

Don't Hit The Wall, Just Squeeze The Ball: How Tangible Interactive Devices Can Help Manage Frustration In Online Games

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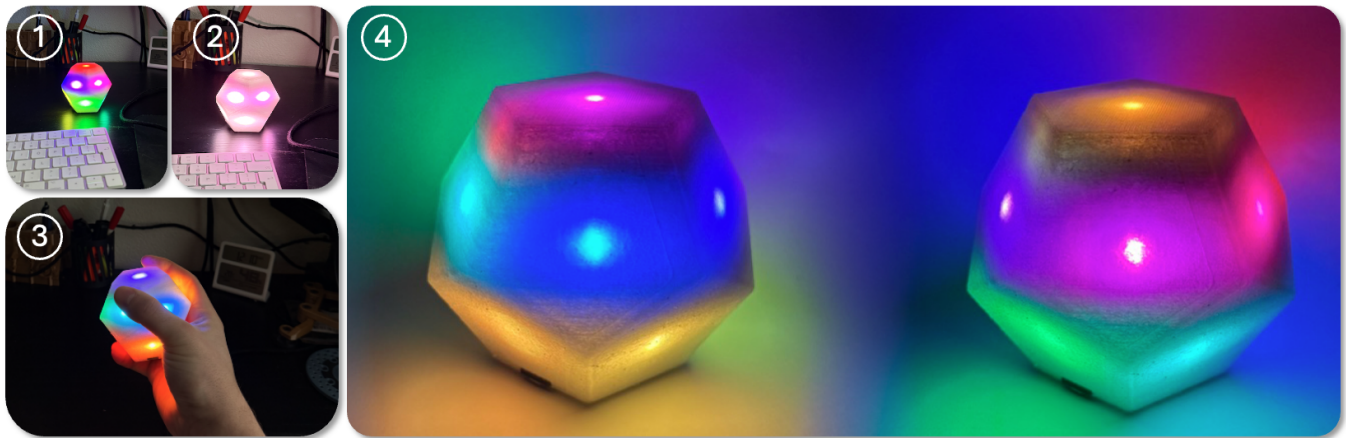


Figure 1: We present *Frustration Buddy*, an interactive stress ball that interacts with the game, triggering distraction and soothing when necessary to help players manage frustration from playing online games. Above, we show four examples of our system: (1) *Frustration Buddy* uses soothing lights while idle; (2) *Frustration Buddy* blinks to get the attention of the player; (3) the player interacts with *Frustration Buddy*, reducing their frustration; (4) close up of the device and its soothing lights.

Abstract

Frustration in games can have negative consequences for both players and those around them. Despite these effects, methods for supporting frustration management in hectic gameplay are scarce. In this paper, we present *Frustration Buddy*, a novel tangible intervention system aimed at managing frustration during play. *Frustration Buddy* leverages distraction and soothing techniques to help players control their emotions. Our paper provides an artifact contribution, complemented by exploratory findings from semi-structured interviews with nine participants on frustration in games, how they manage it, and their opinions on *Frustration Buddy*'s design and applicability in their gaming environments. The results suggest participants were open to the idea of a device supporting frustration management and that the use of a tangible device like a stress ball was well-received. We provide insights on how to design

such a device based on our design decisions and the preferences expressed by the gamers in our interviews.

CCS Concepts

• **Human-centered computing** → **Haptic devices; Collaborative and social computing**; • **Applied computing** → **Computer games**; • **Software and its engineering** → **Interactive games**.

Keywords

frustration, online games, distraction, soothing, light and sound signals, coping, emotion regulation, toxicity

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1 Introduction

In online games, players often experience stressful and frustrating moments. The competitive elements that make these games



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engaging, exciting, and challenging also have a downside: they can make losing or even small setbacks feel frustrating. When players experience unfairness, feel disconnected from their teammates, or experience repeated failure, their frustration can quickly build up [6, 22]. While not always problematic and sometimes part of what makes games enjoyable [22, 31], such frustration can also lead to a wide range of negative outcomes, such as diminished enjoyment of play or the hobby in general [36]. Research found that need for frustration in games has been associated with problematic gaming, escapism, stress, and exit intentions [36]. Further, frustration is often associated with and mentioned as a cause of toxic behaviors in games [33–35, 62, 66]. Such toxic behavior is highly prevalent in online games and is harmful for those involved [9, 24, 38]. Multiple surveys have demonstrated how common toxic behaviors are in games. Between 2021 and 2023, on average, four out of five adults experienced harassment while playing online games [3–5]. Prior work on toxicity interventions found that many interventions focus on punishing undesirable behavior after it has already occurred [64, 65], with a gap in proactive systems that prevent toxicity before it happens. Frustration is often named as an important cause for toxic behavior [33, 34, 62, 66, 68]. Therefore, addressing frustration before it can result in toxicity may be a valuable approach for combating toxicity rather than trying to mitigate its effects.

As such, it is evident that it is important for players to manage frustration before it escalates into more severe consequences, both for the players themselves and for those around them. However, this is not always easy. Research on coping strategies and emotional regulation describes mechanisms that can be leveraged for managing frustration [16, 27]. Examples include the use of distraction to shift focus away from the origin of frustration [27] and the act of self-soothing to reduce anxiety and frustration levels [8, 49]. The problem is that, currently, there are no effective solutions to support frustration management for players in games. Beyond the lack of emotion regulation support, we do not even know which situations in games cause frustration and how players regulate their frustration. Even in competitive gaming contexts like esports, Kou and Gui [37] found that emotion regulation is a critical skill, but players need time to find strategies that are effective for them personally to manage their frustration during play.

In this paper, we present *Frustration Buddy*, a novel, tangible, and interactive system that helps players manage their frustration during online play. With this paper, we provide an artifact contribution, and support it with an exploratory qualitative user study with player interviews, investigating the participants' opinions about the concept of *Frustration Buddy*. *Frustration Buddy* combines the soothing properties of self-generated touch through a stress-ball-like shape and squeezability with distractive capabilities through light and sound signals. It aims to channel frustration towards the device so that it does not result in negative effects on the player or harm to others in the online environment, such as through toxicity. *Frustration Buddy* is envisioned to integrate with games and trigger its frustration management capabilities based on in-game conditions. This integration is not implemented, as our user study was required as a first step, e.g., to understand what appropriate trigger conditions are. By providing a way to vent frustration during play, *Frustration Buddy* prevents the build-up of frustration and the negative effects associated with it. Through exploratory

semi-structured interviews with nine participants, we investigated how players generally experience and manage frustration in online games. Then, we conducted an interview study assessing how the participants feel about *Frustration Buddy* as an initial exploration of their attitude towards having a tangible device for frustration management in their gaming environment. We used the interviews to better understand how design choices for a system like this can enable it to be an effective intervention.

Our findings demonstrate that players experience frustration often and that emotion regulation is considered difficult. Players expressed that they had experience with frustration building up during their play sessions and that they are familiar with (and have engaged in) negative behavior that often follows. One interesting observation is that players often do not like engaging in this behavior and often feel remorse after. However, as they have no effective way to relieve their frustration, they struggle to control it at times. This highlights the need for effective proactive intervention systems. In line with these findings, our participants were positive about the frustration relief that *Frustration Buddy* could provide and provided useful feedback for improving the design, like less focus on sound signals, more calm light signals, and the desire for personal customization.

Our paper provides an artifact contribution focused on the design and technical prototype of *Frustration Buddy*, a system focused on supporting players in frustration management during play. We provide exploratory qualitative insights into frustration and how players control it. Further, we found that participants were generally open to the concept of *Frustration Buddy* and its use for frustration management, while there are concerns about interruptions at the wrong time. While further evaluation of *Frustration Buddy* during gameplay is necessary, our work provides an initial step advancing current knowledge on tangible systems for emotion regulation in games and preventative intervention systems. In particular, our work enables further development of this underexplored area of intervention systems research.

2 Background and Related Work

To situate our work, we discuss frustration in games and its effects, as well as foundational concepts on which *Frustration Buddy* builds in emotion regulation, coping, distraction, and self-generated touch. We further provide an overview of similar systems in prior work.

2.1 Frustration in Games

Game developers often include elements of challenge, difficulty, and the risk of failure in their games [22, 31]. While these elements are great for creating engaging environments for gamers, they are also a source of frustration. For example, the game *DayZ* has a feature where once a player dies, they lose everything they worked for, including their character and their equipment. This concept of permanent death (permadeath) was investigated by Allison et al. [1], who found that, while players do not necessarily enjoy permadeath, it adds to the sense of challenge and enhances the overall experience. Challenge on its own does not necessarily cause frustration. Even failing at a challenge or frustration in general does not have to be problematic and is a core aspect in many games. As proposed by Juul [31], failure is an essential part of games, and overcoming it

can be important for game enjoyment. However, if failure remains unresolved, it can diminish the gameplay experience [22]. Related to this, prior work differentiated types of frustration in games, such as in-game (i.e., challenge) and at-game (i.e., lag, bugs) frustration [25, 43]. In-game frustration can be a driver for motivation and has positive effects for enjoyment, whereas at-game frustration shows no positive effects on experience.

