# Designing 'True Colors': A Social Wearable that Affords Vulnerability

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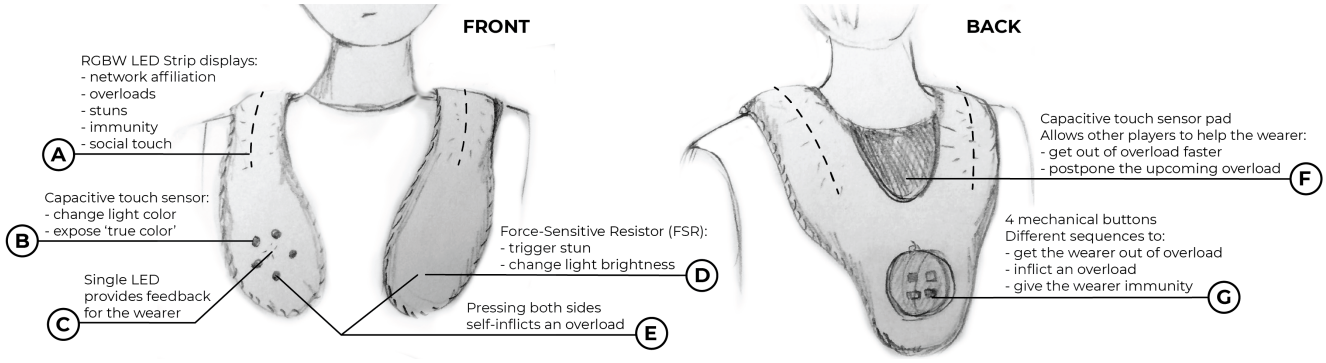


**Figure 1: Final design, including functionalities and hardware components.©Ella Dagan.**

## ABSTRACT

Vulnerability is a common experience in everyday life and is frequently perceived as a flaw to be excised in technology design. Yet, research indicates it is an essential aspect of wholehearted living among others. In this paper, we present the design and deployment of 'True Colors', a novel wearable device intended to support social interaction in a live action role-play game (LARP) setting. We describe the Research-through-Design process that helped us to discover and articulate the possibility space of vulnerability in the design of social wearables, as support for producing a sense of social empowerment and connection among wearers within the LARP. We draw conclusions that may be of value to others designing wearables and related technologies aimed at supporting co-located social interaction in games/play.

## CCS CONCEPTS

• **Human-centered computing → HCI theory, concepts and models**.

## KEYWORDS

Social wearables, wearables, vulnerability, caring, interruptions, Research-through-Design, RtD, LARP, co-located social play, embodied interaction, play-to-lose, social affordances, social touch.

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## 1 INTRODUCTION

Vulnerability is a common experience in everyday life: people deal with uncertainties, risk, and emotional exposure in diverse life arenas– when presenting ideas at work meetings, when engaging in leisure activities, when initiating a new relationship, when having a difficult conversation with a loved one [7]. Such vulnerability may be experienced as uncomfortable or unpleasant, yet research suggests it serves an important function as "the core, the heart, the center, of meaningful human experiences"; a key for wholehearted living among others [7].

Interestingly, vulnerability as a design value is rarely embraced in technology design and HCI. Traditionally HCI has focused more on reducing human vulnerabilities with the notion that "technological innovation could confidently resolve any social issue" [37], and we find "technological fixes" (Winberg cited by [37]) that systematically try to "solve" the vulnerability issue in an attempt at making us feel safe, strong and protected.

In the course of conducting the research described in this paper, we have come to believe that vulnerability may be an important design value to embrace when creating technology aimed at augmenting social experiences in games and perhaps beyond. That is to say, affording individual vulnerability strategically (and of course consensually) may enhance the collective social experience of users of such a technology in a social setting.

Our research group focuses on co-located social contexts, with the aim of designing technology that enhances and supports rich in-person experience. The True Colors social wearable described in this paper was created in a Research-through-Design (RtD) process inspired by prior work on technology co-creation with expert design communities [34, 41]. We worked in collaboration with four LARP (live action roleplaying game) designers, who shared our group's goal of supporting rich collective and in-person experiences.

The end device was designed to help players express personal affiliation, and to support wearers in experiencing and expressing moments of physical strength and prowess, as well as moments of weakness and interdependence. Fifteen copies of True Colors were produced for deployment in a 3-day LARP played by 109 players (approx. 32 hours of gameplay).

In this paper we report on the design process, as well as our study of usage and appropriation of the technology in the LARP. We elaborate on key social experiential qualities [40] our technology supported, and relate them to relevant design aspects. We focus in particular on how the device helped players to engage fully, daring to express and embrace vulnerability, which augmented their social and emotional experience. We believe the results of this research can offer useful insights to others in the CHI community who are developing technology to support co-located social experiences.

## 2 BACKGROUND

Here we focus first on how vulnerability has been tackled in technology design; then, on the design space of co-located social experiences and wearables, foregrounding concepts that heavily influenced our work. Last, we introduce LARPs as the design domain, and a methodological cornerstone for this paper.

### Technology and Vulnerability

An interesting and powerful perception of technology that is inherited from the Enlightenment and is still present today [6] is as an "instrument [...] that makes people's lives better," "as a means that gives people additional powers to get what they want or need," towards "the good life" [6]; This notion of the role of technology focuses on improving health, increasing pleasure, fulfilling desires, in order to help "realize one's potential and perfect oneself" [6].

There are many examples of technology aligned with these ideals. For example, in the domain of fitness and health, commercial wearables such as Fitbit [17] and Nike+ [52], and startup products such as [4] for fitness. In healthcare, wearables have been used to diagnose and offer treatment advice (e.g. [16, 51, 64]). Finally, research and artistic explorations have also explored wearables to improve how people function within the social realm (e.g., [47, 58]).

Contrasting design approaches and design values can offer a different understanding of what that "good life" may be through technology designs that deviate from mainstream's trends. For example, Slow Technology is slow technology: "a design agenda for technology aimed at reflection and moments of mental rest rather than efficiency in performance" [22]. Odom et al. have designed and studied technology that follows this approach [55, 56] .

