The Potential of Game Streaming as Exposure Therapy for Social Anxiety

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Social anxiety is a prevalent problem that affects many people with varying severity; digital exposure therapy—which involves controlled exposure to simulations of feared social situations alongside cognitive restructuring—can help treat patients with anxieties. However, the need to personalize exposure scenarios and simulate audiences are barriers to treating social anxieties through digital exposure. In this paper, we propose game streaming as an exposure therapy paradigm for social anxiety, supporting it with data from two studies. We first propose a framework describing requirements for exposure therapy and how game streaming can fulfill them. We select demand and performance visibility from these characteristics to showcase how to manipulate them for experiences of gradual exposure. With Study 1, we provide evidence for these characteristics and support for the framework by showing that a game's demand affected expected fear of streaming games. In Study 2, we show that the prospect of streaming led to elevated fear, a necessary property for effective exposure therapy. Further, we show that the effect of streaming on expected fear was similar for participants who can be considered socially anxious. These findings provide evidence for the essential effect of exposure therapy, which serves as a first step towards the validation of streaming as a social anxiety treatment. Our paper provides an initial, important step towards a novel, broadly applicable, and widely accessible digital approach for the treatment of social anxiety.

CCS Concepts: • **Human-centered computing** → **Empirical studies in HCI**; • **Applied computing** → **Consumer health**; **Health informatics**; **Computer games**.

Additional Key Words and Phrases: streaming; Twitch; social anxiety; treatment; exposure therapy; video games; digital games; health

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1 INTRODUCTION

The wellbeing of humans depends on having social relationships [118], as a sense of belonging is a fundamental human need [109]. For some people, socializing can be challenging due to *social anxiety*, i.e., a fear of social situations [2] and negative evaluation from others [115]. Social anxiety can have severe consequences for individuals [6, 7], and is associated with other health problems,

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such as depression [116] or substance dependence [122]. Further, the secondary effects of social anxiety can be problematic for society at large, by affecting the work life of individuals through unemployment [7, 80] and absenteeism [34, 121] and an increased need for social support [26, 76].

Social anxiety is treatable, and successful treatments often involve some form of exposure therapy, i.e., a psychological treatment, in which patients face their fears in controlled environments under the guidance of a therapist [4]. For example, exposure therapy for arachnophobia (fear of spiders) involves controlled exposure to spiders [46], and exposure therapy for social anxiety involves controlled exposure to feared social interactions, such as giving a presentation in front of an audience [8, 64] or performing in improvisation theatre [37]. The overarching goal of these interventions is to help the individual to gain resilience against these perceived social threats by deconstructing negative thoughts and replacing them with healthy ones [5, 98]. Due to challenges related to scale (i.e., the need for treatment exceeds the number of therapists), access (i.e., financial and geographical restrictions to treatment), and difficulty in controlling external environments, treatment approaches often involve digital variants of exposure, e.g., through the use of virtual reality head-mounted displays [3, 20, 72]. Used quite successfully in treating specific anxieties, such as small animal phobia (e.g., arachnophobia) and anxieties involving physical entities (e.g., fear of heights [33] or claustrophobia [11]), digital exposure therapy has also shown potential for treating social anxiety (e.g., mixed reality exposure [20] or internet and mobile-based interventions [71, 92]). However, digital treatments also have general limitations, including the need to distribute and maintain required hardware, and expensive development of dedicated exposure software. For social anxieties, there are additional barriers to the digitization of exposure therapy. First, the locus of social anxieties is often specific to an individual [115], requiring the development of personalized exposure scenarios (e.g., public speaking, versus small talk at a party). Second, social anxieties involve the fear of evaluation by others [10], requiring effective simulations of social situations or human observers. And third, there is higher risk of drop out. Prior research shows that especially adolescents do not sign up to these interventions or withdraw after a short time due to the lack of motivation or loss of interest [96]. Thus, new approaches might be beneficial to extend the therapists' set of tools for designing and deploying digital exposure therapies for social anxiety.

One such activity that we propose be considered for use in exposure therapy for social anxiety is *digital game streaming*. Game streaming—in which people broadcast themselves playing games to a live audience online—has seen explosive growth in popularity and revenue generation in recent years [61]. Associated both with competitive gaming in front of spectators and with sheer entertainment value [114], streaming is undertaken by professionals with millions of followers (e.g., Ninja [108] or Shroud [50]) and by amateurs who may stream only for a small group of friends. Following early evidence about the relationship between low self-esteem and streaming [55], work suggesting that streaming can contribute to coping with life's challenges [30, 114], and that it can provide a controllable environment for people with social anxiety [70], we argue that streaming has the potential to help people. Due to its characteristics, it may lend itself to exposure therapy for social anxiety. First, game streaming is likely to induce fear in individuals (a necessary component of exposure therapy) because it requires performance, involves social interactions with others, and includes audiences who judge the performance [73, 82]—characteristics of situations that are consistent in activating social anxiety [57]. Second, because the game itself can vary widely in a single streaming context, personalizing treatment to an individual may be as simple as choosing a different game. And third, streaming is familiar to adolescents [41], which is also the time in life when social anxiety often first manifests and when treatments are most effective [75]. However, before developing novel digital treatments that are based on game streaming, we require evidence that streaming itself can trigger fear and performance concern, which is necessary for exposure

therapy. Further, it is likely that not every game activates fear to the same degree, and we should characterise how aspects of games differentially induce fear.

In this paper, we present a framework for the design of streaming interventions. Building on Heimberg et al.'s *Cognitive-Behavioral Model of Social Anxiety* [59], we present requirements for effective exposure therapy and discuss how game streaming fulfills them. We select the factors *demand* and *performance visibility* to exemplify how game design can be manipulated along these characteristics to induce more or less fear, e.g., with high or low demand corresponding to high or low game speed variants of the same game. To empirically investigate our framework, we present two studies that explore if, how, and when the prospect of streaming games affects fear. In Study 1, we investigated how the factors *demand* and *performance visibility* influenced expected fear of game streaming. We showed videos of four different variants of a Fruit Ninja style game (within-subjects) to 40 participants, who rated their expected comfort, familiarity, and fear. In Study 2, 332 participants were shown videos introducing the same game (between-subjects). One group was told that they would play the game while the other was told they would play the game *and livestream* their gameplay to an audience. In both studies, we estimated the participants' level of social anxiety using the Liebowitz Social Anxiety Scale (LSAS) [83], used for subjective assessment of social anxiety.

We propose the concept of game streaming as an exposure therapy approach. Grounded in the *Cognitive-Behavioral Model of Social Anxiety*, we contribute a theoretical framework describing which aspects of games are important for expected fear of streaming. We show that a game's demand significantly affected expected fear of streaming, with more demanding games being associated with higher fear. Conversely, visibility of performance did not significantly affect expected fear. Further, we provide evidence for additional factors related to game streaming that are associated with expected fear (i.e., expected comfort with streaming) and those with no significant observed association (i.e., familiarity with the game). Qualitative responses confirmed the importance of the game's demand and feeling comfortable for expected fear of streaming games. We show that participants experienced significantly higher fear of playing a game when expecting to stream it to an audience. Consistently across studies, estimated social anxiety (through *LSAS Total* scores) had a strong positive relationship with expected fear, i.e., people with higher social anxiety reported higher fear of streaming and playing games. Finally, we find evidence for the effect of streaming on fear of participants who can be considered socially anxious, which is the population that could benefit most from treatment approaches. With this, we provide evidence for the essential effect of exposure therapy, which represents a necessary first step towards livestreaming as therapy.