Frustration also plays a large role in self-determination theory [53, 54], which is a major psychological framework for human motivation and well-being. It describes three fundamental psychological needs: autonomy, competence, and relatedness. Autonomy describes the need to feel in control over one's own actions, competence describes the need to feel effective and capable, and relatedness describes the need to connect with others. When these needs are undermined, we experience need frustration [6]. Autonomy frustration arises from feelings of being controlled, competence frustration stems from failure and self-doubt, and relatedness frustration results from loneliness and exclusion [6, 18, 36]. All three types of need frustration can emerge during online gaming experiences [6]. Despite their importance, research on need frustration in games is scarce. Beyond specific contexts (e.g., permadeath), we do not yet know enough about which situations cause frustrations for players, which we also address in this study.

2.2 Effects Resulting from Frustration

The experience of frustration in games can be linked to various resulting effects. For example, considering self-determination theory, Kosa and Uysal [36] found that need frustration is a strong predictor for both negative game-related and well-being-related outcomes, such as escapist motivations [30, 36], problematic gaming [36], exit intentions, and perceived daily stress [36]. Combating frustration may be beneficial to avoid some of these associated harms. While frustration is not inherently harmful (cf. Section 2.1), it may be valuable to explore ways to empower users to better manage their frustration as a preventative intervention. This could particularly benefit players who have trouble regulating their emotions themselves, who are affected more strongly by it, or who may experience more serious harms. Thus, emotion regulation support could be valuable in cases when frustration persists without being resolved easily (e.g., when players experience a losing streak in an online game).

On the other hand, another commonly mentioned result of frustration is toxic behavior, i.e., “*disruptive behaviors that are perceived as harmful by others*” [23]. Toxic behavior is a common and persistent problem in games [4, 5]. It is both a source and a result of frustration. In the game toxicity literature, frustration is often mentioned as a cause of toxicity [33, 34, 62, 66, 68]. This also aligns with existing theory, such as frustration-aggression theory [21] and empirical evidence that links need frustration to aggression [51] and stress [36], which both have been shown to be connected to toxicity [35]. At large, it is safe to say that players sometimes lash out at their teammates in moments of intense frustration in games. Considering that there is a lot of subjectivity in what is toxic [9] and that it is now considered normalized in games [9, 50], it is likely that players often do not recognize that their actions are toxic, highlighting the need for intervention systems. Many games do include

basic tools for managing toxic behavior, like systems to report misbehaving players [23]. These traditional interventions have proven largely ineffective at protecting players [64, 65], partially because they are mostly reactive and focused on sanctions. To more effectively counteract toxicity and potentially prevent harms before they occur, it may be valuable to turn to proactive interventions such as addressing frustration before it escalates into toxicity as a more effective approach [64]. Yet, currently, there are no systems that effectively help players manage their frustration, which connects to higher-level concepts of affective self-regulation.

2.3 Emotion Regulation and Coping

Academic literature on emotion regulation has been described as a conceptual and definitional chaos [13, 27]. Affect is described by Gross [27] as an umbrella term for psychological states that involve valuation, defined as relatively quick good-for-me/bad-for-me discrimination [27, 55]. Three affective states commonly fall under this umbrella with stress responses, emotions, and moods. Stress responses are generally negative affective states that occur when experiencing an inability to manage situational demands. Emotions and moods are more specific affective states, like being angry, frustrated, happy, or calm. Moods distinguish themselves from emotions by their longer-lasting nature. To regulate affective states, humans resort to coping strategies, emotion regulation, and mood regulation. Situating our work in the context of affect regulation, the most relevant concepts for *Frustration Buddy* are coping and emotion regulation.

Coping is focused on the regulation of stress. Stress is often defined as a stimulus or response that focuses on the events in the environment of the individual [39]. Through coping processes, one can lower the arousal one experiences to reduce stress [44]. Lazarus and Folkman [39] proposed two strategies of coping: System A focuses on problem solving or addressing the source of the stress, and System B focuses on reducing the emotional distress that is associated with the situation. Considering frustration and stress as related concepts, *Frustration Buddy* can be considered a device that supports (emotion-focused) coping.

On the other hand, *Frustration Buddy* is a system that aims to regulate frustration, making it a system based on emotion regulation. We follow the definition of Gross [26], indicating that emotion regulation is the act of applying active effort to influence the emotions' trajectory. For example, one can actively attempt to play down their frustration, or one can downplay their disappointment to feel better in general. Following Gross's Process Model of Emotional Regulation [27], we can differentiate multiple aspects that can be modified to influence emotion regulation. First, emotion regulation can be intrinsic or extrinsic. Intrinsic emotional regulation occurs when a person is actively trying to regulate their own emotions. Extrinsic emotional regulation occurs when a person's emotions are being regulated by another person or entity, for example, a dog trying to calm their owner. Further, there are different families of emotion regulation strategies. For example, one can modify the situation to change its emotional impact (*situation modification*) or one can redirect one's attention with the goal of influencing one's emotional response (*attentional deployment*) through distraction. *Frustration*

Buddy is a system that supports situation modification and attentional deployment. With frustration as the main emotion to regulate, we followed the framework for emotion regulation interventions by Slovak et al. [58] that builds on Gross [27]'s model. This framework details design considerations for emotion regulation interventions. Through this framework, designers can make theory-informed decisions on intervention mechanisms to be included in the system, the implementation of the selected intervention components, strategic decisions regarding the technology-enabled, and choosing the correct intervention targets. Following this framework [58], *Frustration Buddy* can be considered an external on-the-spot emotion regulation tool that helps players control their in-game frustration.

2.4 Distraction

Frustration Buddy uses distraction, which is the act of directing one's attention away from something else. While distraction is often seen as negative in daily life (e.g., if kids are distracted in school), it is not always bad. Distraction can support emotion regulation, e.g., by letting people focus on a different activity and inducing disengagement coping mechanisms, which reduce emotional distress [40, 42] by providing a mental break from the overwhelming emotions, allowing the person to calm down. Similarly, in situations with negative emotion, distraction can lead to diminished response to the negative emotion-eliciting material [27], which in the case of *Frustration Buddy* could result in better frustration management. By leveraging positive distraction (i.e., distracting oneself from a stressor by thinking about or engaging in activities that induce positive emotion [63]), *Frustration Buddy* supports coping.

2.4.1 Light and Sound Signals. Light and sound signals constantly attract attention and lead to distraction in everyday life [11]. Our susceptibility to being distracted by light signals is a product of the way that our brain processes the information that our eyes provide. While our retina receives a large amount of data from our environment, our brains have limited capacity to process this information for control over behavior. One factor influencing selectivity is bottom-up bias. It is very easy, for example, to find a unique target in an array of homogeneous nontargets [20]. In practice, differences in contrast create a distracting effect, not light itself. For example, you are not distracted by a continuously shining lamp or the sun. By changing the contrast between the background and the target, the brain is biased towards spending its limited resources in this region, resulting in the shifting of attention [20]. Another neural process that can be leveraged is the involuntary attention capture by abrupt onsets [52]. Following this, flashing objects have been demonstrated to catch the attention of users in an on-screen context, specifically with larger amounts of information on screen. Thus, flashing lights are a good way of distraction, which we leverage with *Frustration Buddy*.

Audio signals work in a similar way to light signals in capturing one's attention. Unexpected changes in otherwise repetitive or structured sound signals ineluctably break through selective attention [47]. Sound signals have a direct link to memory, disrupting simultaneous cognitive tasks, such as playing a game [7]. For *Frustration Buddy*, we use both light and sound signals to distract players, enabling the positive effects of emotional regulation and coping, together with facilitating self-generated touch.

2.5 Self-Generated Touch

Self-generated touch refers to the experience of tactile sensations initiated by oneself, such as gripping a tennis racket harder when under pressure [8] or petting an animal [49]. Research has shown that self-generated touch can have a calming effect, particularly in moments of anxiety [10]. On a neurological level, it engages the brain's anxiety regulation mechanisms [16]. With *Frustration Buddy*, we harness this mechanism by encouraging players to touch, squeeze, and fidget with the device, providing a means of self-soothing through tactile interaction.

To leverage the potential benefits of self-generated touch, *Frustration Buddy* is shaped like a stress ball. Research on the effectiveness of stress balls is scarce, focused on specific contexts, and presents mixed results. For example, Nurdina et al. [46] found stress balls to be an effective tool for managing anxiety and frustration in hemodialysis patients. However, Yanes et al. [67] found no such effect for patients during excisional skin cancer surgery. Da Câmara et al. [17] performed a study 28 among children aged 6-11 and found that all of them engage in some form of fidgeting, often to regulate emotions.