Regarding vulnerability, while the opposite is an obvious design value in relation to illness, frailty, and lack of capacity to enact one's will, acknowledging and embracing vulnerability can also bring individual and social value. As Brown puts it: "Perfect and bulletproof are seductive, but they don't exist in the human experience" [7]. Alternatively, Brown continues, "we must walk into the arena, whatever it may be [...] with courage and the willingness to engage [...], we must dare to show up and let ourselves be seen. This is vulnerability. This is daring greatly" [7]. Pro-social and emotional behaviors such as increasing trust, communicating positive emotions, and social connection are not only valuable in the personal domain, but could also be helpful in other spheres, such as the workspace [12, 60, 65].

In recent years, the rise of online social platforms, such as Facebook, present a useful example of a technology with rich

social implications. These platforms afford both the presentation of a 'perfect self', toward enhancing social status and belonging, and also, the possibility of sharing vulnerabilities toward soliciting social support and connection through emotional disclosure [62]. The possibility space of social media may be embraced differently by different people: e.g. strategic self-presentation, and big information sharing [14, 67] is often seen in popularity-seeking users; while displaying hidden self-aspects is –curiously– seen among individuals with social anxiety and self-conscious in public [48, 62].

Social media platforms also show the downside of vulnerability: the potential for spreading rumors, for unwanted sexual advances or cyberbullying [57, 76], leading to negative social outcomes such as withdrawal [69]. Our research group has taken lessons from some of the more negative aspects of vulnerability in these contexts, as well as the general design affordances of social media, to help us think well about how best to support the kinds of social experiences that enrich peoples' lives rather than cause suffering.

## Co-located Social Wearables

Wearables are interesting technologies to investigate and design for co-located social experiences. By their nature, they are close to our bodies, and accessible; they are used while on the go, and are becoming intertwined with our everyday actions [54]; intervening, mediating, and impacting our co-located social experiences. Yet, the first wave of wearables neglected much of the social dimension, focusing primarily on personal health data collection (e.g.[3, 15]).

Although we are witnessing an increased focus on pro-social experiences in wearables, so far this work has strongly focused on supporting virtual social interaction (e.g. smartwatches that bring texting and other networked social interactions to our wrists [1, 3]). The co-located social space still remains under explored [41], and at times neglected: like other technologies for physical interaction [42], the impact of wearable technology on the interaction of people in the same space is often overlooked in the design of commercial wearables [41].

There are inspiring exceptions in wearable design, but they mostly remain in the domain of artistic explorations (e.g. [38, 39, 59]) or research proof of concepts (e.g. [23]), and many have not been systematically studied in social contexts. Notable exceptions are found in the domain of co-located social play, where wearables have been used as alternative controllers [10, 32, 66]. For example, targeting the relevant domain for this paper of roleplay games, and inspiring, are Buruk et al.'s arm-worn device [8, 9] and the social wearables by Márquez Segura et al. [41]. The latter designed a pendant and a shoulder pad used to track and display characters' in-game scores. They supported in-person communication (in- and out-of-character), connection with one's character, increased expressivity of the wearer, and out-of-character communication [41].

Here we highlight some concepts from related work and other inspiring designs, focused on augmenting co-located experiences:

*Interdependence.* Design quality of wearables that "require shared attention and mutual awareness, with interdependent functionality that encourages and rewards co-located interaction" [32]. In the context of social play, interdependence led to pro-social behavior, such as working together, relying on one another, and physical contact, which positively impacted the trust, liking, and connection of players [32]. Although coordination towards a joint task is not so much at focus in the work presented here, the pro-social behaviors and resulting social bonding are very relevant.

*Social affordances.* Pro-social behavior supported by design affordances. Social affordances that positively guided prior work on social play in co-located contexts are: i) Shaping of proxemics: the "use of sensors to shape the flow of interpersonal distance (proxemics) in pro-social ways, and guides mutual attention through strategic use of feedback to players" [35]; and ii) Affording individualized performances and social flexibility, which enable "a broader spectrum of social encounters that can build from these individual performances, leading to unexpected performances" [35]. In the domain of wearables for LARPs, key affordances upon which we build come from prior work in that domain [41]: i) Social signaling: "Supporting and augmenting the expressivity and readability of verbal and non-verbal cues" [41] that players may use; ii) Spectator sensitivity: a very similar social affordance but focused on spectatorship; iii) Emotional resonance: "Supporting players to better connect with the physical and emotional experiences of their characters" [41]; and iv) Social appropriateness: supporting players to regulate, and signal the style and type of interaction they consider acceptable.

*Physical social contact.* Social touch has the potential to facilitate existing social bonds between people [13, 18], reflect their emotions [18, 24] and support the creation of new ones [18]. It could affect increased liking of another person and increased compliance [49, 68, 74]. Some of these effects are apparent in projects that use touch as a design resource, including wearables [2, 11, 59]; games [31, 46]; design research explorations [25]; and other areas in HCI [75].

## Research through Co-Design and LARPing

LARPs (live action roleplaying games) are a form of physical games inspired by participatory theater, featuring rich interactive narratives that are played through performance and engagement in the physical world. In a LARP, the game takes place in a physical space that simulates the LARP world

where players embody their characters and physically enact their actions [63].

Many LARPs are politically themed and explore serious personal, cultural, and societal issues [5]. LARP designers work hard to create safe spaces for LARPers to fully engage with these issues in emerging social situations, giving rise to the exploration and experiencing of a wide array of emotions in a highly immersive environment [26]. This is supported by a LARP reality (e.g. the story of the LARP world), preset and emerging narrative plots that unfold as players engage, and the physical and social reality of the LARP [63].

While the social reality is partially determined by the story and background of characters (usually written up in character sheets), the in-game physical reality is strongly shaped by the out-of-game physical space. Hence, in order to support an immersive experience, LARP designers and LARPers pay a great deal of attention to how the physical space is furnished and transformed (e.g. using props) [71].