Our results provide initial evidence that streaming can elicit a fear response, a necessary foundation towards validating game streaming for exposure therapy for social anxiety. In general, the prospect of streaming gameplay led to fear, which is a necessary aspect of exposure therapy. Our findings further provide evidence for the importance of different game design aspects, e.g., that highly-demanding games led to more fear and that being comfortable predicted fear while familiarity with the game showed no significant association with expected fear. Additional research is needed to fully realize game streaming as exposure therapy for social anxiety—such as exploring experienced fear, the generalizability across different types of games and genres, how user interface components influence fear, and how streaming works in a clinical context over time. Yet, this paper argues for—and demonstrates initial evidence for the essential effect of—game streaming as a widely accessible, broadly applicable, easily personalizable, inexpensive, and thus potentially useful approach in the treatment of social anxiety.

2 BACKGROUND AND RELATED WORK

We contextualize our work in literature related to social anxiety, exposure therapy, and game streaming.

2.1 The Characteristics of Social Anxiety

Social Anxiety is characterized by an intense fear of negative evaluation from others in social or performance-related interactions. This fear results either in changes in an individual's behaviour, e.g., social withdrawal or even aggressive behaviour [53, 87, 124], or in physical symptoms such as blushing, trembling or sweating. With a prevalence of 2% in the general population, social anxiety is one of the most prominent anxiety disorders [35, 36]. Social anxiety is most accurately described on a severity spectrum, on which one can experience a high degree of social anxiety but not meet diagnostic criteria for social anxiety disorder [106, 115]. Furthermore, social anxiety is highly comorbid with other mental illnesses, including depression and other anxiety disorders [77, 95]. Yet, due to similar characteristics, it is often mistaken for shyness by others or perceived as a character flaw by the individual themselves [60, 103]. As a result, socially-anxious people experience greater difficulties in forming new relationships [90], maintain fewer relationships with others [28], and are generally less accepted or even ignored by others [93]. They also have a greater risk of being bullied [18, 99], with differing levels of social competence leading to victimization by others [25, 113].

As indicated by several models [21, 58, 105, 112], the experience of social anxiety revolves around the discrepancy of two major components: the image of oneself and the perceived expectations of an audience. For the experience of social anxiety, the individual first needs to perceive an audience in the environment. However, in the context of social anxiety what is considered an "audience" can vary by individual. For example, giving a presentation in front of a large but familiar audience may induce no fear, whereas giving the same presentation in front of a small but unfamiliar audience may induce fear [87]. Once an individual recognizes a potential audience and there is the possibility to be evaluated, two mental processes start. First, an internal mental representation is formed of how the audience may perceive the individual. This image is affected by different sources, such as previous experiences and the (likely) distorted recollection of them [62], the context of the situation [97], and cultural expectations [16]. In addition, the (social) environment is scanned by the individual to detect potential social threats. As previous research shows, this allocation of attentional resources may result in a worse performance in complex tasks [59, 88], compounding the expected fear of performing again. Second, the perceived self-image is then projected onto the perceived expectations of the audience. As previous research shows, socially-anxious individuals tend to overestimate the expectations of the audience and fear that they will not satisfy these high standards [47]. The individual judges the probability and effects of negative evaluation by the audience. Biased by memories of past social "failures", the individual will likely judge that a current situation will go poorly [58]. To help patients suffering under these conditions, mental health professional may turn to treatment via cognitive behavioural therapy.

2.2 Cognitive Behavioural Therapy and Exposure Techniques for Social Anxiety

Cognitive behavioural therapy (CBT) for social anxiety includes cognitive restructuring and exposure to social situations [98]. Heimberg [57] provides a comprehensive overview of CBT for social anxiety, which explains that exposure therapies help patients to restructure the mental image of themselves and their surrounding environment. These exposures are typically delivered in a variety of formats (e.g., for individuals or groups), settings (e.g., outpatient clinical or inpatient services),

and duration. The exposure component consists of graduated exercises targeting social anxiety related concerns (e.g., performing in front of others) and helping people encounter previously avoided experiences. The underlying mechanism of effectiveness may induce learned habituation, initial fear activation followed by fear reduction, or inhibitory learning, emphasizing the development of new, non-fear related associations, which become more accessible across time and context [56]. For an effective treatment, the patient must be completely engaged in the feared situation, giving their undivided attention to the situation and the resulting occurrence of anxiety and arousal [57]. The cognitive restructuring component for social anxiety, although questioned by prior work [63, 86], involves the re-evaluation of the distorted interpretation of social situations by considering newly gained information through the exposure, e.g., that patients learn that a particular audience may not be a threat for them.

To lower accessibility barriers to CBT, patients can benefit from alternative approaches that are easier to access and less stigmatizing. Digital solutions, such as internet and mobile-based interventions, offer ways to lower these barriers. Prior work shows positive effects of guided as well as unguided digital interventions in lowering the experience of social anxiety [9, 45, 71]. These benefits are partially attributable to the findings that socially-anxious individuals prefer online communication tools, such as text messaging, over face-to-face communication [102]. Other research also suggests that social anxiety patients might prefer digitized treatment variants. For example, it has been shown that social anxiety is a strong predictor for problematic internet usage [24, 104] because affected individuals may feel more in control about the potential threats online. In the context of digital games, social anxiety biases the players' preferences, drawing them towards social gaming genres, such as Massive Multiplayer Online Roleplaying Games (MMORPGs) [100]. However, recent work shows that characteristics of social anxiety manifest in digital games, such as MMORPGs, leading affected individuals to withdraw from highly performance-focused activities and social activities in-game [31, 81]. Yet, even with the barriers induced by social anxiety, affected individuals enjoy playing video games. In general, one major motivation for playing video games is to socialize with others [29]. Thus, gaming might be a suitable activity that is accessible and engaging for players, while still retaining the potential to trigger effects of social anxiety.

Cognitive behavioural therapy is a well-established treatment for most anxiety disorders. However, there are several barriers, such as logistical inconvenience, financial costs, the challenge of committing to a potential uncomfortable experience (e.g., exposure to a feared situation) [107], and social stigmata [111]. Further, social anxiety itself raises barriers for treatment. Due to the fear of negative consequences and evaluation by the mental health professional, socially-anxious individuals tend to avoid to reach out for help [80]. Even if individuals reach out, they are at risk of trying to cope with their anxiety by trying to appeal to mental health professional to avoid any negative evaluation. Social anxiety is dependent on the individual's previous memories and the training may require very specific social simulations to evoke a manifestation of social anxiety [21]. Existing digital treatment variants, e.g., in virtual reality environments, face challenges in terms of customization that is complex, expensive, and also a barrier for those without significant development expertise in creating customized virtual reality scenarios [12]. Thus, other forms of treatment might be beneficial, including recent trends of how consumption of digital games has changed, such as to leverage game streaming, which may open a novel alternative to bridge the gap between customized demands and high development costs.