2.6 Related Work on Interactive Systems with Squeezing and Fidgeting

Frustration Buddy is an interactive system that allows for squeezing and fidgeting, which are tangible interactions. The useful properties of tangible interaction have been identified in the context of computer use. First, this aligns with the tangible interaction framework by Hornecker and Buur [29], where *Frustration Buddy* fits in both the *Tangible Manipulation* and *Embodied Facilitation* themes. As a tailored interactive system, *Frustration Buddy* makes use of its physical form and tangible engagement to direct player behavior. This offers the players access to cognitive and emotional regulation. Further, work by Karlesky and Isbister [32] shows that objects that can be physically manipulated (i.e., squeezed, stretched, or spun) are often used in the computing environment to facilitate self-regulation through fidgeting, which enables self-generated touch. Their work suggests that facilitating repetitive, short, and "mindless" actions is desired when designing such devices. The design of *Frustration Buddy* naturally supports such interaction well.

Beyond this, there is a range of prior work focused on developing novel interactive systems that enable squeezing and fidgeting, support (emotion) self-regulation, or both. Blanc et al. [10] added vibration to a stress ball with the goal of reducing anxiety and arousal. The custom stress ball device in their study was equipped with a vibration motor and force sensors to measure squeeze strength. In a study, they found that the device was effective as a stress relief tool. Shapiro et al. [56] developed a system with a fidget ball that captures and translates the affective message of touch actions like holding and shaking, stroking and squeezing. This work highlights that such stress ball-like devices are inviting their users to channel their emotions to, which is a similar goal as that of *Frustration Buddy*. Nasiri et al. [45] built on this work, presenting a smart stress ball-like device equipped with sensors and focused on enabling fidgeting for adults with ADHD. In a study, they demonstrated that fidgeting behaviors can be used to predict emotional states. Løkeland et al. [41] also developed a squishable object that

can be held in the palm of the hand of a patient in palliative care. The device is equipped with pressure sensors and allows patients to self-report the pain that they experience. Similarly, Guribye and Gjosæter [28] demonstrated a squishable device used for communicating distress between dentistry patients and their dentist. These findings highlight the value of using squeezing as a fast and intuitive way of communicating emotions and distress. Finally, while most work focuses on non-game context, Buruk and Özcan [14] demonstrated that a dodecahedron-shaped device with LEDs can be an effective tangible game interface. They presented their Luck Stone, an interactive randomizer that replaces the die in tabletop role playing games. This work highlights the value of a dodecahedron shape for *Frustration Buddy*, and LED lights as a fit for the gamer demographic.

2.7 Summary, Research Gap, and Aims

In summary, there is a range of tangible interactive systems focused on fidgeting, squeezing, and stress regulation, but there is no work on supporting frustration management in games. On the other hand, there is currently a lack of intervention systems that help manage frustration in games. Especially considering frustration as a potential precursor of toxicity [33, 34, 62, 66, 68], there is a gap in intervention systems. Existing intervention systems focus on reactive punishment instead of support and have not been effective at stopping toxic behavior. There exists a gap in both practice and research for intervention systems that are proactive and rely on support instead of punishment. *Frustration Buddy* is the first system focused on leveraging the power of distraction, emotional regulation, coping, and self-generated touch in an intervention system to help players manage their frustration during play.

3 Frustration Buddy

3.1 Concept

Frustration Buddy is a proof-of-concept device that helps players manage their frustration during online play. It is designed to mitigate frustration by providing them with an external target for their frustration as it occurs, preventing further build-up of negative emotions. By managing frustration, we potentially prevent problematic venting in the form of toxic behavior, or other negative responses such as rage quitting. *Frustration Buddy* is shaped like a stress ball to encourage natural stress management responses through self-generated touch. It features light and sound signals to distract the player and shift their attention to the device, providing an external target to focus on, breaking focus away from the source of frustration. By breaking the focus on the game, we facilitate reflection on one's own mental state.

3.2 Design Goals, Process, and Iterations

During conceptualization, we defined design requirements for *Frustration Buddy*. First, the device should be comfortably squeezable, allowing us to make use of the soothing effects of self-generated touch (cf. Section 2.5). Second, related to this, the device should also be robust, as it has to withstand the force applied by a frustrated user without risking damage to the electronics. Third, the device should be interactive and adaptable to the situation of its user. We want to support emotional regulation at appropriate moments (cf.

Section 2.3) using various levels of distraction (cf. Section 2.4). For this, the device should emit different levels of light and sound signals (cf. Section 2.4.1) in a visually pleasing way, and enable remote control from an external device (in our case, a computer running the game leading to frustration) for tailored timing.

To achieve these goals, we chose to develop a squeezable 3D printed stress-ball-like device, which contains electronics for remote control, lights, and a speaker. We then went through an iterative process with multiple design iterations. We first experimented with the balance of having a squeezable device that is still durable. We experimented with different filaments, allowing us to create softer and softer prototypes. We also experimented with the thickness of the walls and the amount and structure of the infill material that gives the shell its strength while allowing for the light and sound signals to pass through. This had to strike a balance: Too thin and the shell could break, and the light would not diffuse in a visually pleasing way (breaking our second and third design goals). Too thick, and the device would not be squishable, and the light and sound signals would not pass through enough (breaking our first and third design goals). The first few prototypes were so firm that they could not be squished at all. Others were so soft that they could rip open when fully squished. In total, about 10 iterations were made to reach the desired characteristics. In early iterations, electronics would often break; thus, we developed an internal shell to protect them to meet the durability goals. We also moved from wired connections to custom solder boards to further improve reliability. The interactions were developed iteratively along the factors of expected interruption and modality of distraction (cf. Section 3.4). Within these interactions, we also iteratively explored the design space, e.g., for light signals, where different patterns were implemented and the ones that were the most visually pleasing were kept. During the iterative design process, the prototypes were continuously evaluated among researchers, staff, and students at the lab, including people not involved in the project and individuals who are regular gamers and thus the target user group. Based on their inputs, further changes were made. One notable example of this is the rounding of the edges of the shape. Initial prototypes featured sharper angles where the pentagon faces met. This was found to be uncomfortable when squeezing the device by our testers. In later versions, we experimented with different radii of rounding until we found a shape that was considered comfortable.

3.3 Hardware

We custom-built *Frustration Buddy* through an iterative prototyping process using 3D modeling and printing and developing custom electronics and software. *Frustration Buddy* is designed to closely resemble a stress ball (see Figure 1), as this is a familiar shape which has been proven to be effective in providing stress relief in certain cases [46], and fits well in a person's hand. We decided to model the final shape as a dodecahedron, which is a ball-like shape with 12 pentagon faces as flat surfaces for mounting lights. This shape was selected over a truncated icosahedron (i.e., the shape of a football), which is more round, because of the technical complexity of adding lights behind 32 faces.

The outer shell of the device was printed using FilaFlex 70A filament on a Prusa MK4 3D printer, which was placed in an enclosure

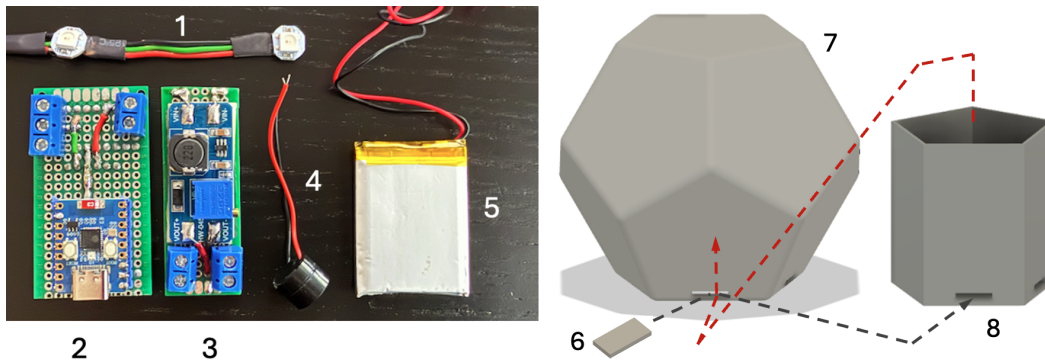


Figure 2: Hardware of *Frustration Buddy*, by number: (1) LED lights, (2) Main Board, (3) Power Control Board, (4) Speaker, (5) Battery, (6) Locating Pin, (7) Outer Shell, (8) Inner Shell

to improve print quality. To allow light to pass through the shell in a visually pleasing way, gyroid infill was chosen. During our design iterations, we found that 5% infill provides a good balance of squishiness, hand feel, and opacity for the lights. Inside the outer shell sits an inner shell that houses the electronics.

