from external light and sound using a lid. Health research has demonstrated several benefits of flotation tanks, including stress management and wellbeing [59]. We anticipate flotation tanks will be an effective vehicle to facilitate playful water experiences (possibly also enhancing those health benefits), since they can act as a controlled environment within which we can relatively easy manipulate water and human stimuli while allowing for a unique experience, that is, flotation.

To explore the design of playful experiences in flotation tanks, we built on somaesthetic (soma) design methodologies. Somaesthetics is gaining traction in HCI, where soma ("the self that is a united whole of mind and body" [22]) design aims to create bodily-connected aesthetic experiences to take embodied interactions to the next level [22, 23, 58].At least to our understanding, soma design has not yet been used for interactive water experiences. However, we believe this methodology can bring our bodies closer to our water perception, since it entails a qualitative approach to an experiential, felt, aesthetic stance, providing the designer with the ability to appreciate and discern those meaningful interactions that "touch us" [22]. Hence, soma design could be ideal for designing engaging interactions to encourage a feeling of being one with the system, in our case, being one with the water through the system. Through a prototyping process with flotation tank sessions, we identify four different UX through an analysis of the water interaction with the human body via a defamiliarization lens. We propose defamiliarization [50] as a playful approach to "make strange" [50], here, making water interactions strange. Finally, we offer preliminary insights for design researchers interested in creating playful experiences in water settings, while also providing industry with initial strategies on how to enrich flotation tank sessions.

2 RELATED WORK

2.1 Virtual realities in water settings

We mainly learned from systems in prior work concerned with water interactions that use virtual reality (VR), which can deprive users of visual stimulation. For example, VR in a neutral buoyancy environment (i.e., a pool) has been explored in space exploration research: Bellomo et al. [11] showed that VR has the potential to familiarize users with new environments and monitor their reactions through biosignals, which also help to understand user's reactions to stimuli. Sinnott et al. [52] investigated how an altered sensory environment affects VR experiences, showing that simulated body movements consistent with real body movements can provide a sense of presence underwater; however, the study questionnaires provided little information about users' sensorial experiences. Ballast VR is a water park where users use VR headsets in pools or on water slides [3]. Based on user reviews of this water park, we conclude users can enjoy being in VR fantasy worlds while they are in real water. However, there has been no empirical investigation of the associated UX. In summary, prior work suggests VR in water settings could benefit from further research and we

will use qualitative interviews to understand these experiences, for example asking about feelings of weightlessness and sensory deprivation.

2.2 Use of interactive technology in flotation tanks

The use of interactive technology in flotation tanks has also been suggested. For example, Auger et al. [9] designed "Iso-phone", a telecommunication concept in which a user can hold a "private" telephone conversation in a flotation tank, using a helmet that helps them float and blocks peripheral stimuli. This is an artistic system that showed flotation tanks combined with interactive technology can facilitate novel experiences. Mann et al. [38] designed a game for flotation tanks in which users watch visual representations of sound waves produced when they sing in VR (captured via a microphone in the tank) together with other tank users, connected over the internet. Although the designers used the tanks' deprivation features, we believe they overlooked the interaction that water can facilitate, since they only used water as the medium for floating but did not leverage the haptic feedback opportunity water affords [17, 21]. Moreover, the VR environment can be leveraged to present fantasy worlds where users explore concepts like relaxation and play [18]. Although interactive experiences in flotation tanks have been suggested [6, 12, 37] and VR in tanks appears to have been commercialized [5, 6], we know little about the associated UX, therefore, our research is still needed as HCI researchers might benefit from this knowledge. Overall, we acknowledge this prior work in the emerging field of what is increasily called "waterHCI" [15, 16, 39, 45, 48]. However, there is still a knowledge gap in how to design interactive flotation experiences where technology and water work together. This preliminary work aims to bridge this gap by asking: how can flotation tanks facilitate playful interactive water experiences?

3 METHODOLOGY: SOMA DESIGN FOR WATER EXPERIENCES

We draw from somaesthetics as an approach to designing for and with water. Soma design builds on the designer's felt experiences reinforcing the union of the mind and body perceptions, leveraging the ability of the designers to sensitize their body to create balanced soma-systems relationships [22, 51]. Hence, as the main designer, the first author of this work engaged with methodologies for soma design. We adopted the three general stages proposed in prior work [22, 23, 32, 58] that allowed for knowledge creation through design exploration, which we explain next:

3.1 Engaging with body practices

In this stage of soma design, the first author engaged with her sensorial perceptions by interacting with water in different settings, such as walking on the beach, swimming in the ocean, and doing flotation tank sessions, twice a week for one month (Fig. 1).