2.3 Game Streaming

With the rise of the internet, broadcasting has expanded beyond traditional media, such as television or radio platforms. New generations of livestreaming platforms allow users to broadcast their content live to their audience, and to host content that can later be consumed at the audience's

leisure [61]. Streaming became a popular way to enjoy playing video games while simultaneously interacting with spectators. In recent years, the consumption of online streams overtook the consumption of traditional cable shows among adolescents [65]. Furthermore, media reports [94] showed that online viewers spent around 8.9 billion hours in 2019 consuming livestreams of games on *Twitch*[1]. Livestreaming began as a niche activity with specific gaming focus but has diversified and has grown into a broader trend that is widely beloved by streamers and viewers alike [84]. The success of livestreaming can be partly explained by the intrinsic motivation of the audience to acquire new skills or techniques for their favorite games [114]. However, streaming may also satisfy the inner need to socialize with others [114], with streaming platforms allowing the audience to connect with other viewers as well as the streamers themselves [52]. In previous research that explored why individuals choose to engage with a livestream, Hasan et al. found that viewers who lack external support spent more time watching livestreams, and that viewers of smaller channels were more socially motivated than large-channel viewers [55].

One hypothesis of why people enjoy consuming livestreams is the opportunity to socialize with others, which is more smoothly integrated as compared to in other media platforms. Stream communities can be seen as social groups, which form around the streaming content, in which users may exchange their thoughts with others [52], and which create the sense of connection with others [114]. These effects seem to be more prevalent in small channels and weaker in larger channels, because the connection between the audience and the streamer weakens with increasing numbers of viewers. Earlier work on the usage of online platforms in the context of social anxiety indicates that socially-anxious individuals prefer digital platforms with asynchronous communication, such as online chats [102] and social media platforms [1] over face-to-face communication with others. Similarly, work in the context of game preferences suggests that players are drawn to social interactions that are mediated by gaming technology. For example, it has been suggested that socially-anxious players prefer highly social game genres, such as MMORPGs. In these game worlds, players feel more socially competent, thus finding it easier to socialize with other players in the digital world [81]. Earlier research has considered game streaming as performative, especially considering the broadcast for particular audiences [101]. Due to this natural presence of an audience who undertake potential evaluation of the streamer's performance, and the inherent interaction with others, the social context of streaming in itself seems to be highly relevant for investigations in social anxiety. Further, this supports that streaming might be well suited for exposure therapy for social anxiety, a notion that we will explore in more detail subsequently.

2.4 Summary

In summary, exposure therapy is an essential part of the treatment for social anxiety. Digital approaches are promising but existing variants, such as those using virtual reality, suffer from challenges like low prevalence of devices and associated problems like limited remote treatment. Streaming could help. Yet, there is no evidence that streaming will generate fear among people with elevated social anxiety, nor is there any indication of how specific parameters of the game itself will affect an individual's expected fear. In this paper, we explore these questions. First, we will elaborate why video game streaming has characteristics that suggest its potential for exposure therapy.

3 DESIGN FRAMEWORK: STREAMING AS EXPOSURE THERAPY

Grounded in theories of social anxiety, and literature on game streaming, we define characteristics that are important for exposure therapy and describe how game streaming naturally fulfills the

[1] https://twitch.tv

requirements for exposure therapy. Heimberg [57] gives an overview of the current status of, and future directions for, CBT for social anxiety. His work is grounded in the model of social anxiety provided by Clark and Wells [22]. We draw heavily from these two works in establishing the basis of CBT for anxiety, and how exposure therapy functions in treating this mental health concern.

3.1 Requirements of Exposure Therapy for Social Anxiety

The core of most exercises within exposure therapy for social anxiety is that, together with a therapist, the patient trains how to behave in certain situations while being observed by an audience, and how to deal with potential failure or success in social situations [57]. Thus, patients are in a way performing in front of an audience, who have the capacity to judge the patient and make their opinion of the performance known. As such, the quality of the patient's performance on the task must be made visible to the audience. Indicators about one's own performance in comparison with others may intensify the experience of being watched by others [23]. Within the context of social anxiety, performance visibility may ignite concerns about continuing to perform, potentially leading to an even more distorted perception of the audience's reaction.

The task itself must be something that completely engages the patient, capturing their focus [38] and engaging them enough for the "*inevitable rush of anxiety and arousal to occur*" [57]. Due to the discomfort of this experience, patients may employ a coping mechanism during an exposure, in which they find ways to cognitively disengage, stop paying attention, or distract themselves [57]. As such, the task must maintain the patient's attention and focus over the duration of the exposure [125], perhaps by being sufficiently engaging or attentionally demanding. The demand of a task may affect an individual's assessment of the possibility of failing in front of others. A task with an easy way to succeed is likely to be experienced as less stressful than a complex or demanding task. Previous research shows that individuals higher in social anxiety avoid highly challenging tasks [31]. Finally, the intensity of the exposure must be matched to the individual patient; gradual exposure is an important characteristic in learning cognitive reframing.

Taken together, an effective exposure task for social anxiety requires: a *performance*, an *audience*, potential *judgement from the audience*, and *sustained engagement / focused attention*. Further, performance on the task should be made *visible* to the audience, and the task itself should be sufficiently *demanding*. And finally, the *intensity of the exposure* should be manipulable for personalized treatments and gradual increases in exposure over time.

Requirements of Exposure Therapy for Social Anxiety	*Characteristics of Game Streaming that Satisfy these Requirements*
A demanding task	Demands of interactivity; cognitive, emotional, physical, and social demands
A visible performance	Visual/auditory feedback of score, wins, losses, successes, failures; leaderboards
An audience (simulated or real)	Online spectators, can vary in size, responsiveness, and affect
Potential judgement from audience	Visible execution, audience reactions through chat, emojis
Sustained engagement / focused attention	Engaging game design that promotes immersion, game mechanics demand sustained participation
Gradual exposure / varying intensity	Manipulation of game demand and audience composition, size, and affect

Table 1. Left: The requirements of exposure therapy for social anxiety, as established in literature. Right: Example features of game streaming that may satisfy these requirements, as argued in this paper.

3.2 How Game Streaming Satisfies the Requirements of Exposure Therapy for Social Anxiety

As described in Section 2.3, game streaming is the act of playing a game in front of an online audience. The very act of playing a videogame (whether in front of an audience or not) is demanding. As argued by Bowman [14], at its most basic level, the interactivity of gaming places a requirement on the player to *"actively and constantly respond to on-screen displays in order to continue the digital experience (e.g., demanding of the user's attentional, emotional, or other resources)"*. However, the demanding nature of playing games goes beyond the basic requirements stemming from interactivity, but also involves cognitive, emotional, physical, and social demands [15]—playing games requires us to think, feel, engage physically, and react and respond to other players and characters. When players respond to these game demands, it can generate an experience of feeling immersed in the game [68], which can lead to experiences of sustained engagement and focused attention, such as flow [27, 117]. Players are generally aware of how well they are meeting the demands of the game: performance is made visible through feedback, ranging from simple visual feedback for the player's actions (e.g., a flashing visual effect or showing a score) to complex systems, such as comparing the player's performance with other players (e.g., leaderboards). Prior research shows that such visualisations affect the player's perception of their competence, autonomy, and presence [13]. To change the intensity of exposure, game features (e.g., game difficulty, leaderboards) can be varied that yield different demands, and performance can be made more or less visible through the use of feedback and more or less important through game mechanics (e.g., multiple lives, health bar recovery rate).

Streaming may add additional demands beyond those inherent in simply playing a game, because as a streamer, it is considered important to perform for one's audience [101]. This could take the form of delivering on highly-skilled gameplay, being engaged with one's audience and answering questions quickly, or being entertaining. For the streamer, this demand likely depends on their own goals, i.e., how they want to be perceived, as well as the audience's expectations [54]. Additionally, streamers are aware that they are performing in front of an audience, resulting in an inherent experience of being watched by others. Audiences usually see how players are performing in the game because streams mirror what players see. As such, audiences will realize when a streamer's performance is not in line with expectations, e.g., if a speedrunner did not reach their goal time. Audiences express their reactions to the streamer's performance though live chat, emoji reactions, and even reaction videos in which they stream their reaction to a streamer's posted video. To support gradual exposure, different streaming characteristics (e.g., size, composition, responsiveness, affect of audience) can be employed that activate more or less fear.

