Pseudo-Scientist: Towards Narrative Interventions for Imposter Syndrome

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Imposter syndrome (IS) is a mental state that can severely inhibit a person's productivity and well-being. Although IS is extremely common (especially in high achievers, e.g., academics), few studies offer effective modes of support and recovery. In response, we introduce the application of relatable narrative as a way to help people overcome IS. We present a randomized group comparison study exploring the impact of various design factors – specifically, choice-based interactivity and character relatability – on our story's capacity to engage and impact 107 STEM undergraduates. Almost all participants enthusiastically endorsed the story as a valuable learning experience, and a majority reported positive impacts to mood and feelings of relatedness to peers. We discuss 1) how our specific digital story design can support positive changes in mental health at both individual and institutional levels and 2) how our findings can inform efficient design of interactive narrative content for educational applications.

CCS Concepts: • **Applied computing** → **E-learning**; • **Human-centered computing** → **Empirical studies in interaction design**.

Additional Key Words and Phrases: imposter syndrome, storytelling, interactive narrative, relatedness, relatability, choice, interactivity, learning, social support

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1 INTRODUCTION

Imposter syndrome (IS) is broadly characterized as an intense feeling of being a fraud despite objective evidence of competence [7]. While it is wise to have a healthy level of skepticism about one's own abilities, IS emerges when these self-critical feelings become unreasonably strong and begin to interfere with productivity and well-being. IS is a mental state that affects most people at least some point in their lives [75], although it is particularly prevalent within high-achieving and competitive professions (e.g., medicine, academia [5, 34, 44, 77]). While IS affects people

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across professions, students are particularly susceptible because they are relatively unskilled and inexperienced in a highly competitive environment [44, 61]. Importantly, IS can disproportionately impact minorities within a profession (e.g., women and people of color in STEM) [7, 18, 33, 69]. The negative consequences of IS to society are likely vast but difficult to quantify since these feelings generally result in untapped (i.e., self-sabotaged) potential. This is specifically attributable to the individual's pessimistic reactions to tests of ability, where excessive self-doubt and fear of failure lead to a host of negative cognitive and behavioral outcomes (e.g., avoiding challenging career advancement opportunities) [19]. On an individual level, people with IS typically suffer from chronic feelings of anxiety, depression, low self-esteem, and a lack of belonging – all of which can significantly decrease quality and extent of life and contribute to burnout, self-doubt, and beliefs of decreased success [7, 34, 84]. Collectively, these symptoms can lead to comparatively lower performance and ambition for minorities in a field, which can have far-reaching effects such as lost productivity to society and decreased diversity in leadership positions (showing one of many ways that IS can perpetuate itself) [69]. Due to the overwhelming prevalence of IS and its negative impact on both individuals and society, it is crucial to develop a solution that could address IS at scale. As an initial step, we chose to focus on evaluating an early undergraduate demographic because 1) it is known to suffer from high rates of IS [7], 2) it would be less likely to be familiar with or have already overcome IS, and 3) people have greater potential to experience more benefits from an intervention if it happens earlier in their life or career. Reducing the prevalence of IS within educational institutions would help improve students' academic performance, mental and career resilience, and overall well-being [69].

Though IS has been extensively studied, there is still little work demonstrating effective methods for alleviating it [7]. Aside from a peer-group workshop approach [3, 32, 66, 69], narrative therapy is one the few methods that has shown potential for relieving IS [21]. Importantly, IS is a self-perpetuating condition because those who experience it often feel compelled to maintain a facade of confidence, which reduces their ability to seek help or relate to others who feel similarly [11]. Thus, a tool that normalizes the experience of IS and helps sufferers feel more comfortable with communicating about their problems would facilitate a critical first step on the road to mental and behavioral recovery. Since IS is so prevalent across demographics, this tool should ideally be able to resonate with a diverse audience. Interactive narrative is well-known to be a valuable tool for engaging readers with socially complex topics for learning purposes [9] and, crucially, is able to be easily deployed at scale. Therefore, to determine the viability of using interactive narrative as a tool for helping readers (specifically, undergraduates) overcome IS, one main focus of this paper is to report the design and pilot testing of our choice-based story, *Pseudo-Scientist*.