From a holistic design approach that considers technology together with social and spatial elements [45], LARPs are interesting testbeds to explore the potential of technology designed to support social and emotional co-located experiences [41]. They offer a semi-controlled environment where expected and unexpected situations unfold, mediated and supported by physical objects, technology, the space around, and the social fabric of characters and their relationships. In addition, LARP designers are excellent co-designers of rich embodied experiences. They often employ tech-infused props and costumes [42], which are carefully crafted and curated to support the collective experience of LARPers [42]. This aligns well with our values as technology designers.

## 3 METHODOLOGY

We followed a Research-through-Design approach [19, 78, 79] to explore the space of wearables that augment in-person social experiences. Inspired by previously work [41], we built on the expertise of LARP designers as social experience designers, and engaged in a three-month co-creation process [61] with Event Horizon (EH) [28] LARP's design team. This process culminated in the production of a social wearable prototype, True Colors, the deployment of 13 copies of it in a 3-day LARP event organized by EH, and the study of their usage by LARPers.

## 4 THE DESIGN PROCESS

Our overarching goal was designing a device that enhanced social interaction, enabling the emergence of rich social dynamics between wearers and non-wearers. Early in the design process, vulnerability was not strongly at focus. Rather, it emerged in our field study as an important experiential quality. Here we explain the set of design goals and experiential qualities [40] that guided our design process. In section 8, we will further reflect upon how particular design aspects supported embracing vulnerability, and how this related to our original design goals.

Experiential qualities that shaped our design choices were: Supporting *rich embodied interaction and experiences* of players. From a somatic perspective, the design was meant to feel good on the body, and to affect and be affected by multiple senses (vision, hearing, and touch). It would support multiple types of social interactions, ranging from friendly to more confrontational. It would *reflect and leverage physical and social bodily practices*, such as *social touch* for comfort, and bonding. We built on prior work to augment the social experience of players, and targeted the design concepts mentioned in section 2, including Interdependence [32], and the social affordances in [41] and [35]).

From the perspective of deployment in a LARP, we aimed to make the designs *aesthetically fitting and authentic* [42], since LARPers and LARP designers curate props and technology using this value, in order to support players' immersion [42]. In addition, our design would support an authentic activity– that is, that the player's actions required to interact with the device were identical (or very close) to the in-game LARP world actions [71]. This would increase immersion, and support players to improvise and appropriate the device as they interacted in-game.

### The Design Domain: New Gyr LARP

New Gyr is a sci-fi LARP, part of the EH series exploring life in a fictional galaxy. It is described as an Integrated LARP, a style that balances "story, emotion, and mechanics while emphasizing collaboration and community building" [26]. It is strongly influenced by Nordic LARPs [53, 72], which are typically non-competitive and very character driven. EH supports "player empowerment, character and world immersion," "dynamic stories," and "play-to-lose conflicts" [26]. Playing-to-lose is a technique whereby a player sets out to create better drama by letting their character lose instead of focusing on "winning" [70, 73]. Vejdemo explains it as "[...] a win for the player, not for the character" [70].

In New Gyr, "some players go for a light-hearted and casual experience, while others dive in to politics, drama, and life-altering situations" [27], There are four main human variants (types of characters) in New Gyr: Humans; Evos (humans with altered genome); Androids (artificial intelligent agents); and Augments, which emerged as our target group for the wearable design, during the design process.

Augments are humans who "turned to technological augmentation to improve their bodies" [29]. They are unpopular among "other variants of humans," and are "often looked down on as being low class" and treated poorly, leading to "painful tension between most Augments and other variants of humans" [29]. Humans would become Augments for health or

practical reasons. Their augmentations are extremely expensive and often financed by big corporations, for whom many Augments worked to pay their debt.

To keep their software updated, Augments need to connect to one of the three Augment Networks (AugNets) controlled by three big corporations. The AugNet a player is part of is their community, thus others might make assumptions about their loyalty and political affiliation based off of their AugNet.

### Final Design

True Colors is a Y-shaped wearable that was worn around the upper chest area (front side), shoulders and upper back by the Augments in New Gyr LARP (see Fig. 1 and video [1]). Its internal wire structure makes it slightly flexible, to adapt to different shoulder sizes. While the front interface was designed to be used by the wearer, empowering them to initiate action, the back was designed for others, divesting the wearer of full control. In-game, this could have a positive or negative effect. Here we illustrate this, describing the functions and interactivity of the device, the in-game actions and meaning, out-of-game technical details, and stipulated roleplaying instructions.

*Affiliation and expressive color.* All devices had a 'true color', corresponding to the distinctive color of the AugNet that device connected to, which was pre-programmed based on the wearer's character sheet. By touching the capacitive touch sensors on the front of the device (Fig.1 (B)) Augments could choose to display this color, a neutral color (white light), or any of the other AugNet's colors.

In-game, this would allowed signaling a true, fake or no affiliation. True affiliation (i.e. true color) could be revealed by touching the capacitive sensor for 3 seconds, allowing players to play scenes of questioning the Augment's loyalty and motivations, and even forcing them to expose their true color. The LARP designers stipulated that players could change their true color only once during the game, which in-game would require roleplaying a long and intense scene with researchers participating in the LARP (this requirement was motivated by the fact that changing colors required re-programming the device on-site).

Finally, players could momentarily control the lights' brightness (Fig.1 (D)) by pressing briefly on the left side of the device. In-game meaning of this function was left open to players' interpretation.

*Attacks.* Augments could inflict a 'stun' on others by pressing on the front left of the device (Fig.1 (D)). This would trigger flashing white, yellow, and blue lights and an accompanying sound effect. The LARP designers stipulated Augments had to make physical contact with other players to stun them. A stunning attack would also take a toll on the Augment, increasing their likelihood to break down.

*Breakdowns.* In the LARP world, Augments suffered from inevitable periodic 'overloads' of their augmentations, which incapacitated them. The LARP designers stipulated that these would be roleplayed through significant trouble moving and great pain until the overload was over.