Table 1 summarizes the requirements of exposure therapy for social anxiety (see Section 3.1)—as established in literature—along with features of game streaming that may satisfy these requirements—as we argued above.

4 STUDY 1

In Section 3, we described characteristics required for effective exposure therapy and how game streaming meets those. Now, in Study 1, we empirically investigate how some of these characteristics affect the effectiveness of game streaming for elevating fear.

4.1 Methods of Study 1: Game & Manipulation of Game Streaming Characteristics

For this study, we selected *a demanding task* and *a visible performance* from the set of requirements important for exposure therapy that can be met by games in a variety of ways.

Game: Fruit Warrior II. We designed and implemented *Fruit Warrior II* based on *Fruit Ninja* [51] for this paper (see Figure 1). We implemented four versions of the game with different game mechanics to exemplify the design framework and to evaluate how these specific characteristics of the framework affect fear. In *Fruit Warrior II*, players slice fruits that are floating on the screen. Most of the game's characteristics and mechanics surrounding this core concept are implemented to lead to high or low demand and visibility. Table 2 shows a non-exhaustive list of game design aspects for *Fruit Warrior II* that result in low and high demand and visibility.

	Manipulated Game Design Aspect	*High*	*Low*
Demand	possibility to lose	life system	no life system
	higher possibility for failures	bombs	no bombs
	possibility for high/low performance	score	no score
	game pace	fast	slow
Visibility	explicit progress indication	numerical score	abstract progress bar
	visual feedback for performance	visual effects	no effects
	social comparison to other players	current rank displayed	rank not visible
	social comparison to other players	leaderboard	no leaderboard

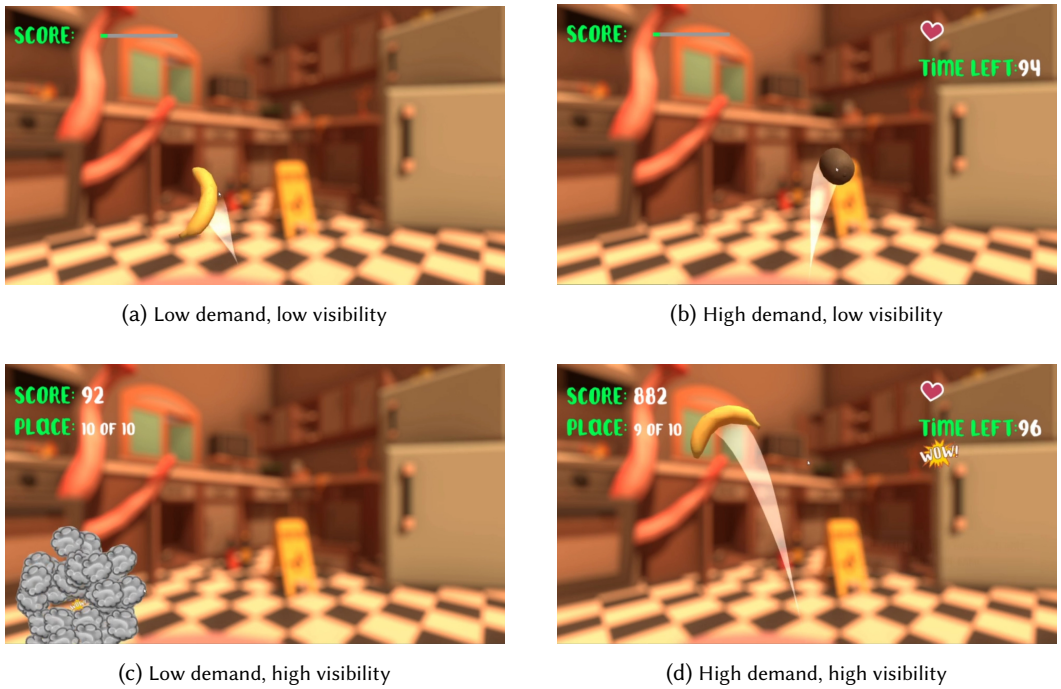
Table 2. Exemplary list of game mechanics for a Fruit Ninja style game supporting high vs low demand and performance visibility.

Manipulating Demand. We manipulated demand through the game's difficulty, following earlier work that conceptualized difficulty as an increased opportunity for failures [85]. In our game, we implemented this by inclusion of the *possibility of losing* a game or not (*life system* vs *no life system*) and additional *opportunities for failures*, through the inclusion of *bombs* or *no bombs* as elements that resulted in failures, similar to difficulty manipulation through the number of obstacles in earlier work [43]. We used *fast* vs *slow* game *pace* to manipulate difficulty, which intuitively affects a game's demand and has been used in earlier work using dynamic difficulty approaches [43, 119]. Finally, we manipulated the *possibility of high/low performance* through presence of a *score* vs *no score* as a measure of the players' performance, i.e., how well they are doing in the game [19, 44]. This inclusion of a score supported the opportunity to achieve a higher or lower score, which in turn could trigger anxiety through higher perceived demand, e.g., if a player performs worse.

Manipulating Visibility. We used four game design aspects to manipulate visibility of the players' performance to their audience. This involved making *score explicit* or not (*numerical score* vs *abstract progress bar*), which aimed to provide the audience with an continuous display of how well players are doing. We used the presence of *visual feedback for performance* [126] (*visual effects* vs *no effects*) to draw attention to performance in microtasks. This involved things like *"wow"*-indicators for correctly slicing fruits as well as *skulls-and-bones* effects for the loss of lives, making it obvious to viewers if the player makes a mistake. In addition, we used two types of *social comparison* by introducing a *rank system*. For high visibility, we showed the player's *current rank* in contrast to other players as well as a concluding *leaderboard* [13] that drew further attention to this at the end of the game.

4.2 Study Design, Game Variants and Video Previews in Study 1

We empirically investigated how the prospect of streaming activities with varying demand and performance visibility affects the players' expected fear. This resulted in a 2x2 within-subjects



(a) Low demand, low visibility

(b) High demand, low visibility

(c) Low demand, high visibility

(d) High demand, high visibility

Fig. 1. Screenshots from the introduction videos in Study 1 showcasing the different game variants.

design with the factors demand (*high demand* vs *low demand*) and performance visibility (*high visibility* vs *low visibility*), resulting in four conditions (see Figure 1).

For each condition and game variant, we recorded and annotated a 90 second video comprising of a tutorial video showing gameplay and speech bubbles (with consistent wording for the same mechanics) that explained the game mechanics (60 seconds) and a mock-up stream that embedded a gameplay video in a streaming interface similar to *Twitch*, e.g., with a mock-up viewer counter and chat window, in which fake messages were added periodically to give the impression of a regular video stream chat (see Figure 2 right as an example for this in Study 2). We chose this approach over using an existing platform like Twitch for ease of implementation considering that we needed to ensure videos included chat messages that were believably sent by other people. All conditions used different text messages because of the within-subjects design but they were designed to have the same number of positive and negative statements.