The inner shell is pentagon-shaped and slides into one of the faces of the outer shell, which was left open for this purpose. It is held in place by 3 locating pins that slide through the outer shell, securing both shells together. The inner shell is made out of hard plastic (PLA), so it can resist the squeezing of the outer shell. The inner shell was printed on a Bambu Lab P1S printer. Figure 2 shows the electronics system and inner and outer shell designs.

The system electronics are housed within the inner shell. *Frustration Buddy* uses an ESP32-C3 Super Mini at its core. The ESP32 is a commonly used development board for systems that require moderate amounts of compute and low power consumption but a lot of functionality. It is used in many small devices, like IP cameras, thermostats, coffee machines, and many other smart devices. It supports wireless communication and is cost effective. The ESP32-C3 features general-purpose input/output (GPIO) pins, which enable signaling to other components (for example, turning on an LED light, receiving sensor data, or sending data to a screen). For *Frustration Buddy*, we use these connections to control the LEDs, speaker, and gyroscope. The ESP32 is mounted on a prototyping board.

The main board also facilitates two power buses. Most components in the electrical system require 5.0 volts to operate. However, the ESP32 uses 3.3 volts when it is signaling through its GPIO connections. As 3.3 volts is outside of the range of acceptable input voltages for the other components, the 3.3 volt signals need to be boosted to 5.0 volts. To achieve this, the main board features a level shifter circuit, which takes the 3.3-volt output signals of the ESP32 and forwards them to the other devices as 5.0-volt signals. This prevents unexpected behavior from the other devices. The main board is connected to 11 programmable LEDs, one for each face of the dodecahedron, minus the face where the inner shell slides into the outer shell. These allow *Frustration Buddy* to display millions of colors. Lastly, the main board features a gyroscope that supplies data for the interactions.

Frustration Buddy is powered by an internal battery. The battery is managed by the power control board. This board is similar to

the main board, facilitating multiple circuits without the need for loose wires. As the battery depletes, its voltage gradually reduces. The battery outputs 4.2 volts when it is fully charged, and 3.3 volts when it is fully depleted. This voltage is further influenced by the amount of current the system is using. For example, if the system lights all of its lights and communicates over Bluetooth while the battery is almost depleted, the system voltage may drop as low as 3.0 volts. As our components require stable 5.0 volts to operate, we needed a way to stabilize this battery voltage. In order to achieve this, the power control board is equipped with a step-up regulator circuit, which ensures a constant voltage on its output, despite any fluctuations in the input voltage. This way, the power control board ensures that none of these factors interfere with the sensitive components on the main board. Lastly, the power control board features a USB charging circuit, allowing *Frustration Buddy* to be charged with a standard USB-C charger. Figure 3 shows a diagram of the electronics system.

3.4 Interaction

Frustration Buddy offers four primary interactions (see Figure 4). These interactions were based on the theoretical foundations that we used to design *Frustration Buddy*, facilitating self-generated touch and a range of distraction variants from no active distraction to more distracting, including various distraction signals (flashing lights, soothing animations, and sounds) and required engagements to stop the distraction. Each interaction is explained in detail below:

First, *Frustration Buddy* **passively (1)** acts as both a stress ball and a fidget toy. This invites gamers to interact with it through self-generated touch. This interaction is player-initiated, allowing them to channel frustration or seek stress relief when they see fit. The soothing animation can be turned on or off based on user preference. The second interaction is a **soothing animation (2)**. When *Frustration Buddy* uses this interaction, it uses its LEDs to display a calming effect by cycling through a smooth gradient of colors. This was described as having soothing properties like a lava lamp by participants in our user study. The third interaction is *Frustration Buddy*'s **distraction mode (3)**. When triggered by a signal from the game, such as the player losing, it actively tries to distract them and break their focus. The LEDs on *Frustration Buddy*

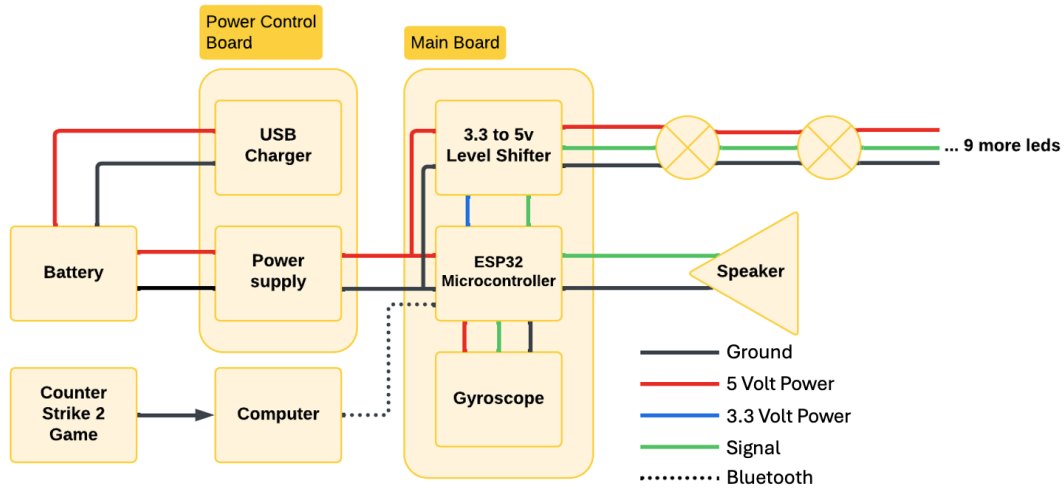


Figure 3: Diagram of Frustration Buddy's electronic system

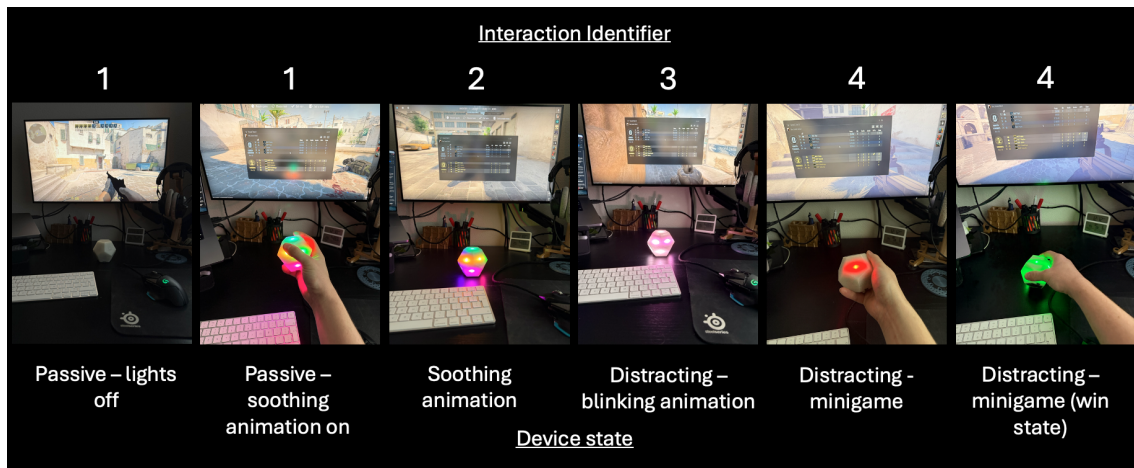


Figure 4: Different interactions enabled by Frustration Buddy.

will flash in a bright white color in order to try to capture the focus of the player. An optional beeping sound can be turned on as well. Both the light and sound signals stop when the device is picked up. Because an interaction is required to stop the distraction, there is a high chance that we break the focus from the source of frustration at that time, i.e., the game. By breaking focus from the source of frustration, we allow for a brief mental reset before the player shifts their focus back to the game. Finally, the fourth interaction features an **interactive game (4)** (on *Frustration Buddy*). The game is intended to force engagement with the device, increasing the distracting effect. In this mode, the distraction is triggered similar to the distraction mode but can only be disabled by completing the game. By playing the game, the player is disconnected from the source of frustration for longer, giving them more time to regain control over their emotions. During the mini-game, *Frustration Buddy* lights up its faces in a specific order. The player must then place it on the desk with the face that illuminated last facing up.

the built-in gyroscope detects if the player did this correctly. If the player responds correctly within two seconds, *Frustration Buddy* blinks green to indicate that the player has won. If the player is incorrect or too slow, it blinks red for five seconds, signaling a loss before transitioning back to the soothing animation or passive state.

4 User Study Methods

We conducted a qualitative user study to explore opinions about the concept of *Frustration Buddy*.