The beginning and end of an overload were signaled with short, sharp sound effects to evoke a sense of urgency and danger. During the overload (4 - 6min) the device would flash in red (similarly to emergency vehicles like ambulances). The frequency of "naturally" occurring overloads depended on the quality of the augmentation (as stipulated in the Augment's character sheet), which was pre-programmed prior to the LARP (each 1.5 - 2.5hr).

The Augment player could also trigger an overload by pressing down both sides at the front of the device (Fig.1 (E)). Overloads could also be triggered by other characters with hacking or mechanical skills. This was triggered by a code input through the keypad at the back (Fig.1 (G)). This code was provided by the LARP designers to selected characters. Clicking on the keypads emitted sounds, which could alert the Augment. Finally, performing stuns increased the likelihood of suffering an overload, implemented through a counter tracking the number of stuns one preformed.

*Healing.* An overload would pass over time, however, others could decrease its duration or even bring it to an end. Social touch (Fig.1 (F)) through skin contact with the capacitive sensor at the back of the device would decrease the duration of the overload, and change the overload's flashing red lights to pulsating rainbow lights.

Social touch was beneficial even at times between overloads, delaying the occurrence of the upcoming one. Augment Engineer characters were given a healing override code by the LARP designers. This could be input through the keypad to immediately shut the overload down. The LARP designers stipulated that this service would have an in-game service charge, which Augment Engineers could waive for friends or as a pro bono gift to other players.

*Immunity.* Very few Augment Engineers were given a special code to provide an Augment with overload immunity for the day. 'Immunity' status was visible to others through rainbow color lights permanently displayed instead of affiliation colors. This procedure had an extremely high in-game service charge.

*Maintenance.* The wearables' batteries had to be replaced every day. Hence, the LARP designers stipulated that Augments would have to seek the researchers on-site for a daily maintenance check.

[1] A video description of the device can be accessed: https://youtu.be/BBAlV4MCY04

### Design Iterations

An extensive review of documentation about this LARP and a first meeting with EH's team revealed potential needs and design opportunities, such as enhancing the narrative and improvisational character of the game, exploring identity and affiliation expression, and supporting individual and collective action, possibly through special abilities.

We built a first Y-shaped collar prototype with simple interactivity, as an aid for discussing and concretizing our design goals with our collaborators. It included several touch capacitors mapped to simple behaviors of a LED array. A front capacitor changed the light color and brightness, and inspired by [32], another capacitor at the back triggered a rainbow light effect.

To encourage *social* touch, we incorporated size recommendations in prior works [41], and designed a big enough pad to accommodate the palm of a hand. This would make this sensor more visible and socially appropriate to interact with than a smaller one [41].

We held a bodystorming session [44] with an EH designer at the site where the LARP event would be hosted. During this session, two new play mechanics emerged: showing and disguising affiliation/identity using the lights; and triggering uncontrollable breakdowns. The latter mechanic was very fitting to a particular set of characters: the Augments, which then became the target group for the final device. Other design modifications emerged from this situated exploration, such as including sound effects for more legible feedback, and bigger, robust, and flexible prototypes that fitted on top of warm jackets (the site was often foggy and cold) and adapted well to dynamic actions, like fights.

These insights were reflected in a second prototype, which included the *overload functionality*. We revised the social pad at the back, to decrease the duration of the overload. We also added a keypad at the back to trigger instant overloads. In a subsequent meeting with EH held at our lab, we used embodied sketching [43] to enact potential use scenarios, and possible interaction mechanisms. Among possible default triggering mechanisms for the overloads, EH selected the use of a timer. Two of the prototype's mechanics inspired interesting scenarios: social touch to prevent or alleviate an overload; and specialized skills actions on the device, such as fixing or triggering overloads. This inspired a new specialized action, the stun attack mechanic, which aligned well with the Augments' backstories of heightened physical skills.

We implemented these changes in three models and tried them out in an HCI graduate class, resulting in ideas for final polish of the interactions. Finally, in preparation for the LARP event, we created 15 prototypes of the final design (see Fig.1), which were customized with the help of our LARP designers to match the specifications in each Augment's character sheet regarding their affiliation color, and quality (frequency and duration of overloads).

## 5 USER STUDY

We deployed 13 True Colors wearables at the LARP event, attended by 109 people: 91 players (13 Augments, wearing our devices), 15 non-player characters (NPCs/staff), and 3 of us. Self-selected pronouns of participants on record were: 33 he/him/his; 39 she/her/hers; 13, they/them; 2, she and they; and 1, ze. The LARP event took place at [50], using three buildings and open spaces; it lasted 3 days (approx. 32hr of gameplay). LARP workshops, held each day prior to gameplay, allowed players to practice LARP techniques and develop their in-game character and relationships.

### Players' Briefing

EH recruited and communicated with their participants in their usual means, including social media. Prior to the LARP event they announced our involvement in the LARP and shared on social media groups pictures and description of the True Colors, including their functionality and in-game use. Prior to the LARP, each player received a customized character sheet detailing their character's story, and in-game relationships with other characters.

In the Augments' character sheets and other players strongly connected to them (e.g. Augments Mechanics) in-game use of our designs was specified, including codes for those with hacking skills. On-site and prior to the game, the EH team presented us and our out- and in-game roles to attendees.

All players signed participation consents for our study and all except two agreed to be filmed. On-site and before the LARP started, we held a briefing session with Augments and players with close connection to them, to explain and demonstrate the designs' functionalities, hand out a leaflet summarizing these, and answer questions.

### Documentation

We used three strategies to document the event. First, on-site observations: field notes, and video recordings taken by us in-character, i.e. playing the role of technologists-scientists doing augmentation maintenance and research, which allowed us to engage in in-game actions similar to our design and research needs; and players to experience our actions fitting to their LARP world.