We conducted a small validation pilot, in which 4 participants watched the gameplay parts of the four game variant videos (counterbalanced within-subjects) and rated demand and performance visibility on scales from 1 (= *"not <demanding/visible>"*) to 100 (= *"extremely <demanding/visible>"*). The results from this pilot confirmed that our videos were perceived as intended. The *high demand* condition ($M = 43.75$) was perceived as more demanding than the *low demand* variant ($M = 11.25$). The *high visibility* ($M = 84.38$) condition was perceived as more visible in terms of their performance than the *low visibility* variant ($M = 38.13$).

4.3 Procedure and Participants of Study 1

We implemented an online experiment using an existing software framework [69], and deployed it on Amazon Mechanical Turk. Mechanical Turk workers were instructed that they would be

presented videos of four different game variants and that after seeing all four, they would have to livestream gameplay of one of those variants for a usability evaluation. First, participants completed questionnaires about sociodemographic background, experience playing games, and baseline social anxiety (*Liebowitz Social Anxiety Scale (LSAS)* [83]). The *LSAS* consists of 24 scenarios, which are either linked to social interactions (11 items), such as *"meeting strangers"*, or public performance (13 items), such as *"eating in public"*. On two 4-point scales, participants are asked to rate their fear (0 = *"none"* to 3 = *"severe"*) and avoidance (0 = *"never; 0%"* to 3 *"usually; 68%–100%"*) of these situations over the past week. The *LSAS* is a valid tool for measuring social anxiety assessment through self-report [40, 49]. The *LSAS Total Score* (sum of all scores) represents the participants' degree of social anxiety. People with scores above 30 can be considered to have social anxiety and those with scores exceeding 60 are potentially affected by generalized social anxiety disorder, subject to clinical diagnosis [110]. Similar to earlier work [31, 32, 48, 74, 79, 91], we used the *LSAS Total Score* as a baseline measure for social anxiety and not as an dependent outcome measure. Participants also completed the challenge orientation subscale (5 items) of Tondello et al.'s Scale of Game Playing Preferences [120], which measures preferences for challenge and difficulty in games and might be important for their experience of the *high* vs *low demand* conditions. Participants rated their experience playing Fruit Ninja style games (*"Please rate your experience with Fruit Ninja (or similar)"*) from 1 (= *"Novice") to 100 (= "Expert")* and whether they had streaming experience (*"Have you ever streamed your gameplay on platforms like Twitch.tv?"*; *"yes/no"*). The game variants were presented in order (within-subjects and counterbalanced via Latin square), explained via text (e.g., that gameplay was *"<quite/not very> demanding"*) including descriptions of each condition's game mechanics and the 90-second videos. Participants were redirected after the video had been played in full. Then, using scales from 0 to 100, they were asked to rate their *familiarity* with such gameplay (*"On a scale from 0 to 100 (0=not familiar; 100=extremely familiar), please estimate how familiar you are with gameplay of this game variant"*), how *comfortable* they felt (*"On a scale from 0 to 100 (0=not comfortable at all; 100=extremely comfortable), please estimate how comfortable you will feel when streaming your gameplay of this game variant"*), and their expected *fear* of streaming gameplay in this variant (*"On a scale from 0 to 100 (0=no fear; 100=extreme fear), please estimate how much you fear having to stream your gameplay of this game variant."*). We also included an open text field for explanations for their ratings. After the last rating, they were debriefed and compensated and told that they would not have to stream.

50 participants completed the task. We removed invalid responses involving bots and non-diligent respondents by analyzing response times and invalid responses [17, 89] (n = 10) and then had a final sample of 40 participants (men = 28, women = 11, preferred not to disclose = 1), aged 22 to 61 (M = 36.80, SD = 9.98). They mostly played games regularly (*"every day"* = 19, *"a few times per week"* = 11, *"a few times per month"* = 7, *"a few times per year"* = 2, *"never"* = 1), and identified as gamers to a moderately high degree (M = 60.825) on a scale from 1 (= *"not at all"*) to 100 (= *"gamer"*). Their experience with game streaming was moderate; 27.5% reported to have streamed games before and 77.5% had watched gaming streams before. We used the *Liebowitz Social Anxiety Scale (LSAS)* to measure their baseline social anxiety levels. In this study, the participants' LSAS total scores ranged from 6 to 104 (M = 54.95, SD = 28.09) and were comparable to other samples from Amazon Mechanical Turk [31].

4.4 Results of Study 1

Our main interest was testing if demand and visibility affected expected fear and secondly which contextual factors affected fear. We used 2x2 repeated measures ANCOVA to test the effects of the conditions (*demand* and *visibility*) on *expected familiarity*, *expected comfort*, and *expected fear* while controlling for baseline *LSAS Total Score*, *challenge orientation*, *previous streaming experience*,

and *experience with Fruit Ninja*. All analyses in this paper were conducted using JASP 0.14.1 [67]. Table 3 shows descriptive statistics across conditions.

	HD/HV	*HD/LV*	*LD/HV*	*LD/LV*
Familiarity	64.700 (28.580)	65.825 (30.954)	66.925 (30.213)	67.550 (29.549)
Comfort	63.950 (28.539)	66.375 (27.406)	70.475 (29.149)	71.650 (29.292)
Fear	36.925 (33.884)	35.725 (30.446)	33.475 (32.433)	33.175 (35.323)

Table 3. Means (and standard deviations) for expected familiarity, comfort, and fear ratings across the four conditions in Study 1 (high/low demand (HD/LD) and visibility (HV/LV).

An ANCOVA showed that expected familiarity was not significantly affected by *demand* ($F(1, 35) = 1.111$, $p = .299$, $\eta_p^2 = .002$) or *visibility* ($F(1, 35) = 2.235$, $p = .144$, $\eta_p^2 < .001$). Similarly, *expected comfort* was not significantly affected by *demand* ($F(1, 35) = 1.453$, $p = .236$, $\eta_p^2 = .004$) or *visibility* ($F(1, 35) = 2.348$, $p = .134$, $\eta_p^2 = .001$). However, the *expected fear* of the streaming situation was significantly affected by *demand* with a medium sized effect ($F(1, 35) = 4.426$, $p = .043$, $\eta_p^2 = .112$) but not *visibility* ($F(1, 35) = 0.247$, $p = .622$, $\eta_p^2 = .007$).

Expected fear was positively associated with *LSAS Total* score ($r = .501$, $p < .001$) (see Figure 3). Additionally, we inspected the correlations for *expected fear* with the potentially related factors *expected familiarity*, *expected comfort*, and *challenge orientation*, suggesting potential associations between *expected fear* and *expected comfort* ($r = -.264$, $p < .001$), while the association with *expected familiarity* ($r = .006$, $p = .936$). was not significant. We used a linear mixed model to test for these effects while accounting for the non-independence resulting from the design, in which we measured *expected fear*, *expected comfort*, and *expected familiarity* as within-subjects, i.e., four times per participants, once for each condition. A maximal model including interaction effects did not converge. Thus, we used a linear mixed model without interactions but full random effects structure including random intercepts, random slopes, and correlations, Satterthwaite approximation, the predictors *LSAS Total* score, *expected comfort*, and *expected familiarity*, and the random effects grouping factor *participant ID*. The model showed that *fear of social situations and performance* was significantly and positively associated with *expected fear*, while *expected comfort* was a significant negative predictor, and *expected familiarity* was not a significant predictor. See Table 4 for an overview.