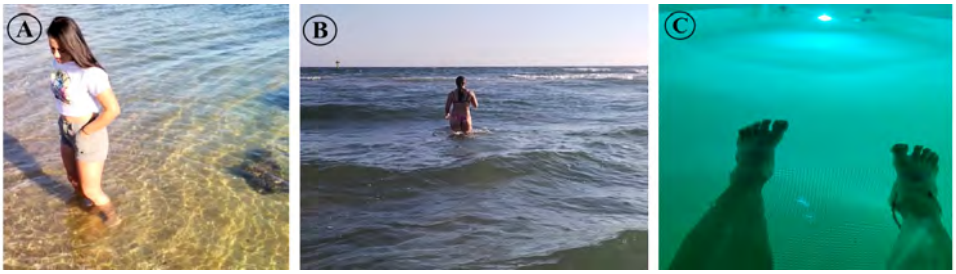

Fig. 1. Stage 1 of soma design – body practices to engage with bodily perceptions of water. A) walking on the beach; B) swimming in the ocean; C) a flotation tank session.

These interactions were different from day-by-day water interactions with water, such as drinking water or showering, as she reflected on her physical perceptions of them and their influence on her emotional state. Her goal was to "sensitize" her body [22, 58] to being in contact with water, particularly concerning how she moves through the water and feels the water. As suggested by prior work [57], she documented these experiences by writing down her perceptions before, during, and after these experiences.

3.2 Material exploration

In this soma design stage, the first author undertook material explorations twice a week for two weeks using different technologies such as water pumps in bowls of water, speakers in buckets of water, and playing a VR game in a bath. She also explored buoyant materials supporting flotation (Fig. 2).

Fig. 2. Stage 2 of soma design – material exploration in water settings: A) feeling vibrations of a waterproof speaker in a bucket of water; B) feeling water jets produced by a water pump; C) exploring buoyant elements in water.

3.3 Soma design prototyping

In the last soma design stage, designers explore ideas by doing, using self-experience and project goals to develop the prototype design [49]. The flotation tank body practice presented opportunities such as a closed environment where water properties can be controlled and sensory deprivation that brought the first author closer to her bodily feelings. The first author had three 30-minute sessions over three weeks (one per week) in the flotation tank [2] that was installed in our laboratory. We recorded these sessions using a GoPro camera, and developed the soma documentation using soma trajectories [1] using the Oculus Quest 2 headset. In the second session (Figures 3A, 3B, 3C), she floated inside the closed tank for 10 minutes; next, she floated for 10 minutes with a pneumatic inflatable around her hand (made with a programmable air pump Programmable Air), trying to simulate a breathing rhythm; and then she floated for another 10 minutes feeling the bubbles from a pneumatic air pump. In the third session (Figures 3D, 3E, 3F), she floated inside the closed tank for 10 minutes; next, she floated for 10 minutes feeling water jets on her hands and feet; and then she floated for another 10 minutes using a heart rate sensor [7] while playing the same relaxation VR game.

4 PRELIMINARY RESULTS

4.1 Findings from the body practices

Interacting with water in different settings and reflecting on this allowed the first author to discover how water's properties, such as temperature and flow, made her feel. One recurrent observation was the perception of water temperature. The cold ocean water while walking on the beach was an abrupt temperature change, and on the contrary, warm water inside the flotation tank felt comfortable. Furthermore, the water temperature induced certain moods; for example, cold water made her alert and warm water relaxed her. Moreover, the water temperature afforded perceptual