Second, we conducted 18 semi-structured interviews (I1-I18) with the 13 Augments and 5 other players who had interacted significantly with the device, some of which took place in small groups, at players' request. Interviews lasted approx. 20 min and focused on: 1) questions about the device (e.g. "what did you think about the device?") ; 2) notable situations experienced around the device (e.g., "what interesting

interactions did you see happening in the game between players around the device?") ; and 3) the impact of the device (e.g. "how do you think the device impacted social interaction and social experiences, if at all?").

Last, after finishing the LARP, we invited all players to fill in a 15-question survey on the same topics, collecting 72 responses (P1-P72). This data was thematically analyzed by three researchers (two of whom participated in the LARP).

## 6 RESULTS

Of those who filled out the survey, 57 players reported interacting with True Colors directly; 12 saw or had little interaction with it; and 3 did not see or interact with it. All the devices worked well, except for one: environment humidity and perspiration accidentally triggered the capacitive touch at times, displaying rainbow colors. The devices consumed less battery than expected (requiring only one change of battery), and did not need technical fixes, except those requested by the LARP designers and LARPers to fit their drama.

Most participants liked the look and feel of the device, commenting they were "intuitive to use" (P25), "remarkably comfortable" (P35, P68) and generally "good for many people of all body types"(P61) – only one device was slightly too small for a player with wide shoulders. The lights worked particularly well indoors, and outdoors at night; they were less visible outdoors in the direct sun, a situation in which sounds were appreciated. Many praised the aesthetics of the design, described as "cool" (41 mentions), making Augments appealing, "shiny and awesome and special" (P11), despite their backstory, which presented them as outcast: "I'm jealous of how cool it looked and wanted to hang out with the wearers in the game" (P11).

Regarding the functions and interactivity of True Colors, interestingly, players did not use the stun function much (3 instances reported); nor did anyone report hacking and inflicting an overload on another player; nor being forced to expose their true color. However, participants embraced the overload function, some changed affiliation colors, and one player asked us to change their true color in-game, which we roleplayed to reprogram the device.

The open-ended expressive brightness function was only occasionally used. I4 reportedly used it "a few times in-game to indicate mood swings or changes in behavior from normal personality;" other participants used it non-diegetically, i.e. for off-game purposes [42], as a flashlight at night, or to check that the right colors were on (e.g. outdoors during the day).

Next we describe the main **themes** that emerged from our analysis, with illustrative selected responses.

### Interactable (16 responses)

The designs were perceived as interactable [36]: "they felt like a thing that I could interact with for real [...], causal in a way [...], like a device that could be used and was meant to be used" (I18). They supported players to interact with one another: They "greatly facilitated me having social interactions [...], be more in the game, meet people, and interact" (I7); "gave me many opportunities to interact with characters I would not have interacted with otherwise" (P71). Not only they "gave a reason to interact" (P17, P68) with others, but they also allowed players to interact in a way that was relevant to their characters.

These interactions were often not directed towards the technology. P31 explained that the devices "increased possibilities for interaction" because "identifiable Augments also meant that people interacted with them differently even if they weren't directly interacting with the technology first," which leads to the following theme.

### Supports Identity Affiliation (38 responses)

Our devices "were easily visible and 'othering'" (P49), giving "a consistent look to a subset of characters" (P59). Wearing our devices allowed participants to "instantly know who were Augments" (P64), which they liked: "No one ever had to ask (in- or out-of-game) if someone was an Augment" (P35).

The devices worked well to signal the AugNet the wearer was affiliated with, and contributed to the players' awareness of, and impact in the in-game political climate. P3 reflected on how players progressively took sides and displayed it: "I loved on the first night noticing that everyone was set to neutral and seeing that change over the weekend."

In-game, only a few selected Augments had the Immunity upgrade (displaying a static rainbow color; Figure 2), who were easily identified: "the devices were markers of status for those with rainbow 'immunity' from the overloads" (P66); which was considered by players to interact with them appropriately: "we could respond to their social status" (P63).

### Enhanced Scene Building (33 responses)

The devices "made play more interesting for many players" (P35), giving players "a way to interact with the scene in a new way" (P31). Some "witnessed multiple players using it to build scenes" (P51), some of which built up on specifically designed functions of the device, like the overloads. E.g. P21 "saw several players glitch [overload] in important scenes, changing the scene's gameplay and interaction."

Players also *improvised around the interactivity* of the device, like I4's usage of the lights to indicate mood swings reported earlier. We found ourselves using the sound that the keys made to roleplay maintenance scenes when characters came to change their batteries. We believed these sounds gave a sense of causality and helped them -and us- immerse in the scene at hand.

Players also *came up with incredibly dramatic scenes* involving their augmentations. For example, two players decided to


**Figure 2: The wearer on the right has their device color display Immunity mode.©Event Horizon.**

overload together in a dramatic scene involving augmented strength "we decided if we did that [using their skill] we were immediately supposed to trigger an overload" (I16).

On another occasion, a Human and his Augment friend requested that we implant an augmentation in the first. Off-game they asked if we had another device, which we did, and suggested to roleplay this situation as an illegal surgery in which we would transplant bits and pieces of the Augment's augmentation to his friend, which would result in two augmentations of lower quality than the original (i.e. more frequent overloads). In-game and prior to the surgery, we were paid a substantial amount of in-game money. We then "operated" on both characters while they sat side by side. We programmed the devices according to their new quality specs, and used the keypads to roleplay surgical maneuvers, to which they responded in agony.

### Uncontrollable Timing (31 responses)

The overloads were described as "causing a lot of interaction" (I5), and were perceived as unpredictable, random, and outside player control, which added a layer of excitement. E.g., P59 reported that he "was having a conversation and another player went into overload across the way. I really appreciated the randomness of overload." I16 added that "there were a lot of these kinds of spontaneous plotlines that just erupted as a result of the device doing something."