	B	*se B*	*df*	*t*	*F*	*p*
Intercept	20.878	11.001	27.536	1.898		0.068
LSAS Total Score	0.631	0.124	31.352	5.072	25.724	$< 0.001^{***}$
Comfort	−0.303	0.107	21.844	−2.829	8.004	0.010^{*}
Familiarity	0.025	0.098	14.052	0.250	0.063	0.806

Table 4. Results for the linear mixed effects model predicting expected fear. $^{*}p < .05$ $^{***}p < .001$

Participants' Open-ended Responses in Study 1. Participants were asked to explain their reasoning for their expectation ratings. We used a content analysis approach [78] to analyze responses, investigating explicit and implicit references to demand and visibility and how they elicit fear. Content analysis was chosen over other forms of qualitative analysis (e.g., thematic analysis), as it is a lightweight approach appropriate for the fidelity of the data. Some participants expressed general fear of streaming gameplay because of the audience: *"If someone would watch me I would*

feel nervous to the point that I would not perform as well as I was alone." (P35), *"I do have some fear about streaming it to others"* (P31), and *"I don't want others to watch how I perform because it will make me nervous especially if they start saying mean things to me"* (P39). Participants noted that making mistakes in front of an audience adds an additional layer of anxiety to the situation: *"fear of playing the game (clicking the bomb) added to fear of being watched"* (P13). Further, the responses were in line with the quantitative results in that they highlighted the importance of demand. For instance, P12 described *high demand* as follows: *"The difficulty is pretty high, so I might struggle at the beginning. I would be a little anxious about other people watching me if I do struggle."* This came up repeatedly, e.g., *"More focus on performance means more opportunities for you to screw up in front of other people."* (P20, *high demand*). Similarly, lower demand was expected to be less fear-inducing: *"I would feel no fear. Given this level of gameplay is even easier, I would feel very comfortable"* (P51, *low demand*), *"considering how slow the fruits were going, I feel extremely comfortable playing it. And I would not be nervous to play it in front of a group"* (P31, *low demand*), and *"I would feel comfortable playing this because of how slow and low-pressure it is, and that includes playing it in front of an audience"* (P31, *low demand*).

4.5 Discussion of Study 1

The visibility of performance did not affect expected fear significantly, which could indicate that performance visibility may be less important for expected fear in streaming a game. However, it is also possible that it is not a construct that is associated with fear linearly but rather a necessary property, i.e., performance has to be visible enough to enable a streaming activity to induce fear but it does not increase fear further once the necessary level has been reached.

In terms of demand, participants experienced significantly higher fear when they expected to play a highly demanding game compared to a less demanding game. This highlights that fear depended on the game's perceived demand, which is in line with the importance of performance concern in social anxiety. First, this indicates that demand is a characteristic of game streaming that affects fear, which supports the notion that a game can be manipulated along the requirements for social anxiety exposure therapy (see Section 3.1). This finding is an important consideration for our evaluation of the fear response: participants needed to perceive a game as demanding to experience a fear of the situation. Finally, this is also important for considering how social anxiety occurs naturally in a game streaming context.

Our data suggests that not *familiarity* with a game in itself but *expected comfort* was important, which was significantly and negatively associated with *expected fear*. So, while individuals did not have to be unfamiliar with a game to fear the situation, they had to feel uncomfortable about streaming a particular game to experience fear. Our results suggest that this was possible when they perceived a game as highly demanding. Then, this could lead to fear of being negatively evaluated for their mistakes, as is common for individuals with levels of social anxiety [123]. Further, expected fear had a positive association with fear of social situations and performance, suggesting that participants with a tendency for social anxiety did experience more fear (see also Section 5.4).

5 STUDY 2

In the second study, we aimed to assess essential effect to be used in exposure therapy, i.e., whether streaming play leads to higher fear than just playing a game. In particular, we investigated if the prospect of game streaming was associated with higher fear. We implemented a between-subjects study, in which participants were asked to play a game, while instructing them that their gameplay would be streamed to an audience (*stream* condition) or omitting this instruction (*no stream* condition).

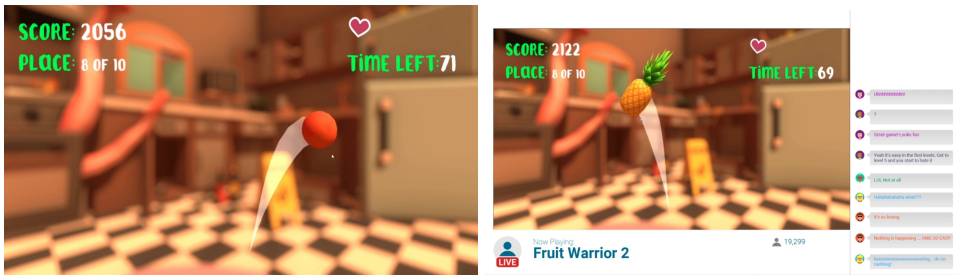


Fig. 2. Screenshots from the conditions in Study 2: Gameplay only (*no stream* condition, left) and gameplay embedded in a streaming interface (*stream* condition, right).

5.1 Game and Video Previews in Study 2

We used a variant of *Fruit Warrior II*, introduced in Section 4. In particular, we used the high-demand/high-visibility variant of the game, including a life system, bombs, a time limit, a leaderboard, and high game speed. This variant was chosen because high demand activated fear more than low demand in Study 1, and high visibility was important for fear from a theoretical standpoint even if it did not lead to significantly higher fear in Study 1.

Using this game, we recorded two different videos for the conditions. They showcased gameplay and the interaction with the streaming environment for the *stream* condition. The videos had the same length (= 136 seconds), were structured with splash screens showing the same game name (= *"Fruit Warrior II"*), and the same game tutorial part (= 30 seconds). The rest of the videos showed an extended preview of the gameplay itself. They showed the same gameplay while the surrounding interface of the *stream* condition was designed to give the impression of gameplay streaming similar to platforms like *Twitch* with a live indicator and mock-ups of a viewer count and a live chat (see Figure 2).

5.2 Procedure and Participants in Study 2

The technical setup of this study was similar to the one used in Study 1. Participants provided informed consent, answered questionnaires about their sociodemographic and gaming background, and challenge orientation [120]. Again, we used the *LSAS Total* score [83] to assess their baseline social anxiety levels. Then, they were told that they would interact with a game prototype to evaluate its usability. Participants were shown one of two descriptions (including the instructions for streaming or not; assigned pseudorandomly) and the teaser video based on the condition. The videos were embedded on the instructions pages, also stating for the *stream* condition that other participants were watching the participants, would be able to see how well they were doing, and might comment on their performance. After the videos had finished, participants were redirected to the next page, on which they were asked to rate their expected *fear* of the upcoming task on a scale from 0 to 100 (0 = *"no fear"*; 100 = *"extreme fear"*). Then, they were debriefed, including the information that they did not actually have to stream gameplay, and were compensated. See Study 1 procedure for descriptions and wording of measures.

We recruited 402 participants (mutually exclusive from Study 1). After removing data (n = 71) according to a validation protocol similar to Study 1, the remaining 331 participants (men = 190, non-binary = 1, women = 135, preferred not to disclose = 3, preferred to self-describe = 2: *"Trans Woman"* and *"Male"*) were aged 18 to 71 (M = 39.124, SD = 11.186), overwhelmingly played games regularly (*"every day"* = 135, *"a few times per week"* = 129, *"a few times per month"* = 39, *"a few times per year"* = 20, *"never"* = 8), and identified as gamers to a moderately high degree (M = 61.736,

$SD = 31.009$). Their experience with game streaming was comparable to participants in Study 1 and moderate; 34.4% had streamed games before and 72.8% had watched gaming streams before. Their *LSAS Total* scores ranged from 0 to 134 ($M = 59.11$, $SD = 31.24$) and did not differ significantly between conditions ($t(329) = 1.408$, $p = .160$). Participants were assigned pseudorandomly to the conditions ($stream = 164$, $no\ stream = 173$).