4.1 Aims and Study Design

We conducted semi-structured interviews with gamers. The interview protocol was designed to first assess the participants' experiences with frustration in games, including situations that may cause frustration and how the participants manage it. Then, we showed the participants the prototype and asked questions assess the participants' attitudes to explore if they are open to the concept

and to gather feedback on the design of the artifact. Through our interviews, we aimed to answer the following research questions:

- **RQ1:** How do players experience frustration in online games, and how do they try to control it?
- **RQ2:** How do players feel about using an external, tangible distraction device to manage frustration in games?
- **RQ3:** What design elements are considered important for a tangible device that uses distraction by players?

4.2 Participants

We interviewed nine participants (three women, six men). The participants were aged between 18 and 34 with an average of 25.8 years ($SD = 4.8$). When asked how much the participants identify as a gamer, the responses ranged from 58 to 91 with an average of 77 ($SD = 10.9$), on a scale of 0 (= “not at all”) to 100 (= “a great deal”). When asked how they play games, eight out of the nine participants stated that they play on a PC at a desk, and the remaining participant plays on a console on the couch. Among their favorite genres, MMORPGs, shooters, sandbox, open world, rogue-like, action adventures, and fighting games were mentioned. The participants were recruited through posters on notice boards throughout the campus of our institution. After nine participants, we reached saturation when the interviews did not result in additional meaningful insights related to the study’s core aims. We determined this by discussing the content of the interviews among the research team.

4.3 Procedure

Participants were invited for a one-on-one in-person interview. The participants provided informed consent and demographic information through a brief survey implemented on our institution’s Qualtrics instance. Once the consent sheet was completed, we started an audio recording and the interview. This procedure was approved by the research institute’s Ethics and Privacy Quick Scan.

First, we asked participants to provide one or multiple examples of moments where they experienced frustration during online play. We discussed the experience and asked the participants how they would have wanted to act in that situation. Then, we introduced our device: “*This is the interactive stress device that we are studying. It uses light and sound signals to distract you in moments during gameplay where stress or frustration might be high. The goal of the device is to momentarily remove you from a stressful or frustrating environment and have you interact with the device instead of the source of stress.*” (see supplemental material for full script). *Frustration Buddy* was handed to the participant. While actual game integration was not part of this study, *Frustration Buddy* was set up to display its lights and sound signals on a loop. This way, the participants got to experience the texture, squeezability and signals. We then explained the functions of the different signals and how we intend to integrate them into game. We then continued with more specific questions.

We asked the participants questions on how they believe *Frustration Buddy* would affect them, e.g., “*If you were to use this device during your gaming sessions, how do you believe it would affect your overall gaming experience, both positively and negatively*” and “*Could you foresee any situations where the signals might worsen frustration instead of relieving it? If so, which ones?*” Then, we asked more in-depth questions about the functionalities of the device, such

as “*Would the lights be helpful for you?*” and “*What do you think about the different interactions the device currently demonstrates?*” Lastly, we included questions on how the participants would use the device, e.g., “*What would make you more likely to use a device like this during gaming sessions?*” and “*Do you see any potential broader applications for this type of device outside of gaming?*”

The interviews took approximately 30 minutes. The full interview protocol is included in the supplementary material.

4.4 Data Processing and Analysis

After the interviews, all recordings were first automatically transcribed using the Amberscript [2] transcription service and then manually checked and corrected to ensure validity.

For our main analysis, we then conducted a thematic analysis [12, 15]. All transcriptions were first exported to Excel and then manually coded using an inductive, open coding approach. The first author was sufficiently familiar with the data after conducting the interviews and verifying the transcriptions, and then conducted an initial coding of the interviews. The last author independently reviewed the coding for the first 2 interviews and provided feedback on the initial coding. This resulted in a few refinements to the coding approach, which was then completed for the remaining interviews.

We chose a coding approach combining both semantic and latent codes. For example, the quote “*I definitely think light would be great*” resulted in the following semantic code: “*positive towards light signals*”. Latent codes were used less often, but in cases where the underlying meaning of a comment could be extracted, this was done. For example, the following quote was coded as with the latent code “*initial worry over distraction*”: “*Is it like, actively (distracting) when I’m playing the game? Because then it would be like kind of distracting for the game I’m trying to play.*”

After coding, we conducted collaborative affinity mapping. We first placed the codes in a shared Miro board, where the first and last authors collaboratively grouped related items in a bottom-up approach, aiming to generate themes. Through multiple rounds of discussion and refinement, we developed themes that contribute to all of our research questions.

5 User Study Results

We conducted a thematic analyses aiming to provide exploratory insights into how players experience and manage frustration in games (three themes related to RQ1) and to assess the participants’ opinions and attitudes related to the concept of *Frustration Buddy* (two themes related to RQ2 and five to RQ3). Table 1 shows an overview of all research questions and the themes related to them.

5.1 RQ1: How do players experience frustration in online games, and how do they try to control it?

In the first part of the interview, we focused on the frustration that players experience in online games and identified three themes: *poor personal or team performance can cause frustration, feeling frustrated can result in a range of negative behavior, and that players want to, but often struggle to control frustration.*

Research Question	Theme
RQ 1	Poor personal or team performance can cause frustration Feeling frustrated can result in a range of negative behaviors Players want to, but often struggle to control frustration
RQ 2	External support could help players regulate frustration Poor integration may cause more harm than good Physical interaction is desired, but design specifics vary between persons Calming lights are favored over blinking lights
RQ 3	Sounds don't fit the gaming environment well Good trigger timing is essential and complex Gamers desire customizability

Table 1: All research questions and their associated themes

5.1.1 *Poor personal or team performance can cause frustration.* The first theme revolved around the causes of frustration. One participant reported repeated losing as frustrating (“it’s always when I lose, um, when it’s a losing streak specifically, sometimes I rage quit” [P9]). Participants noted that a common source of their frustration in online gaming was their own performance (“depending on the type of game, where I’m more terrible at, like shooters, that I do feel the frustration a little bit more,” [P5]). This frustration due to underperforming was also connected to the social context. One participant described a situation where they played a shooter game with a friend and faced a sniper (“so we tried three times or something and we just couldn’t kill him. We were just too bad for his skill. it was a bit of a build up [of frustration]” [P6]). Our participants explained various situations where they attributed the frustration to another player in their group. For example, P4 described a situation when they played Cuphead with a friend who did not understand one of the game mechanics: “[you] can jump on that soul, you get one life back, so you kind of get revived. When my friends could not do that, that gave me frustrating experiences” [P4]. Such issues were described for public matchmaking where one is paired with strangers, e.g., in World of Warcraft dungeons: “There were times where you felt like the other people were not either taking seriously or just yeah, not not good enough or something like that [...] It can be very frustrating if that person then doesn’t do well and 45 to 50 minutes of your time is just gone.” [P3].

5.1.2 *Feeling frustrated can result in a range of negative behaviors.* In the second theme, the participants mentioned the negative effects of frustration. Our participants described rage quitting (i.e., quitting the game angrily in the middle of the game) as a common result of frustration (“But I’ve also had moments in for example, League of Legends where I rage quit it” [P3] and “I just quit gaming” [P6]). There were also cases where the frustration manifested in physical actions of anger (“I felt that it wasn’t fair, and I was so angry I broke the chair I was sitting on” [P7], “I would scream or I would knock on the table.” [P8]). One participant also described a situation from the past where they needed a way to release their frustration in a way to avoid breaking their own hardware: “I can remember from when I was younger, when I was playing FIFA or something, that, um, I could get frustrated to a point where I might throw the controller, but [...] don’t break it. So I was aware of the fact that what I was going to do was not okay ish, if I can say it like that. So I threw it on the bed

or something, but it was just a way to get the frustration out” [P3]. The built-up frustration is also vented into the game world, with multiple participants indicating that they have resorted to lashing out at others (“I, um, lash out to my friends, or I end the discord call and I just go away.” [P9], “I think that was the primary source of me being frustrated and lashing out to my friends.” [P4]). Participants also experience social reclusion (“I tend to become silent” [P1]), loss of enjoyment of games (“I realize I’m not enjoying the game at the moment. I’m just gonna stop playing it” [P5]), taking breaks from the games (“It was mostly just, quit the game for like a week or two” [P6]), and even cycles of thinking about quitting and then playing again in a matter of minutes (“Sometimes when I do quit the game, I just come back 5 to 10 minutes later because I still want to play the game” [P5], “I say I’m done with the stupid game, but then moments later, I come back and I say, okay, we can’t end on a loss, so play again” [P9]).