The overloads were really liked and embraced, and the favorite feature of many: E.g. I5's "favorite part of the device was the sudden, like unpredictable overload;" P71 added that it "allowed players to react to forces outside their control," which "added to the drama" (P68), "made play more interesting" (P35), and notably contributed to players' experience. They described them to happen at the worst possible times (for their characters), which was extremely well-fitting (for the players): "it seemed to pick really bad times to overload which is story appropriate [...]" (I5).

This helped them develop and experience "a lot of interesting moments. We tended to [overload] at the most inopportune moments" (P16). Some players commented this timing felt "perfect". E.g. I3 explained a deep emotional scene of "really good timing, I don't know why it's probably just coincidence [...] Saturday night I had a fun intense scene with two characters, sort of dark secrets coming out and emotions running high and I overloaded part through that scene and the timing was absolutely flawless, it was amazing."

### Encouraged Caring (55 responses)

Overloads were frequently easily perceived; they elicited strong emotional experiences and reactions from players. I6 explained them as "a very good mechanism to ensure that [having big feels] happened, both on the receiving care and the giving side;" and P7 as "powerful moment(s) that brought players together to comfort each other." Interestingly, P15 framed that as **vulnerability**: "it was vulnerability, [the device] more materially represented [the] character's struggle."

Players discussed the experience, and response towards this manifested vulnerability from three perspectives. Augments enjoyed *asking for and receiving care.* P17 commented that the device complemented their roleplaying, which ranged from agony cries to crises more stoically suffered: "it really helped to get other players to pay attention to me, especially during overload." I7 added that it "helped me feel immersed and to feel important and special, and to help me initiate contact with other players."

Despite Augments embraced overloads, they were not observed triggering them. Only two cases were reported by players: in the first, two players triggered their overloads together to create a bonding scene (described in the Enhanced Scene Building theme); in the second, an Augment triggered an overload to allow another player demonstrate their in-game healing power.

Players positively talked about the social appropriateness of the device [41]. I14 commented: "I think the back mechanic is awesome [...] If you're coming in to help it's kind of a pre-negotiated consent mediated by the device [...]. Pat me on the back it's comforting." Design choices players praised were the location of the capacitive touch pad, its well-defined area of interaction, and its (palm) size.

From a spectator view, *watching others being cared for* was noted as a very valuable emotional experience: "seeing augments being soothed by friends was really touching" (P58). Players "enjoyed hanging out with random augments and seeing others help them when they overloaded" (P6).

Last, the wearable encouraged *caring for others*: "it encouraged me to worry for my augment friend" (P29). Caring

strategies included monitoring the frequency of the overloads; seeking help: "find someone to care for them when they overloaded" (P29); and using social touch: "on several [many] occasions I had to soothe her out of overload" (P72); "when it went into overload, we helped her via the 'soothing' pad" (P43). These situations were often described with feelings of acceptance, bonding, compassion, and fulfillment, allowing "characters feel useful in helping augments overcome overloads" (P25).

Players profusely reported on, and we abundantly observed, the urgent care reaction overloads triggered on co-present others. I6 reported that "if something is going wrong with somebody else's Augments there are usually five other people close at hand who really really want to be helpful." This extended to in-game enemies: "I overloaded right in front of him [an enemy] and he helped me out and there was a plotline there that we never followed through but it immediately made a friendship" (I16).

The power of the overloads as a visceral help trigger across human variants surprised players and us alike, given the poor treatment they would normally suffer, according to New Gyr's backstory. I13, an Augment, reported that "people have been nice" and elaborated: "no one was like 'oh it's one of you Augments... haha I hope you sit there and never feel better'". P16 added that "many characters with the overload code would spontaneously help an Augment in need," and "we made more friends as a result than we expected."

The trigger to help frequently overrode monetary interests of Augment Engineers involved, surprising players and us alike. In-game it was customary to pay for goods and services, such as medical or engineer treatments, like deactivating overloads. But players reported rarely noticing anyone asking to get paid for that service. I7 commented: "a lot of times they [Augment Engineers] insisted that I won't try to pay them." I17 added this "seemed to be a pretty common thing, just giving it out [for free]" and "people were super cool about [helping with overloads]". We were occasionally asked to deactivate an overload and completely forgot to ask for money.

The social practices of caring that the overload supported, and their impact were deeply enjoyed. I8 commented "the social caring aspect" was "cool and I really enjoyed playing with that"; "what it added to my game I actually thought was significant." Overloads offered players the opportunity to help in different ways: shortly in urgent situations: "people could quickly jump in to help so I think it makes it to a nice short and easy encounter with somebody" (I1); as well as continuously through a caring routine: "a kind of repetitive training to help your friend. It helped that 'oh my friends need help, and its not their fault'" (I2). Many developed unexpected relationships over time: "Octavius and I really bonded a lot over just that simple back rubbing that was necessary to fix the overload. And over time Octavius went from being a test subject to much more of a friend that I think my character was expecting" (I16).

## 7 SUPPORTED EXPERIENTIAL QUALITIES

In this section, we first revise the experiential qualities [40] that shaped our design choices, and then focus on that of vulnerability, which our players embraced during the LARP event.

With our co-design experts, we created a wearable that was *aesthetically fitting* [42] to the LARP's narrative and world mechanics. They materialized and made visible technology implanted in human variants, the Augments; as well as existing in-game phenomena and off-game mechanics, like the overloads. This positively impacted the immersion of Augments and other players.

Our True Colors devices supported players to engage with *authentic activities* [42], e.g. an in-game soothing caress would reflect in a more tolerable physical crisis (decreasing its duration). Regarding *the embodied experience of players*, the affordances and interactivity of the device supported players to engage in an embodied type of pretence play, coming up with, feeling immersed in improvised scenes that were not necessarily designed for.

Our devices were reportedly responsive to and impacted multiple senses; and experientially *supple* [33], foregrounded the moment-to-moment experience, and the emergence of social dynamics, from friendly (e.g. healing) to unfriendly ones (e.g. attacks). Players particularly engaged with and enjoyed the former; from short good-natured encounters, to continuous caring protocols. Regarding *embodied cultural practices*, the healing mechanic leveraged well the social practice of caring for another through physical contact. This was the favorite feature of many players and we focus the next subsection on how players embraced vulnerability together and enjoyed caring for one another.