5.3 Results for Study 2

Our main interest was to test if the *expected fear* of the upcoming task depended on whether participants were expecting to stream gameplay to an audience or not (*stream* vs *no stream*). To that end, we conducted an ANCOVA testing the main effect of condition on expected fear while controlling for several factors. These covariates were generally associated with expected fear. Expected fear was significantly associated with *LSAS Total* score ($F(1, 325) = 59.426$, $p < .001$, $\eta_p^2 = .155$), suggesting that people with higher social anxiety scores tended to experience higher fear. Further, there was a significant association of expected fear with *challenge orientation* ($F(1, 325) = 7.379$, $p = .007$, $\eta_p^2 = .022$), and whether they had streamed before (dummy coded binary *streaming experience*, $F(1, 325) = 18.663$, $p < .001$, $\eta_p^2 = .054$), but the association with *experience playing Fruit Ninja* (a game similar to ours) did not reach significance, $F(1, 325) = 3.349$, $p = .068$, $\eta_p^2 = .010$.

While controlling for these covariates, the main effect of interest suggested that condition significantly affected expected fear, ($F(1, 325) = 6.711$, $p = .010$, $\eta_p^2 = .020$) with the *stream* condition eliciting significantly higher expected fear than the *no stream* condition with a small to medium effect size ($d = .237$, see Table 5).

	Stream	*No Stream*
Fear	30.870 (33.111)	21.565 (30.885)

Table 5. Means (and standard deviations) for expected fear ratings in the conditions in Study 2.

The fear response of people with social anxiety is particularly relevant for the treatment of social anxiety, which is our ultimate research goal. While we require further studies (ideally in clinical contexts) that explicitly test participants from such a population, we conducted an initial investigation of this effect. We selected the participants with *LSAS Total Scores* above 30 ($n = 255$: *stream* = 127, *no stream* = 128), i.e., participants who can be considered socially anxious [110], and tested the main effect of streaming to elicit fear. We conducted a similar ANCOVA as described earlier. Covariates showed similar patterns, with significant associations of fear with *LSAS Total Fear* ($F(1, 249) = 21.414$, $p < .001$, $\eta_p^2 = .079$), *challenge orientation* ($F(1, 249) = 5.706$, $p = .018$, $\eta_p^2 = .022$), and *streaming experience* ($F(1, 249) = 3.291$, $p < .001$, $\eta_p^2 = .054$). In contrast, the *experience playing Fruit Ninja* was not significantly associated with expected fear ($F(1, 249) = 3.291$, $p = .071$, $\eta_p^2 = .013$).

The effect of streaming was significant ($F(1, 249) = 4.273$, $p = .040$, $\eta_p^2 = .017$) with comparable effect sizes and fear being higher in the *stream* ($M = 37.039$, $SD = 33.567$) compared to the *no stream* ($M = 27.883$, $SD = 33.002$) condition ($d = .229$). This is further evidence that streaming affected expected fear, particularly for participants who can be considered socially anxious.

5.4 Discussion of Study 2

The results of Study 2 suggest that the prospect of game streaming affected expected fear of the participants. The participants in the *stream* condition showed higher expected fear than those in the *no stream* condition suggesting that expecting to stream can induce fear in individuals. Further, our

results show that *LSAS Total* scores, challenge orientation, and previous experience streaming video games were associated with expected fear. This suggests that there are individual characteristics that affect if an individual is more or less subject to expected fear of gameplay.

Expected Fear and Social Anxiety. In both studies, expected fear was strongly and positively associated with *LSAS Total* scores, i.e., baseline social anxiety (see Figure 3). This highlights that participants with a tendency for social anxiety, i.e., higher scores on *LSAS Total*, also experienced more fear of the tasks. This suggests that game playing and streaming might be well suited to trigger fear for socially-anxious individuals in particular, which can be explained by the effect of demand and prior work suggesting that play itself is demanding [14, 15]. While expected fear of playing *and* streaming was predicted by *LSAS* scores, our results suggest that streaming might lead to more fear than playing alone. The main effect of streaming on fear for people with *LSAS Total Scores* above 30 provides further evidence for the fear response of streaming for socially anxious people.

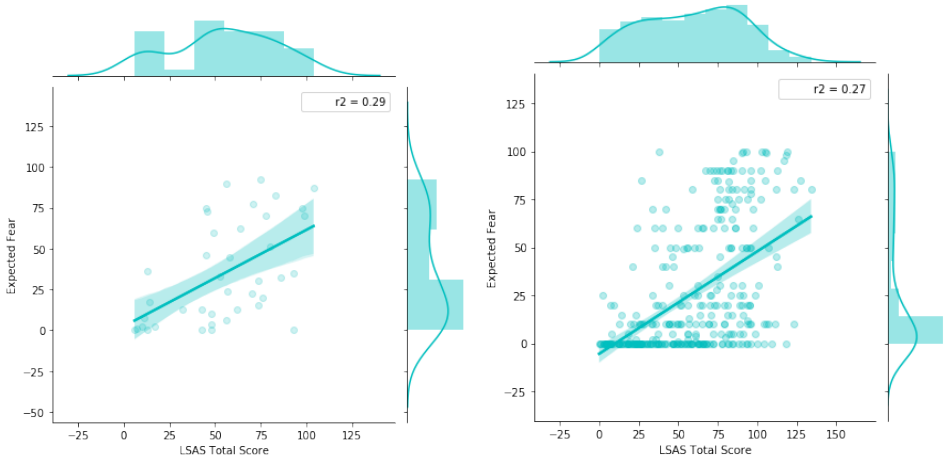


Fig. 3. The association between social anxiety scores (LSAS Total scores) and expected fear in Study 1 (left) and Study 2 (right).

6 GENERAL DISCUSSION

We summarize contributions and results, discuss implications for the treatment of social anxiety, and limitations and future work.

6.1 Summary of Contributions and Findings

Our contributions and results can be summarized as follows:

- We propose the concept of game streaming as an exposure therapy approach for social anxiety.
- We present a framework that argues how game streaming meets the requirements for social anxiety exposure therapy.
- We show that higher demanding games led to more expected fear than lower demanding games in participants who expect to stream gameplay.
- We did not find support that higher performance visibility led to significantly higher expected fear compared to lower performance visibility.

- We found that expected comfort with the upcoming task was a significant, negative predictor for expected fear, but that expected familiarity with the upcoming task was not a significant predictor for expected fear.
- We show that the prospect of *streaming* a game led to higher expected fear than just *playing* a game.
- We show that the effect of streaming on expected fear was also significant for socially-anxious participants in particular, i.e., participants with *LSAS Total Scores* above 30.
- We show that *LSAS Total Score* was a significant positive predictor for expected fear of playing and streaming gameplay.

6.2 Implications for Therapy

Our results provide initial evidence that video game streaming might be useful to trigger a fear response, which is necessary for exposure therapy approaches used in treatment of social anxiety. While we require more research that builds on this initial evidence (see Section 6.4), we briefly discuss this approach's potential benefits for social anxiety treatment.

First, expecting to *stream* a game led to higher fear than expecting to *play* a game. This supports the assumption that game streaming can activate fear in individuals. This means that streaming fulfils an essential requirement of exposure therapy and thus might be beneficial for social anxiety exposure therapy.