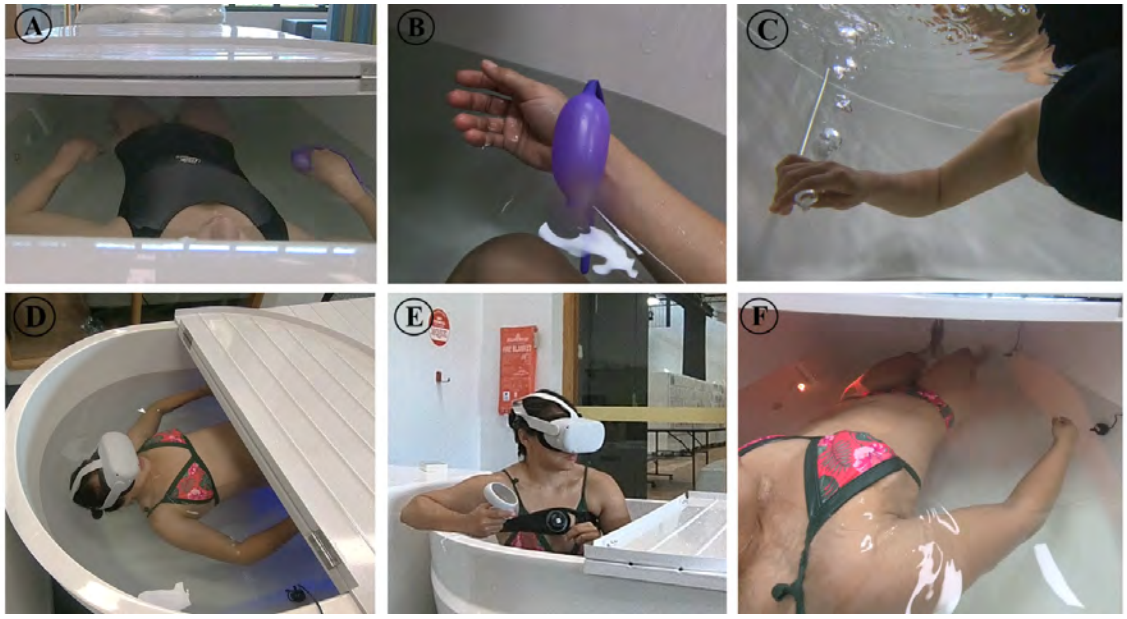

Fig. 3. Stage 3 of soma design – second prototyping session: A) experiencing use of a pneumatic inflatable in the flotation tank; B) experiencing an inflatable around the hand; C) experiencing the feeling of bubbles coming out of a pneumatic system; D) experiencing a VR system in the flotation tank; E) experiencing a biosensor in the flotation tank; F) experiencing water pumps in the flotation tank.

illusions; for example, in water at skin temperature she could not perceive contact with the water. These findings align with theory of feeling the "wetness" of water [20] and what users of flotation tanks reported in other research [6, 31]. Another recurrent perception was the water movement or flow. Swimming in the ocean is different from swimming in a pool because of the waves and currents. Ocean waves made swimming challenging but more fun, because they constantly changed how she moved through the water. This is consistent with the way water sports are seen as challenging tasks [36]. Moreover, feeling currents around her body made her notice how water flows can create haptic experiences over the skin that remind of haptic feedback in HCI. These findings relate to prior research [17, 24, 49] that considered water an active interface. The somaesthetic reflections were particularly useful in regard to these haptic perceptions as the approach encourages designers to reflect on the tactile and kinesthetic qualities of the aquatic environment [32]. Finally, in the flotation tank sessions she experienced how water buoyancy enabled weightlessness and different movement compared to on land. Combined with the sensory deprivation, this triggered different experiences from increased body awareness to the flow of thoughts, as users of flotation tanks already previously reported [31, 59]. Echoing this, prior work has aimed to leverage the feeling of weightlessness to create illusions like floating in space or being underwater [25, 41, 52].

4.2 Findings from the material exploration

Here we aimed to simulate most of the body perceptions that the first author experienced during the body practices and to explore materials that could enrich such perceptions. For example, inspired by the ocean currents, the first author explored the use of water pumps, which gently simulated the ocean's pleasant haptic aesthetics, as proposed in prior work [21, 42]. The perception of sound underwater also drew our attention, since she felt that her body was another medium for propagating sound waves, as if the sound was coming "through" her. Thus, we explored the use of an

underwater speaker, finding different sounds could produce perceptible water vibrations. Finally, exploring buoyant materials helped us understand how they could enhance flotation and lessen any fear of drowning.

4.3 Findings from soma design prototyping

4.3.1 First session. Through experiencing music inside the tank, we found that the sound produced by the waterproof speaker was like a 360-degree audio experience. However, although the Bluetooth connection was relatively stable, the sound turned off when the speaker was at the bottom of the tank, so an underwater Bluetooth connection is not as reliable as previously suggested [19]. In the VR game "Tripp", the scene simulating an ocean made the first author feel transported and relaxed. This is a method of immersion proposed by Vindenes et al. [6, 60] where VR designers match the perception of virtual water with real water. When she played the main game scene, where she had to guide an object with head movements, the game interactions did not suit the visual perspective of lying down and looking upward, losing the sense of immersion and game flow.