Despite the known value of interactive narrative for captivating an audience [28, 70], there is limited work that empirically evaluates how choice-based interactivity [57, 81, 82] and character relatability [12, 15] affect the extent that a reader is engaged with and impacted by educational story content. In order to maximize impact with finite resources, narrative designers need to understand what kinds of investments are required to design a sufficiently engaging reading experience with a specific topic. The popular psychology framework of Self-Determination Theory (SDT) states that people are optimally engaged with an activity when they are intrinsically motivated, which can be accomplished by stimulating feelings of autonomy (e.g., through the provision of choice), competence (e.g., via performance feedback), and/or relatedness (i.e., the feeling of connection with other people) [72]. Leveraging this theory, we seek to understand how prominent design factors – specifically, choice-based interactivity and character relatability – affect the capacity for our story to engage and impact the reader. SDT predicts that the overtly interactive aspect of our story – affording the reader choices that drive the plot – would generate feelings of autonomy [74]. In parallel, the relatability of the main character – determined in this case by whether the reader

identifies with our depiction of someone with IS experience – would support feelings of relatedness [26, 87]. Thus, the other main focus of this paper is to determine if investing in either of the above design factors was required for our story to achieve its desired effects, as well as to explore why.

Here, we introduce our initial exploration toward understanding whether and why a digital interactive story themed around IS can positively impact undergraduate students. Determining if the story causes positive behavioral outcomes (e.g., by observing whether students end up engaging in meaningful communication about their IS with others) is beyond the scope of this study. Instead, as a critical first step, our main research objective was to determine the viability of this story for normalizing and validating students' feelings of IS. Complementing the expectation that the story would succeed in this endeavor, we suspected that it would also have a positive impact on readers' mood (i.e., they would feel better).

> ***RQ1a**: After reading a relatable interactive story themed around IS, do undergraduate students report improved awareness of IS, specifically within themselves and/or peers, and does this increase in awareness correspond to an improvement in mood?*

Mood has been shown to impact learning and cognitive function, although a clear model for this relationship is still under debate (e.g., negative emotions can enhance learning or cognitive activity, while high-intensity positive emotions may hinder them) [52]. Considering the affective focus of the learning environment offered by our story, we seek to understand how changes in mood may predict increased IS awareness (i.e., learning). To assess the likelihood that the story could support positive behavioral outcomes, we also aimed to explore the dataset for evidence that the story can impact readers' willingness and/or ability to communicate with others about their IS.

> ***RQ1b**: How effective is a relatable interactive story themed around IS for helping readers become more willing and/or able to communicate with others about IS?*

Our other main objective was to explore the ways our chosen design factors – namely, interactivity and character relatability – support the potential effects identified in RQ1. Because we designed the story to primarily help readers develop awareness of IS rather than learn an actionable skill (e.g., how to overcome IS), we did not feel it was relevant to invest in performance feedback as a design feature. Therefore, our scope was limited to investigating the impact of reducing either autonomy (by removing the provision of choice from the story) or relatedness (by viewing the story from the less relatable character's point of view).

> ***RQ2a**: Does removing the provision of choice in a branching narrative – effectively making it a linear story – decrease engagement and/or impact compared to the interactive version of the same story?*

> ***RQ2b**: Does reducing the relatability of the main character decrease engagement and/or impact compared to the more relatable version of the same interactive story?*

Our current work presents two main contributions. First, based on this study's encouraging results, we envision that our story will provide a valuable and accessible online resource for individuals and institutions to use to help address IS. More broadly, our work emphasizes the potential of digital storytelling as an easily accessible resource for supporting readers' mental health, particularly by facilitating self-reflection and feelings of relatedness. Second, we elucidate how specific narrative design features may be better suited to support different learning processes. Our work ultimately serves as a case study to guide the narrative design process in serious games, helping to make it more efficient and effective in a way that is informed by the intended audience and desired impact.

2 RELATED WORK

2.1 Imposter Syndrome: Definition and Causes

In this section, we focus on key concepts and examples of IS, particularly as they relate to our story design. Since Clance and Imes (1978) first reported on IS in working women [13], the phenomenon has become increasingly studied, especially within the last decade [7]. According to a recent systematic literature review, IS describes high-achieving individuals who, despite their objective successes, fail to internalize their accomplishments and have persistent self-doubt and fear of being exposed as a fraud or impostor [7]. People with IS struggle with accurately attributing their performance to their actual competence. Instead, they ascribe successes to external factors (e.g., luck, charm, good social contacts, hard work) and interpret setbacks as evidence of their professional inadequacy. IS is not a recognized psychiatric disorder, and people with IS do not fall into any one diagnostic category [34, 40]. While certain personality traits (e.g., high neuroticism [4]) and experiences (e.g., having parents with high expectations [75]) can certainly play a role in developing IS [34], recent theories claim that the feelings of inadequacy (i.e., "fraudness") that sufferers face are exacerbated by their feelings of "otherness" (i.e., lack of belonging) [18, 69]. For instance, while IS impacts people from just about every background, it is most commonly experienced by people from underrepresented and minority groups [18, 69]. Gender or ethnic minorities are, for example, understandably susceptible to feeling "out of place" because they can see when they are underrepresented within an institution. However, some people can experience feelings of otherness without these visual cues simply because they come from a less privileged socio-economic background. For instance, a person who is the first in their family to pursue higher education may be unfamiliar with navigating and relating to academic culture. This relative lack of experience conflicts with their ability to build their academic self-concept and contributes to their feeling like they do not belong [18, 69]. In contrast, someone from a more privileged and better-prepared background can also feel like a fraud by attributing their success to their socio-economic advantages (e.g., luck, charm, good social contacts) rather than their abilities [7].