The results from both studies show that *LSAS Total* score was a consistently strong, positive predictor for expected fear. This suggests that people with elevated social anxiety levels might be particularly subject to the fear of performing in these studies. In addition, we showed that streaming led to higher expected for for participants who can be considered socially anxious, i.e., with *LSAS Total Scores* above 30. For now, we do not want to overrate this effect, as we require more research with participants who are clinically diagnosed as socially-anxious or to be affected by social anxiety disorder (see Section 6.4), which requires clinical assessment. However, our findings suggest the that streaming can elicit a fear response in convenience samples and specifically for individuals with a tendency for social anxiety, as assessed through *LSAS Total Scores*. As such, this supports the initial evidence that streaming might be useful to trigger fear, which represents the first step towards validating streaming for the treatment of social anxiety.

The findings of Study 1 have implications for the selection and design of games aiming to elicit fear. Our results suggest that highly demanding games led to higher expected fear. This is important in the context of treatment that continuously exposes patients to more fear-inducing situations. Following our results, therapists could select games of lower demand in the beginning of treatment and increase that demand throughout the treatment, e.g., by selecting more demanding games or increasingly challenging difficulty modes. Additionally, streaming as exposure therapy can benefit from the wealth of research on dynamic difficulty adjustment (e.g., [43, 66]) to optimally balance the difficulty of the task to the player's skill or exposure intensity requirement.

Our results also suggest that performance visibility was not affecting expected fear significantly. We require further research to disentangle three potential causes: (1) Performance visibility is indeed not important. (2) Effects were not significant due to sample size and comparably low effect sizes. Further research with more power would be beneficial to investigate this. (3) Performance visibility is not associated with fear in a linear fashion. It makes sense to assume that performance has to be visible to be able to induce performance concern and fear of negative evaluation through the audience at all. Yet, it could be that both high and low performance visibility conditions allowed visibility of performance above this necessary threshold. To investigate this, it might be worth to compare the existing conditions with one in which performance is not visible at all. In summary, in considering the design and selection of games used in game streaming for social anxiety exposure

therapy, we have some evidence of the importance of a game's demand for expected fear of streaming, whereas we require more research on performance visibility.

Therapy should be individualized to keep patients engaged to avoid them not focusing on stimuli, which could diminish the effects of treatment. As such, it is desirable that patients are engaged in tasks. In a way, this may result in a conflicting situation, in which patients must fear the task of the exposure—to elicit the required anxiety—but also must enjoy it—to keep them engaged. The streaming paradigm might be well suited to handle this balancing act by using games that people enjoy, but embedding them in the social situation of streaming, resulting in the necessary social anxiety outcomes. This approach can be customized to use specific games (e.g., from certain genres) that individual patients enjoy to maximize their engagement. As such, streaming would be a universal solution that could be applied to different games, that in turn can be used to cater to individual preferences.

6.3 Implications for Design

While not the main focus of this paper, we will briefly highlight implications for game design and the design of streaming environments.

Our results suggest that higher demand led to higher expected fear of streaming gameplay. Generally, there is a substantial interest of streamers and audiences for particularly challenging play (cf. speedrunning or games like *Dark Souls* [42] or *Getting Over It* [39]). Yet, our results highlight that game designers should be wary of designing highly demanding games with an aim for streaming because this could potentially limit their audience, as some streamers might want to avoid such games due to expected fear of being negatively evaluated if they would stream them. In addition, we require further research to evaluate if these results are specific to *streaming* games or *playing* games in general. This would provide additional insight into the player experience of highly demanding or challenging games. The anxiety induced due to the challenge might be an underconsidered aspect of the player experience of such games. This might be important for understanding the player experiences of players with social anxiety as well as for the design of game mechanics and features (e.g., easy modes) that increase the accessibility of such games to audiences with anxiety.

Our results suggest that streaming games in itself might lead to elevated fear. This is important for the design of streaming environments considering barriers of entry for new streamers. If streamers, especially those with a tendency for social anxiety, experience fear because of performance concern, designers of streaming platforms might help them by supporting them in overcoming initial fears. While we require further work that examines different solutions to this, one could imagine a *"beginner"* streamer mode hiding performance indicators (e.g., mistakes) from viewers or recommender systems for games that are lower in terms of demand, which could help decrease the initial fear of negative evaluation.

6.4 Limitations and Future Work

This paper proposes game streaming as exposure therapy for social anxiety and contributes the evaluation of fear response of streaming, i.e., the necessary effect in exposure therapy as an initial first step. As can be expected when establishing a new research direction, we have identified a number of avenues for future research that will support replication, generalization, validation, and application of our findings.

In this paper, we used only a single game, i.e., a *Fruit Ninja* style game. At this point, we do not yet know if the results replicate with other games. This would be especially important considering the generalizability of the approach, i.e., that making people stream a game would be easily applicable for all types of games. As such, it is important to confirm the effects to provide further evidence

that streaming can elicit fear, representing the first step towards a widely applicable exposure therapy approach for social anxiety, which would be applicable to different games according to the patients' individual preferences.

So far, we showed that streaming can lead to an increase in expected fear but require further evidence in how anxiety develops in further steps employed in exposure therapy. This involves studies that examine if streaming does also lead to higher *experienced* fear while streaming. Further, we require more research on how patients retrospectively evaluate the fear they experienced during streaming, which is important in light of the contextualization of the experience together with medical professionals, i.e., in discussions with therapists, which is important for the treatment [20].

Our results suggest that expected fear was strongly associated with *LSAS Total* score and that streaming affected fear especially for people with *LSAS Total Scores* above 30, suggesting that socially-anxious individuals reported elevated fear for streaming. However, at this point, we only used a convenience sample with social anxiety levels similar to earlier samples from Amazon Mechanical Turk [31]. To show the benefit of streaming for the treatment of social anxiety, we require further work that replicates and builds on these findings in a clinical context, involving with populations with a diagnosis of social anxiety or social anxiety disorder.

In Study 1, we used several game mechanics to manipulate demand and performance visibility. At this stage, we have not yet investigated them individually. For instance, including a rank system might introduce the additional aspect of social comparisons that might be useful to trigger fear response in people with social anxiety but do not yet know how it interacts with the other mechanics. For the design of future intervention approaches, we therefore require further research that disentangles how much the mechanics individually contribute to fear response.

7 CONCLUSION

Social anxiety is a common problem affecting people's health. Therapy approaches, including exposure therapy, are necessary and useful for improving patients' lives. In this paper, we presented the concept of videogame streaming as an intervention approach: It is comparably cheap by not requiring additional implementation effort, easily customizable to the patients' preferences through selection of specific games, and widely accessible by being remotely applicable and not requiring specific hardware solutions. Further, younger generations might be more willing to engage in such low commitment therapy approaches that involve activities that are enjoyable for them. Grounded in the theory of social anxiety and exposure therapy, we presented a theoretical framework that describes how important characteristics of game streaming meet the requirements for exposure therapy for social anxiety. We exemplified how to use these characteristics by manipulating demand and visibility through game design aspects to inform selection and implementation of games used in therapy. Then, in Study 1, we showed that higher demand led to higher expected fear while performance visibility was not significantly, linearly associated with expected fear. In Study 2, we showed that the prospect of streaming induced an elevated level of expected fear, providing evidence for the essential effect that is necessary for exposure therapy. We showed the importance of comfort with a streaming task for activating fear and that socially-anxious participants experienced higher fear. While we require more research about confirmation of findings, effects of engaging in streaming, generalizability, and application with clinical populations, this paper provides a first step towards a novel approach for exposure therapy for social anxiety.

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