### Embracing Vulnerability

Our devices offered Augments (as players, and as characters) opportunities to initiate action and take control of situations they were involved in. E.g., characters could decide to express/disguise affiliation colors, or stun someone. They could also decide to let their characters "take a hit" and suffer an overload whenever they chose by triggering it, which aligns well with the concept of playing-to-lose [73]. Yet Augments did not exploit the stun attack function nor reported cases of being forced to expose their true color.

While the stun function was barely brought up, the overloads and social healing functions were very frequently mentioned as the players' favorite aspects of the device. Augment characters chose to embrace vulnerability over power and control as resources to co-create interesting co-located social


**Figure 3: The wearer on the right has their device color display Immunity mode.©Event Horizon.**

interactions. Far from being perceived as a burden to players, vulnerability was understood a source for meaningful personal and social experiences.

Given that overloads were such a powerful resource for supporting collective experience, we were surprised to find that, except in two situations, players did not mention using the overload's trigger. Instead, they valued overloads as they came. We relate this to the observed visceral reactions of those witnessing overloads. Players quickly jumped in to help those suffering overloads, despite stipulated in-game animosities, or in-game personal feuds. Players readily soothed Augments in overloads, and prioritized getting them out of their suffering over their own economic interest.

We argue that this influenced, and may have been influenced by, others' perception of the overloads as outside the control of the Augment; as I2 put it, it was "not their fault". Given the visceral reaction of others, perhaps Augments restrained from triggering the overloads so to not "abuse" others' poignant reaction. Had they triggered overloads more often, others' readiness to help might have decreased. We can only speculate.

Yet here we argue that Augments and other characters alike embraced these moments of vulnerability as they came, often at the characters' worst possible times, dictated by an external (i.e. in-game internal) force: "their augmented bodies." Although Augment players embraced a certain lack of control over these situations, choosing not to trigger them, we argue they did not ultimately experience them with total lack of control.

First, they could decide how to roleplay these overloads, augmenting or decreasing the sense of urgency of care they needed. Second, they counted on co-present others, to whom they momentary transferred control, and with whom were overcame the overload. This brought about emotional situations, and ultimately, players together, developed bonds and strengthened relationships. This resonates with literature on vulnerability. "Our willingness to own and engage with our vulnerability determines the depth of our courage and the clarity of our purpose" [7].

Vulnerability is the catalyst of compassion and human connection, and ultimately meaningful experiences and a meaningful life [7]. When roleplaying overloads with expression of pain and showing lack of control, players were "daring greatly," [7], having the courage to expose their weakest selves to others. They risked being unattended and cast away, as New Gyr's backstory dictated, suffering this painful situation on their own. This is not what happened.

Other characters came to their help and Augments welcomed this help. Augments trusted others would act with compassion, they trusted others would work towards mitigating their pain, and they trusted others would respect their boundaries. This is what we observed and were told happened, resulting in feelings of acceptance, compassion, connection and belonging, and the development of strong bonds and relationships, often unexpected and against all odds.

## 8 DESIGNING FOR VULNERABILITY

Although our wearables fitted well with the LARP narrative and supported in-game phenomena, like the overloads, they unexpectedly changed the perception of these phenomena to in-game characters. They triggered a strong and unexpected call for action, and care for other players, overriding animosities across human variants stipulated in Ney Gyr's world, as well as in-game personal feuds. It ultimately changed the characters' perception of Augments, their augmentations, and the overloads. Albeit this was not an intended design goal, players (Augments and others alike) embraced this unexpected phenomenon. It brought characters together and helped them bond and develop relationships, which was appreciated by players.

In this section, we relate the original guiding design values and key concepts that inspired us, concrete design aspects, and our empirical results related to the experiential quality of embracing vulnerability. We present these insights grouped under key design strategies to support vulnerability, which served us to reflect on the project, and can have the potential to inspire others designing social wearables in the domain of LARPs.

### Supporting 'Big Feels'

The device overloads evoked strong reactions through design features such as sound effects and flashing red lights, prompting wearers to play out and feel immersed in a breakdown situation, demonstrating an *emotional resonance* affordance.

They also demonstrated *social signaling* and *spectator sensitivity* [41], when amplifying the expressivity and readability of Augments' signs of pain, attracting attention of co-present others, and triggering an instant help response in those emotionally close and not so close to the Augment.

Similarly, the healing function of the device had a dual affordance of *emotional resonance* and *social signaling*. From the perspective of the player engaged in *social touch*, the soothing pulsating rainbow lights resonated with their desire to help and their feelings of sympathy and compassion. From the Augment's perspective, these lights worked to express the kindness and warmth of the physical contact, and its therapeutic effect. The change in the light color from flashing red to pulsating rainbow worked well to represent bonding, and the soothing effect of physical contact.

Additionally, the therapeutic impact of this contact was reflected in the design decreasing the duration of the overload. Hence, the lights resonated with the bonding experience of those involved, which, from an audience's perspective, magnified an already emotionally moving scene, showing *spectator sensitivity*. Visibility from a first, second, and third person perspective was essential to have an emotional impact on the Augment, the respondent, and the audience.

From these results we suggest that designers consider the social and performative impact of light and sound colors and patterns in social technologies, as well as the potential of appropriate social touch.

### Supporting Authentic Self-Presentation

Although Augment players could trigger the overloads, they chose to let their wearables decide when these moments of crisis happened. We relate this to an accurate representation of the quality of the device. With the help of our LARP designers, we programmed the wearables to manifest various qualities (frequency and duration of overload) that matched each Augment character's sheet. We interpret the fact that players didn't trigger overloads as a sign that they found the externally controlled timing of the overloads fitting with their character; supporting an authentic character presentation.