5.1.3 *Players want to, but often struggle to control frustration.* In a third theme, we found that the participants tried their best to regulate their emotions. The participants used various strategies focused on avoiding situations that are more likely to result in frustration, such as choosing to play with friends (“I’m more frustrated by [strangers] by myself, and I tend to rage quit. With friends it is more like, let’s take a pause and start in ten minutes or something like that. But we’re always in a playful mood.” [P2]) and to play more casual games or game modes (“I play a different game where I am not competing, you know, like, uh, a sandbox game, like Minecraft, for instance. That’s easy, because then it’s easily distracting you because you’re not competing against anyone. You’re just enjoying whatever you want to do” [P5]). This response matches the “situation selection” approach from the process model of emotional regulation. We also saw strategies to deal with frustration through humor and playing it down (“my immediate response to that is humor, basically. Um, so making jokes about that, making jokes about myself, uh, playing it down maybe, or, um, yeah, I mean, taking it not so serious, even though maybe it’s, it’s serious.” [P1]). This response matches “response modulation” in the process model of emotional regulation [27]. Another strategy we observed was self-reward by staying calm instead of being toxic (“And just knowing that you might actually help that person [who is struggling], that’s also then maybe a good feeling.” [P3]). P7 described one strategy focusing on their own performance and decisions to avoid bad emotions:

“I don’t want to control my emotions. Because if I control, uh, my decision making during the game, I don’t have bad emotions because, like, in every situation, I could have done something better.”

Interestingly, our question on controlling stress and frustration asked how they would control it *if* they could. For many participants, this remained an envisioned ideal situation, not a reality. Many comments indicate that controlling these emotions is considered difficult, and the lasting effects after feeling frustrated can be hard to overcome. For example: *“[I would like to] be more focused. Like when something doesn’t work out, don’t get mad immediately.”* [P7]. P2 found it difficult to return to play after experiencing frustration: *“I was just pondering, most of the time I was just like should I play again? I don’t want to because I’m annoyed.”* P3 found themselves unable to regain control over their emotions and got stuck in a frustrating loop of defeat: *“And then you try more. And usually when you try more, you lose a bit harder because you’re getting more aggressive.”*

5.2 RQ2: How do players feel about using an external, tangible distraction device to manage frustration in games?

We created two themes related to the participants’ thoughts about the concept of *Frustration Buddy*, indicating that *external support could help players regulate frustration* but also that *poor integration may cause more harm than good*. Generally, the participants of our study were cautiously positive about the concept of using distraction to manage frustration during gaming.

5.2.1 External support could help players regulate frustration. Some participants described potential benefits of the concepts such as helping them relax (*“So it would be nice to have something relaxing in the middle of it.”* [P8]), enabling breaks between games (*“I think having a little break or a little pause between games will just help de-stress and go clean in your new game.”* [P9]), and calming them down in moments of frustration (*“Yeah, of course it’s going to help me if I’m frustrated. It’s going to help to calm me down, to forget about the game, to come back and have a better experience overall”* [P7]).

One participant noted how the concept may be useful by allowing for squeezing:

“So it’s difficult for me to say how useful I would find a strategy like this. Because the amount of frustration that I normally feel when playing video games is much less than it used to be. So if I were to place myself in my 16-year-old brain, I think this would definitely help. Not in particular to this device itself, but even just a stress ball. I can’t believe that I never did that because I’m always grabbing or squeezing these kind of things. I think that already would help me a lot.” [P5]

This quote highlights that the act of self-generated touch and its positive effects are well known to the participant. However, they never tried to leverage this effect in a gaming context. Their attitude towards a tangible object for managing stress led them to expect similar effects from *Frustration Buddy*. Ultimately, the participant alludes to a stress ball in itself being potentially beneficial. Another interesting aspect is how they ascribe the benefit to their younger

self, where they experienced more frustration and may have had more trouble managing it.

Another participant also highlights the benefits of *Frustration Buddy* being squeezable and how this may be used while strategizing.

“For example, you lose and you start and you go back to the character select screen and you think, maybe I should pick a different character, and it’s just nice to just squish on your hands while you’re thinking to also calm yourself down and to think of more options. So to distract yourself from the frustration again, not because you died, because you’re making a decision that will impact that, that might help you in the future.” [P7]

P7 highlights the value of self-generated touch as a way of calming themselves down. They noted how this also allows for distraction as a tool to help reflect and prepare better for the next attempt.

Other effects mentioned by participants include help in managing negative emotions after losing a round (*“I think it would help because then it’s like a breeze of, uh, something different coming in, and then you can clear your mind a bit, because if you’re just in this state of one round, after another round, you’re still focusing probably the previous round”* [P8]). When asked if playing with *Frustration Buddy* could help break negative spirals, P8 mentions: *“Yeah. Because for example, what I sometimes do is I stand up and grab some tea, I make some tea. And because I know, like it’s five minutes or so that it takes to load to the next round, at least in Smite [a game the participant likes to play]. So it’s quite a time, right? Okay, grab some tea or some snacks. But that doesn’t help for the health of course.”*, which suggests that *Frustration Buddy* can help combat other coping mechanisms like eating snacks between rounds. P2 explains that they like the idea of a distraction breaking their frustration briefly: *“I love that it’s, let’s say distracting a little bit, [...] But it’s just like, wait a second and then go back again. Yeah. So I like that.”* In general, P3 suggests that the potential of being able to return to a new game or round quicker and in a better state of mind (*“Maybe then if I am not frustrated anymore [after playing with Frustration Buddy], I can go back into the game and enjoy myself more”* [P3]).

We also specifically asked participants how a system like this could influence their performance. Some participants noted that managing frustration and relaxing could result in better performance for them (*“I think I will perform better because I don’t take any negatives from previous game to my new game. It’s like a total reset.”* [P9] and *“My mood would rise a little bit more because I’m more relaxed and I guess I could perform better in the game. Yeah. In Counter-Strike, for example, or in League of Legends, I think it could really affect my performance”* [P3]).

5.2.2 Poor integration may cause more harm than good. While the participants were generally positive, there was a theme of concerns about the system if it was not integrated well. Some participants mentioned concerns about distractions breaking their immersion (*“When I play, I believe that I’m immersed. If the game is really good I would not want that immersion to be broken by distraction.”* [P4]) and causing them to forget important information (e.g., how to beat an enemy) (*“I have a feeling I will forget important stuff when I have to do something else immediately”* [P7]).

The participants explained that the timing of the intervention is essential for determining if the concept will work for them, e.g., to avoid distractions when immersed (*"mid immersion distractions would also be something that I would not want."* [P4]). P4 thought about completing dungeons in World of Warcraft and highlighted how forced interaction may be detrimental at the wrong time:

"If it turns on and I have to play with it before I can continue my game, that would just ruin the dungeon. [...] Other than that, if it's if it's timed well and, um, it doesn't distract you mid-game, of course. Or mid-game is, of course, a very big no. You don't want to have to play a game if you're still playing yourself a different game or the online game, then, um, yeah, that that would not work." [P4]

P2 mentioned: *"If it's well timed with, uh, the video game, such as I just died, and it's the moment where I'm frustrated, probably because I haven't started already, like the second run or something like that in a specific game. It will be really interesting. It's just a small distraction that I can look at. Maybe exactly as you said, like squish or something like that. If it's not timed right. I would probably throw it away"*. This highlights the fine line between good and bad timing.

Lastly, one participant mentions that there could be a negative social association with using a tool that manages stress and frustration: *"I have a feeling that, like, I don't have a problem with that, but some other people may find it weird that they have to use a device to enjoy a game. Like why would you play a game if you need a device to control their emotions?"* [P7].

5.3 RQ3: What design elements are considered important for a tangible device that uses distraction by players?

With our thematic analysis, we identified five themes of important design elements that should be considered when designing a tangible device that distracts players during their gaming sessions. These are considerations for *physical interaction, light signals, sound signals, timing, and customizability*.

5.3.1 Physical interaction is desired, but design specifics vary between persons. Our participants emphasized the importance of a good tactile and squeezable design and physical interaction. Especially the ability to squeeze or squish the device was perceived well by some participants who like such interaction (*"It helps me think, you can say. Like, again, it's for me. I like to squish things."* [P7]). This was also described as common behavior in the case of frustration (*"The thing is that I really like it if it's something squishy, because I tend to do this when I'm frustrated and I would like something to do instead of putting my nails in my palms."* [P8]).

However, participants also expressed concerns about the prototypes' current form factor affecting the quality of the physical interaction. For example, the material and size of the device are considered important factors for adopting such a device. Some participants found the design to be too stiff (*"Maybe for some people, it's too tough or too stiff."* [P7]), while others preferred a smaller shape that would fit their palm instead of their whole hand (*"I would make it way smaller. It's like I should probably fit into the palm of*

my hand and not the whole hand." [P1]). Further, the material of the device was considered important (*"Materials of, of course, one thing that is quite important for the look and feel and especially I see the haptics of that. Um, 3D prints are fine for prototype stage, but not really satisfying to feel."* [P1]). Interestingly, this participant already differentiated between materials at a prototype stage and materials for a further stage, such as a commercial device. While not a part of our prototype, multiple participants stated that adding vibration to the device would be a welcome addition (*"And some vibration would be the most interesting, to play puzzles with it and just feel it in your hand vibrating"* [P6]).