While the reasons why people develop IS can vary widely, there are a few key universal symptoms that are important to focus on because they increase its resistance to treatment. People with IS find it difficult to connect meaningfully with others for greater perspective and restructured thinking. They feign confidence, making them reluctant to reach out to others for help because they do not want to reveal their feelings of fraudulence. When everyone in a community thinks this way, no one admits to IS, which leads everyone else to believe that they alone experience it. This is particularly unfortunate considering the known ubiquity of IS. Importantly, high achievers (a group known to have high rates of IS) often work in a highly competitive environment [44]. In some elite professions, particularly medicine, the simple act of expressing imposter feelings can be "an admission of perceived weakness" that risks one's hard-earned status and credibility [41]. Thus, while individuals can and should take steps to recognize and address feelings of IS, there are clear personal hurdles that complicate attempting and achieving real positive change. As a result, experts have recommended that institutions should assist members of their community by assuming responsibility for eliminating systemic factors that contribute to IS [25, 30, 33]. Studies have shown that cultural shifts within an institution, such as greater representation (especially in leadership) and perceived support (like workshops), can help address the prevalence of IS among the workforce [7]. Our present work focuses on understanding the value of an easily accessible digital narrative tool that both individuals and institutions can use to help confront IS.

2.2 Prior Approaches to Treating Imposter Syndrome

A systematic review from 2019 evaluated the prevalence, predictors, and treatment of IS [7]. Despite the overwhelming prevalence and systemic impacts of IS, they found little research documenting the assessment of effective treatments for IS. Based on analysis of 62 studies involving over 14,000 participants, the authors found that "none of the included articles presented an evaluation of a specific treatment (e.g., cognitive behavioral therapy) for managing IS symptoms." Informing our story design approach, the report identifies some recommendations in the literature for addressing imposter symptoms, including "validating patients' doubts and fears, directly addressing fears of failure, and providing group therapy since these patients often feel isolated and that they alone experience imposter feelings". Since that review was published, a handful of healthcare workforce studies have shown how group discussion (e.g., via workshops) can help participants understand, acknowledge, and confront IS [3, 32, 66, 69]. One case study highlighted that narrative therapy, a "technique that externalizes the problem to create a perceptual separateness between the person and the presenting issue", can be used to help people with IS safely navigate their identity and feelings from a more objective perspective [21].

While the above studies indicate promising methods for alleviating IS, both approaches are not always accessible at scale. For one, both require experts with specialized skills to lead the learning activities, which inherently limits their availability. Second, people with IS are averse to sharing their true feelings of inadequacy and shame with peers [11], which can complicate the approachability and/or efficacy of group learning activities like the workshop. While more private environments, such as an individual therapy setting, are perceived as safer [21], they can be even less accessible than a workshop for some individuals and are much less efficient for treating a large number of people (which is the case for IS). This issue of accessibility for IS mental health support has been approached from various HCI perspectives. For instance, there is considerable lay interest in IS across the Internet, with thousands of "What is..." or "How-To" articles on this subject being created every year [7]. People with IS who do not have access to institutional resources or a skilled therapist (but likely also those who do) are resorting to using freely accessible Internet content to fill their needs gap. This landscape of online content emphasizes that a learning tool that can be provided over the Internet would be able to easily reach an expansive audience, thereby maximizing its value. We also found scientific literature describing an online training module featuring an instructional video, which showed some promise for helping dental students develop awareness of and coping strategies for IS [54]. Directly supporting our specific approach (but not specifying IS), some researchers advocate the use of digital narratives to facilitate self-reflection and support mental health [8]. Considered together, these perspectives indicate the potential for using a digital narrative tool for helping people safely confront – and ideally overcome – their feelings of IS.