As this is congruent to the strong links between vulnerability and authenticity, we argue that players chose to present their character's authentic self. This may have influenced the general perception of overloads as non-voluntary; "no one's fault". From a roleplaying perspective, acting upon an externally controlled stimuli instead of a personally controlled one can help the player better roleplay an unexpected scene and better connect with their character's experience (*social signaling* and *emotional resonance* affordances).

From these results, we suggest that designers consider ways to accurately and appropriately (consensually) signal aspects of a person's authentic state to others, toward enhanced social interaction and mutual support.

In addition, overloads were interpreted by players as authentic to their situations, i.e. well timed, feeling right for the situation, and 'magical.' We relate this to the unpredictability of the overloads and to the design quality of *ambiguity* [21], i.e. the fact that the cause of an overload was left open to interpretation, including the quality of the augmentation, their use of specialized skills, or being deeply engaged in an intense emotional experience.

From these results, we suggest that designers consider including strategic elements of ambiguity in social technologies, allowing for collaborative interpretation and story building among those supported by the technology.

### Overcoming Difficulties Together

The device provided specific mechanisms for social exchanges, with clear indications for how and when to act. Vulnerability was embraced not as a situation of complete lack of control, but instead as a situation that could be controlled with the help of others. Our devices provided a specific mechanism to offer co-present others the opportunity to express their compassion and kindness and alleviate the situation of the wearer: the social touch function, which was easily accessible to and easy to trigger by others through a clearly marked, and well delimited area of action–the capacitor touch pad at the back. Our device also signaled when others should immediately act by providing audio-visual feedback during an overload. Last, the device provided clear feedback from the social touch by changing to pulsating rainbow lights. The interaction happened at a social level; it brought people together and encouraged them to connect.

From these results, we recommend that designers consider providing well-demarcated and bounded opportunities for people to help one another in using social technologies, to encourage cooperation and collaboration.

### Information, Choice, and Consent

Aspects of appropriateness, approval, and consent are important when designing technology that is worn on the body, that supports close physical contact, and through which users embrace vulnerability. These aspects were specifically addressed by design, both of the LARP event, and our wearable. Regarding the former, the LARP organizers and LARPers worked hard towards jointly creating a safe LARP event, e.g. in workshops through meta-techniques to help players let others know their boundaries.

As for our designs, players using them were informed about the device's functions, interaction modality, and interactivity of the device prior to the game. These formed part of the magic circle of play [30] that these players voluntarily accepted when agreeing to participate as Augments, as reflected in the interviews. In-game, Augments could revisit this agreement, and modify the *social appropriateness* affordance [41] accordingly.

They could – and some did – wear clothes on top of the device, remove it at any time or use LARP meta-techniques (e.g. hands signals learned during the workshops prior to the LARP) to help other players regulate their interactions. Regarding the wearable's design, the body position and the area marked for social touch were considered to be socially acceptable [77].

Design qualities mentioned to increase appropriateness and acceptance were the delimited area of interaction, and social touch without direct skin contact, including material qualities such as the "puffiness" of the device.

Regarding choice, Augments could decide to trigger an overload, and how to roleplay them, which would impact how others perceived a call for help. Other players could also decide if and how to respond to overloads. By design, any type of contact with the back's pad, and of any duration, would positively impact the overload. This resulted in diverse kinds of interactions, from brief to longer social encounters. Also, others who wanted to support an Augment during their overload could call for more help from the knowledgeable character players (Augment Engineers), who could input a code to immediately stop the overload.

From these results, we recommend that designers carefully take into consideration how affordances and the frame of engagement around social technologies can build a safe space of engagement for those who use the technology.

## 9 CONCLUSION

We designed and then tested True Colors, a social wearable meant to augment co-located social interaction in a LARP context. The final design worked well within the LARP narrative and world mechanics, supporting valuable social interactions among players. To both the researchers' and the LARP designers' surprise, players eschewed the more combative possibilities of the wearables, instead focusing on the opportunities that the devices afforded for engaging in collaborative, supportive social encounters. By gravitating towards using breakdowns and healing functions, the players emphasized the social value of experiencing vulnerability together.

This paper extends previous work on wearable technology in LARPs [41] and includes key components that supported embracing vulnerability, including supporting emotional resonance, social signaling, and spectator sensitivity (e.g. of moments of weakness); supporting authentic self-presentation and choice; and supporting overcoming difficulties together (e.g. through social touch). Although our insights are limited to games/play (particularly similar forms of LARPs), it validates previous works on social affordances for LARPing [41] and in games and play more generally [35]. Our results together with these works point to the value of social affordances as good guiding design concepts that provide a fruitful level of abstraction and concreteness. Similarly to experiential qualities [40], they focus on user experiences, yet explicitly referring to and evoking social ones. They are also concrete enough to relate to properties of the technology, such as its functionality, interactivity, and (technology) affordances [20].

Vulnerability has been researched and established as valuable positive and valuable from an emotional and social point of view [7]. Here, we add to that work relating vulnerability to valuable experiential qualities, design concepts and features (social affordances), which provides a good starting point to extended design work to support embracing vulnerability. Also, our observations of, and data from, players embracing vulnerability through wearables adds to previous empirical data substantiating and illustrating the value of embracing vulnerability [7]. Last, our strategies to design for vulnerability resonate with previous research insights of those who live fully through embracing vulnerability [7]: they cultivate authenticity (Supporting Authentic Self-presentation); "dare greatly" to live "wholeheartedly" (Supporting 'Big Feels'); do so together (Overcoming Difficulties Together); and do so by choice (Information, Choice, and Consent).

Rather than always being a flaw to be excised, strategic vulnerability has the potential to also produce a sense of social empowerment and connection. Although the results presented in this paper were obtained within a LARP setting, the design and reception of these wearables reveal an interesting niche for wearables that might inspire others outside the realms of play.

Still, how one designs for vulnerability beyond the magic circle of games remains unclear. We see the design instance presented in this paper as a first exploration of many more to come. We encourage other designers of technologies in HCI to explore new paths that engage people with one another to create deep social connection, and consider the potential value of designing for (appropriate) vulnerability.

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