5.3.2 Calming lights are favored over blinking lights. We found that light signal design is crucial for our participants. Participants clearly favored smooth and soothing light signals over blinking or flashing light signals. They stated that flashing lights were too intrusive (*"The flashing itself is a bit intrusive. I don't think I would like it that much."* [P3]) and could have a negative impact on player performance (*"I think the blinking would really hinder me (in terms of performance) and be an eyesore."* [P6]). This is directly connected to distraction, which can be too much, even if it is the main goal of our system (*"Lights can be definitely distracting if they are just like flickering or grabbing my attention aggressively. Of course, that's the other extreme that you don't want to have."* [P1]). Other concerns regarding the light signal design were also expressed. For example, participants mention that there could be risks for users with high photosensitivity (*"Some people also have very (high) photosensitivity or something like that."* [P1]). Similarly, concerns were expressed about excessive brightness or rapid changes in the lighting signals, specifically in dark gaming environments (*"It becomes dark and my entire room becomes dark. Then this will distract me a lot more. [...] Not sure if it would be distracting in a good way."* [P5]). Thus, both individual characteristics of the player as well as the context will affect the usability of the device.

On the other hand, calming light effects like the breathing animation or slow fading were perceived as more appropriate and calming (*"Like it is right now [referring to the calming animation playing at this moment of the interview] that is slowly fading between color is already quite nice. I would appreciate it."* [P2], *"There's this nice zen feeling. I don't know how else to describe it, but the kind of feeling that you have on a lava lamp."* [P5]).

5.3.3 Sounds don't fit the gaming environment well. In our study, the participants were generally negative towards sound signals. An important design consideration is to take into account that many gamers play with noise-canceling headphones, which makes sound signals through speakers in an external device ineffective (*"I don't think I'd like [sound signals] very much. I also play video games with the noise-canceling headset, so I barely hear anything from outside. And if something were to make noise, then I'd find that more annoying than helpful."* [P5]). Another element to consider is that gamers often share the space in which they play with others. The use of sound signals may disturb others in the space (*"Especially when I would be gaming in more open space or something. That would be quite bad for silence."* [P6], *"If I'm in a room with other people and it starts making noise and starts flashing and I'm frustrated, I might get more frustrated because I'm distracting people who are in the*

room with me because of the ball.” [P7]). This, again, highlights the importance of context for the applicability of the device.

5.3.4 Good trigger timing is essential and complex. The most important design consideration brought up by the participants was the timing of the triggers. Participant 3 summarizes how distraction at the wrong time can have a detrimental effect on their gaming experience:

“So for example, in World of Warcraft, if it turns on and I have to do something about I’m in the middle of a dungeon, so if I die. But it is the first death, the first death or the second death, that doesn’t necessarily mean that I won’t finish a dungeon, but then if it turns on and I have to play with it before I can continue my game, that would just ruin the dungeon.” [P3]

Beyond exemplifying a situation where distraction can be bad, this quote also highlights the need for more complex trigger timing because a singular indicator like player death is not always effective for triggering distractions. The need for good trigger timing applies to the amount of interaction *Frustration Buddy* requires as well. For example, Participant 6 explains how the timing of the minigame could have negative consequences: (*“Perhaps if a puzzle comes up or something, like when I’m in a round or when I’m actively gaming in an active situation and then the puzzle will come up, I kind of tend to solve the puzzle perhaps, but when I wouldn’t want to do it because I’m just gaming. Yeah. Because that would be kind of distracting as well”* [P6]). The need for good timing is also true for light signals: (*“when I’m in a good point [...] and it’s flashing, maybe it becomes complicated. Also if I’m not able to then finish the task. So for this I would probably feel also bad”* [P2]). Some participants mention that they would incite aggression towards the device if it used sound to distract them (*“Not in a good way I would think. [...] I think I might be able to divert my attention or frustration towards it, but then I would become more hostile towards the source of the sound, I guess.”* [P5], *“if it is too annoying) I would just throw it away. So, it’s a good thing if you make it durable”* [P8]).

5.3.5 Gamers desire customizability. The final important design element is the ability for users to customize the actions and properties of the device. For example, the option to choose sound signals that appeal to the user would be received well: (*“Music in general calms me. So, if it’s using music that personally is resonating with me in terms of calming me down. I think that might be a good addition”* [P4]). Another participant mentioned the desire to change the colors and transition speed of the light signals: (*“the fading between the colors is relatively slow I would say you could also if you want to get attention to it, make the fading a bit, go a bit quicker. But then with the same color for example”* [P3]). They go further to explain that it would be a good addition if there could be a community around customization of the device, allowing for more features and games (*“personally, I would really like customizability. So, for example, maybe you could also make it like, um, not open source, or you could also make it open source, of course, but more like an online community as well where people could make games themselves to play”*, [P3]). Lastly, another participant mentioned that they would like to configure the device to fit their use-case best: (*“I think it would be nice if you can choose like you have options. Yeah. So I would turn*

off the puzzle. For example. I would just make it just have nice slides and just I will pick it up by myself” [P7]).

6 Discussion

We discuss findings and implications. We reflect on frustration in games, frustration management support, preventative toxicity interventions and the limitations of our study.

6.1 Frustration in Games

All participants in our study stated that they experienced frustration during their gaming sessions. We identified various causes for this frustration, which can be summarized in poor personal and team performance. Frustration due to a player underperforming maps to competence frustration in Ballou and Deterding [6]’s grounded theory for psychological need frustration in games. It further aligns with prior work on failure [22], in which players consider unresolved failure with outcomes like frustration. On the other hand, frustration due to underperforming teammates may be broader, relating to competence but also autonomy (i.e., one feels a lack of control over a match outcome) and relatedness frustration (i.e., associated negative social interactions with teammates). Our participants described cases where they felt frustrated and acted in ways that they would have liked to do differently. The fact that all participants were able to and quick to describe situations like this highlights the importance and need for support mechanisms for controlling frustration.

Our participants stated that they did not feel in control of their emotions and the resulting negative behavior. For example, we heard mentions of participants getting frustrated to the point of throwing controllers, hitting their desk, screaming out loud, and even breaking the chair they were sitting on. This reflects behaviors that are also commonly seen in internet culture, like gamer rage compilations, memes, and satire videos. Interestingly, even though negative behavior like toxicity has been normalized in gaming [9, 50] and considering how frustration is mentioned as a cause of toxicity (see Section 2.2), our participants did not explicitly report being toxic as a result. However, some participants mentioned negative behavior towards players they do not know, including being “not nice” or “passive aggressive” and many did admit to rage-quitting. Such behaviors could be perceived as toxic by other players, even if the participants may not intentionally harm others. On the other hand, the fact that people did not mention toxicity could indicate that our interview setting led to social desirability bias in the responses [48].

Our findings highlight how frustration can be difficult to control for some players in game contexts. This aligns with prior work on esports that found that esports players struggle with emotion regulation [37] and work that found low to moderate levels of self-reported self-regulation among esports athletes [60, 61]. This can lead to behavior that causes regret for the frustrated person, and possibly distress or harm to any potential victims of the behavior. Our participants are reflecting on these moments with the desire to do better. However, in their current environment, they are unable to vent their frustration in a healthy way. Connecting this to theories of emotion regulation, this indicates a lack of available positive

regulation strategies and a reliance on negative strategies like emotional outbursts [27]. From a coping perspective, our interviews indicate that our participants attempt to use emotion-focused coping, where they try to alleviate the emotional distress (the build-up of frustration) without changing the stressor (the game). However, as there are no healthy strategies like positive reframing or seeking emotional support available, the common outcome is the negative strategy of lashing out in anger [39]. Thus, better support for frustration management may be valuable.

6.2 Frustration Management Support

Our participants reported that they sometimes struggle to manage their frustration during play and then resort to emotion regulation strategies such as lashing out, eating snacks, smoking, or walking away. These strategies all rely on response modulation and situation selection strategies, where the participants attempt to change an emotional response after it has been initiated, or choose to avoid the situation altogether [26, 27]. However, they found these emotion regulation strategies to be not always helpful, sustainable, or healthy. *Frustration Buddy* could act as a healthier replacement, as highlighted by some participants who explained how engaging with *Frustration Buddy* between rounds or during breaks could allow them to manage their frustration. Our participants reported many situations where external support can help them during their gaming experiences. For example, in multiple interviews, participants mentioned that frustration can linger when gameplay slows down. Examples include lobbies, loading screens, or while waiting to respawn. These moments during gameplay offer ideal opportunities for external support. By providing a tangible distraction, *Frustration Buddy* was seen as a tool that can help players decompress without disrupting gameplay.