4.3.2 Second session. When we explored air pumps, we found that the inflatable around the hand was easily perceptible and she found it easy to synchronize her breathing rhythm with the inflatable's rhythm. This matches other work finding inflatables useful for breathing awareness [27, 28]. Moreover, the feeling of bubbles coming out of the hose was also delightful; the bubbles generated an enjoyable tingling sensation, enriching the experience of floating.

4.3.3 Third session. In the last session, we explored the haptic feedback provided by water jets from small aquarium pumps [4]. Although the first author perceived the water jets only when her hand was close to the pump, the haptic feedback was enriched because of the external deprivation. We also used a heart rate sensor [7] to detect changes in her heart rate while playing the VR game. However, the Bluetooth connection was lost due to the water contact, so we could not transmit the data in real time. Despite this, she continued playing the VR game but noticed she could not perform the extensive head movements needed because it could cause contact between the headset and the water inside the tank Overall, safety was a concern while prototyping. Although waterproof technology can be used, rapid prototyping was easier with tethered technology, which carries an electrical risk. The technology also needed to be salt-resistant since regular pumps are easily damaged by saltwater. Moreover, haptic feedback from water jets and bubbles enriched the flotation experience. Finally, a VR game for a flotation tank must consider the point of view from lying down and bodily interactions are limited because of the confined space, so physiological signals and narrow head movements might be good alternatives for game control.

5 DISCUSSION

According to our results, we hypothesize different UX that can be designed for flotation tanks using a combination of water properties, flotation tank features, and technology, based on the assumption that water can defamiliarize bodily experiences. Defamiliarization was proposed by Schklovsky, who stated that making everyday experiences unfamiliar helps people rediscover sensory perceptions [50]. Defamiliarization has been used in interaction design work [10, 33] games [61] and soma design practices [57] to promote reflection on the self. Drawing from this, we postulate that water can defamiliarize our body experiences. We propose technology can affect this defamiliarization by either: 1) amplifying the defamiliarized experience, making the bodily experience even more unfamiliar; or 2) dampening it, making the bodily experience more familiar (Figure 4). Hence, we can use interactive technology to amplify or dampen defamiliarization in water to provoke critical reflection and inspire new design possibilities. In other words, we aim to use interactive technology to defamiliarize habitual aquatic practices (e.g., swimming and floating) to make them

even more (or less) "strange". To achieve this, we draw from game design and playfulness design as gameplay focuses on experiential qualities and can facilitate engaging experiences in water settings [24, 43, 47]. Play can be elicited by the pleasure and enjoyment that arises from doing activities in a different way [8, 56], linking to the aforementioned "making strange" [10]. Therefore, we propose the following user experiences in flotation tanks could facilitate play.

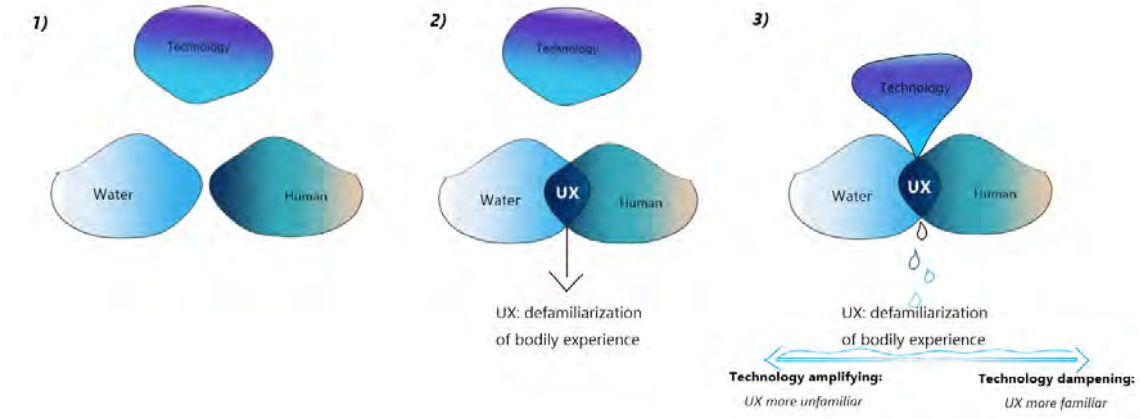

Fig. 4. Human–water interactions using technology. 1) the water, the human, and the technology; 2) if humans have an aquatic interaction, they usually have a user experience (UX) in which water defamiliarizes the bodily experience (compared to more common land-based experiences); 3) if technology mediates the human-water interaction, it can either amplify or dampen the defamiliarization.