The self-generated touch functionality of *Frustration Buddy* was often mentioned as a desirable feature. For example, P7 expects it would help them think more clearly and make more strategic decisions. Similarly, P5 mentioned that simply having something to fidget with would help them stay calm. *Frustration Buddy* facilitates this urge to find a positive situation when stress levels are high through situational selection [26, 27] and provides relief through soothing touch [10].

Our study also provided initial insights in the design requirements for trigger conditions in the gaming environment of our participants. For example, participants emphasized that the timing of the intervention is essential. Research on emotion regulation shows that healthy individuals flexibly choose between reappraisal and distraction depending on the intensity of the situation [57]. Distractions in low-intensity moments were particularly welcomed by our participants, whereas a lot of concerns were expressed for distractions during high-intensity or competitive gameplay. The participants expect that imperfect timing during these situations will have the opposite effect, resulting in increased frustration and reducing the desire for a tool like *Frustration Buddy*. This is an interesting finding, as the work by Sheppes [57] suggests that distraction is good for high-intensity situations. Potentially, this holds only for internal emotional regulation and not externally triggered emotional regulation. Similarly, there may be different benefits to

external support depending on the intensity of the situation. However, more research is needed to empirically test these assumptions.

Further, our participants expressed a strong preference in signal modalities: light signals were clearly preferred over sound signals. Further, considering the options for different light signals, there was a strong preference for soothing light signals over blinking light signals. We initially designed the device to use the blinking lights as the main distraction tool, but we found that the soothing lights achieve similar distracting properties. During the interviews, there were multiple occasions where the interviewees were actively distracted by the soothing light signals from *Frustration Buddy*. This demonstrates that soothing light signals are capable of leveraging distraction, even when a person is in a one-on-one conversation. It removes most of the concerns our participants expressed regarding light signals, which were almost exclusively aimed at the blinking lights, such as being too intense, too distracting, or a potential hazard for individuals with high photosensitivity. However, we have not yet investigated effects in a real gaming scenario. When players are focused on a screen that also has bright lights, it is possible that signals may be perceived differently compared to the interview setting. We still have to empirically test the strength of distraction across different settings in a realistic gaming context.

From a designer perspective, the participants reported experiences that can be used to reflect on our design decisions for *Frustration Buddy*. Several participants mentioned appreciating the squishability of the device. This appreciation may be a result of our iterative design process, where we tweaked the devices' materials, shape, and feel to encourage self-generated touch. While we cannot causally link these responses to our design decisions, the design may have supported the calming experiences some of the participants described. As such, experimentation with similar factors (e.g., shell thickness) and dedicated design goals can be recommended for designers of future systems. Similarly, the participants' reactions to the different interaction modalities can be linked to our iterative design process to create distracting interactions ranging from lightly intrusive to very intrusive. Multiple participants experienced being distracted by the soothing lights, which aligns with our goal of creating noticeable light signals without them being perceived as intrusive or annoying. Similarly, the strong responses related to blinking light signals suggest that we achieved the design goal for an intrusive interaction. While we cannot claim that our design is the sole reason for the device being perceived as effective, these responses highlight how the participants' opinions plausibly connect to the design choices we made when developing *Frustration Buddy*.

Overall, our findings suggest that well-timed intervention by a device like *Frustration Buddy*, with the right signal modalities, can be a valuable tool for managing frustration in games.

6.3 Preventative Toxicity Interventions

In our interviews, we intentionally did not directly ask about toxic behavior, instead opting to ask about frustrating situations. However, the respondents often mentioned acts that could be considered toxic by other players. For example, lashing out at teammates or friends to relieve frustration or rage-quitting the game and leaving

the other players with one less teammate can be considered toxic behavior.

Toxic behavior is often punished using reactive systems such as banning the player or imposing a chat restriction. These systems always act after an incident occurs, like a verbal fight in game chat, and often players don't feel satisfied with the outcome, for example, if they think that someone else started the conflict. Unlike reactive intervention systems, which could result in resistance and more frustration, self-regulation-oriented systems like *Frustration Buddy* enable players to control their own emotions and feel better about themselves. Our participants described that they expect to be able to “cool down”, reducing the urge to vent emotions in a negative way. Our results support calls for empowering and mood-focused intervention systems as alternatives to currently common systems that focus on sanctioning [64, 65].

To make an effective preventative system, our findings make it clear that good timing is essential. This suggests that these systems would benefit from effective early detection systems, for example, through recognition of behavioral patterns or performance changes. The importance of timing is likely the biggest design factor for a system like *Frustration Buddy*, and accurate and early prediction would facilitate this in an effective way. Participants also suggested that interventions could be effective during low-intensity gaming moments, highlighting the need for context-sensitive detection and intervention activation.

Overall, our findings suggest that there may be value in preventative toxicity interventions. Our participants expect that a tool like *Frustration Buddy* can facilitate emotional regulation and thereby reduce the likelihood of toxic behavior occurring. This highlights the potential of these tools to create a healthier gaming environment.

6.4 Limitations

While our findings support the usefulness of *Frustration Buddy* as a tool for managing frustration in games, there are limitations to this work, including the physical design of the device and the study.

First, at this point in our research process, we focused on designing and developing the *Frustration Buddy* artifact and exploring attitudes and opinions from the interview participants as input for design reflection. However, we have not yet conducted a study where *Frustration Buddy* was evaluated in real gameplay, limiting our ability to make claims on how the artifact would perform in this real-world scenario. The goal of this research was focused on an artifact contribution and exploratory insights, exploring frustration and emotion regulation foundations for the concept (RQ1), attitudes towards the system (RQ2), and insights for the design of the system (RQ3). While there are valuable insights for guiding future designs (e.g., concerns about inappropriate interruptions, which can guide the design of trigger conditions), the main focus remains on the artifact with a detailed description of the design and technical implementation of *Frustration Buddy*. Future work is necessary to provide a comprehensive evaluation of the system and the findings by integrating *Frustration Buddy* in a dynamic, high-pressure environment in games. A future study could investigate if *Frustration Buddy* can successfully support players in managing their frustration, which interaction type is most effective, and what the best trigger conditions are for them.

Second, our current prototype of *Frustration Buddy* was designed with a specific size, shape, color, and stiffness. This design was iteratively developed following the specified design goals, but the final design may not be suitable for a broader audience. Some participants mentioned that they found the size of the device too large, too firm, or did not like the material, color, or texture. These observations on personal compatibility are similar to those of Torres-Gomez et al. [59], who conducted a comparable study with a stress ball and also found mismatches between some participants' preferences and their design. We expect that the mismatch between user preference and actual design could affect the personal comfort and effectiveness of the self-generated touch functionality.

Third, while our participants were overall positive towards *Frustration Buddy*, we have to acknowledge that they might have been biased while sharing their opinions. As Dell et al. [19] demonstrated, participants are significantly more likely to favor an artifact that they believe was created by the interviewer. As we disclosed that we created the device during the interviews, it is possible that some participants provided overly positive responses to our interview questions. However, reflecting on the genuine critique on elements like sound design, flashing lights, and timing, we are confident in the reliability of our results.

Last, our semi-structured interviews were limited to just nine participants. We gathered valuable early insights through this study and trust the validity of these results, as they align with known issues in the gaming space and the research that grounds our design choices. However, further evaluation is necessary. We will use these results to aim for larger-scale studies in more realistic settings, like participants actually playing games while using *Frustration Buddy*.

6.5 Future Work

To continue this research, we aim to integrate *Frustration Buddy* into a commercial game. By creating an environment where the intervention system interacts with in-game scenarios, we will be able to evaluate how players experience its functionalities during real play. We envision an experiment design that minimizes social desirability bias, for example, through complementing data collection with sound and video recordings in addition to self-report data. This will allow us to study the effects of its interaction modes in managing both the buildup of frustration and direct “in the moment” frustration in realistic environments. We also plan to use this experiment setup to investigate the effect of managing frustration as it occurs on downstream toxic behaviors, like lashing out or rage-quitting, providing insight into the potential use of *Frustration Buddy* as a preventative tool for toxicity in online games.

7 Conclusion

In this paper, we present *Frustration Buddy*, a tangible system for managing frustration in online games using distraction and self-generated touch. We provided a detailed description of the design and implementation to allow others to implement similar systems. Then, we conducted an interview study to gather insights into frustration and its management in games, and to explore the concept and prototypical implementation of *Frustration Buddy*. Through semi-structured interviews with nine participants who regularly play games, we found that our participants all experience frustration

during play and have unique ways of regulating this frustration. They feel that, in general, *Frustration Buddy* can help them manage frustration, helping them “reset” between rounds, preventing the buildup of frustration, and helping them reflect on gameplay better. However, they also highlight concerns if the system is not integrated well into the game and the real-world environment. Our findings demonstrate the value of having support in the early moments of emotional distress that lead to lasting frustration, suggesting a new direction for preventative intervention systems for gaming environments.

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