5.1 Weightlessness as UX in a flotation tank

Flotation tanks can simulate neutral buoyancy enviroments with a feeling of weightlessness [31, 52], allowing users to float without much effort and have feelings of restfulness and even pain relief from deep muscle relaxation [34]. We propose the salty water in a flotation tank defamiliarizes everyday bodily experiences of gravity through weightlessness, which distinguishes the experience from "everything else in life" [31]. A VR environment could amplify defamiliarization around the UX of weightlessness by showing the user a view of floating in the air. Conversely, this UX could be dampened by reducing the water's buoyancy, for example by adding fresh water. In this sense, the weightlessness UX could elicit play since it is quite different from our normal bodily experiences on land [8, 35, 56].

5.2 Breathing awareness as UX in a flotation tank

Flotation tanks can elicit a breathing awareness experience (BAE), the directing of attention inwards to the breath [46]. A flotation tank can facilitate BAE since it causes sensory deprivation that allows users to hear their breathing, providing an easy way to engage with respiration [6, 31]. BAE is also elicited by the relaxed state often achieved due to the buoyancy that allows muscle relaxation [34, 59] and the pleasant feeling of water [42, 54]. Using technology inside a flotation tank could amplify or dampen the defamiliarization, for example, amplifying it by measuring the user's breathing rate, then using VR to create visual stimuli of breathing particles [44] coming in and out of the user's mouth synchronized with haptic feedback from water jets or bubbles. Moreover, visuals related to water, such as ocean waves and water drops, could be synchronized with the user's breathing to elicit a BAE [26, 53]. Contrasting this, BAE could also be dampened by loud auditory stimuli that distracts users from their breathing. BAE could elicit play since its link

with relaxation gives users the pleasure of relief from stress and tension. Amplifying the defamiliarization of BAE using technology to provide haptic feedback could elicit play since sensory stimuli allow for excitement [8, 56].

5.3 Out-of-body experience as UX in a flotation tank

Flotation tanks can facilitate out-of-body experience (OBE), where a person seems to see their body and surroundings from a location outside the physical body [13]. Users of flotation tanks have reported OBE, describing feelings of disembodiment, such as "I feel like my body is somewhere else, I feel like I do not have a body" [31]. We propose the warm body-temperature salty water in the tank defamiliarizes bodily experiences by allowing for weightlessness and disembodied feelings not easily achievable in on-land interactions. Technology such as VR and water pumps could amplify this defamiliarization in the OBE UX by showing the user a third-person view of their body. In contrast, VR and water pumps could also dampen the OBE, for example by creating a strong sense of body ownership through visual and haptic stimuli corresponding to the stimuli on the user's real body. Play could also be facilitated by allowing the discovery of new body perceptions. Discovery elicits play since it satisfies curiosity [35, 56].

5.4 Altered states of consciousness as UX in a flotation tank

Flotation tanks can also facilitate an altered state of consciousness (ASC) [31], a feeling of perceiving consciousness differently from the way it ordinarily functions [30, 55], in other words, radical changes in thinking and feeling from a normal waking state. ASC in flotation tanks has been described as a disturbed time sense, blurred body boundaries, visual and auditory hallucinations, and a sense of increased thinking [29, 31]. We believe that flotation tanks can facilitate ASC experience mostly due to the sensory deprivation. The warm water blurs the boundary of the body in relation to the wetness sensation [6, 31]. We believe technology could amplify or dampen the defamiliarization of the ASC experience. On the one hand, visual stimulations associated with hallucinations [30] could be displayed using VR and haptic stimuli using water jets could create additional unusual sensory perceptions. On the other hand, dampening could be achieved by playing sounds known to prevent ASC. ASC experience could also lead to play through discovery of a new environment, for example through VR with rules and mechanics different to the real world, such as simulation of slow motion and illusions enhanced with water haptics [8, 56].

6 CONCLUSION AND FUTURE WORK

The preliminary work presented here proposed, for the first time in HCI, soma design methodologies to explore the design of playful water experiences. Moreover, we identified four different user experiences that can facilitate play in flotation tanks mediated and enriched by technology. This offers preliminary insights through a defamiliarization lens, to HCI researchers interested in design of playful experiences in water settings. To explore the user experiences proposed in this work, we will conduct a study next where participants will be introduced to a flotation tank session including technological enrichment and they will be interviewed about their experiences and perceptions. We believe that this study will provide further insights towards a more complete understanding of the how to design playful experiences in water settings.

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