2.3 Interactive Storytelling for Learning Applications

Interactive narratives are an established approach for educating players across a wide variety of topics in the academic [1, 27, 36, 56, 63, 71, 80], commercial [23, 35, 83], and freeware [10, 43, 65, 67] spaces. The purpose of these experiences is frequently to teach information or a skill [23, 35, 36, 67, 71], but an increasing number of experiences are focused on training players about navigating social situations and encouraging healthy behavior [1, 10, 27, 56, 63, 65]. Our focus in this paper is on the latter approach to designing an educational interactive narrative experience, both in distribution and purpose. Most of these existing interactive narrative experiences are distributed through a web browser to maximize their accessibility to players who could benefit from engaging with them. Nearly all of them [10, 27, 56, 63, 65] are designed to educate about social situations by affording roleplay from the perspective of a character having the experience directly.

The designs of the interactive narratives most similar to our work in this paper, [10, 27, 56, 63, 65], are heavily built around roleplay of either singular [10, 56, 63, 65] or multiple [27] perspectives. These narratives then use diegetic choices to encourage identification (making choices from the character's perspective), transportation (feeling located within the story world), absorption (complete focus on a task), and responsibility (feeling responsible for the choices made) [50] in players and further draw them into the narrative experience. The ultimate goal of these interactive stories is to encourage reflection about the play experience to in turn suggest healthier or safer choices in the real life situations depicted in these games. These games also provide a contrast to a number of educational visual novels which utilize scripted sequences to teach their players rather than purely choice-based approaches to teach procedure and proper approaches [9].

In terms of subject matter, our work with IS on this project most closely parallels Picho et al's Resilient IN [63], with its theme of stereotype and social identity threat. IS is a distinct phenomenon and one rarely treated as an explicit subject in interactive fiction, as Impostor Syndrome by Squinky [79] and A Blank Page by Edu Sánchez [76] are the only works which can readily be found when searching the term on the Interactive Fiction Database. Additionally these works aren't explicitly designed to be an intervention for people with impostor syndrome, but rather expressions of individual experiences. In turn, interactive narratives explicitly featuring impostor syndrome have not been tested for their impact on players.

2.4 Intrinsically Motivating Readers to Engage with Serious Content

Self-Determination Theory (SDT) is a foundational framework in psychology that explains the intrinsic motivations behind human engagement in various activities and is particularly relevant in the context of educational design [22]. This theory identifies three factors as being most potently motivating: autonomy, competence, and relatedness. These factors are crucial in explaining the growing popularity of interactive narratives as educational tools, offering a well-studied lens through which to examine their efficacy and appeal [9, 26, 86]. Compared to linear narratives, the interactive genre inherently affords a greater range of features that can leverage SDT's motivational factors to help engage the reader. In interactive narratives, readers can experience autonomy through the act of making choices[1], while competence is satisfied when those choices provide appropriate challenge and feedback. Comparatively little research has investigated how feelings of relatedness can be stimulated with single-player genres like interactive narrative [17, 26, 87], and our work in part aims to address this gap.

2.4.1 ***Choice-Based Interactivity (RQ2a).*** Within the context of interactive narrative, autonomy can be broadly defined as the capacity to pursue one's own goals within the structure of the story [50], i.e., to empower players to shape the game's narrative [64]. Although interactive narrative experts have emphasized the value of choice-based interactivity [29], comparatively little research has empirically demonstrated the benefits of this particular design feature for learning purposes [82]. When investigating the educational value of, specifically, allowing the reader to drive the course of a text-based story by making choices, the few studies that exist have shown mixed results. For example, Steinemann et al. [82] found that participants displayed more prosocial behavior when they experienced an interactive version of the story (i.e., one that contained choices) as opposed to a linear version. However, this effect was not able to be replicated in their follow-up study [81]. Nagai and York [57] also showed that a choice-based interactive narrative did not improve language learning scores compared to a linear version of the story (whereas gaming literacy seemed to have a measurable impact). Together, these studies suggest the potential for choice-based interactivity in

[1]Though see [88] for discussion on how linear stories can also afford agency via the reader's interpretation of the content.

narrative to provide measurable benefits, but that further work is required to explicate how or why (see RQ2a).

Various factors can impact how well choice-based interactivity will support reader engagement and subsequent learning. The framework of choice poetics [50, 51] explains that the inclusion of choice may impact the reader through a combination of their mode of engagement (e.g., role-play vs. exploration), the types of choice idioms encountered in the story (e.g., dilemma or puzzle varieties), and the breadth of potential dimensions of player experience (e.g., agency or identification). For instance, a player who approaches an interactive narrative with the intent to role-play may experience more identification with a protagonist they helped define via character customization choices (compared to a case where they must play as a character defined purely by the authors). The complex interplay between these factors (some of which are out of the author's control, like the reader's chosen mode of engagement) shows the scale of challenge inherent to the design of choice-based interactivity, especially for educational purposes.

2.4.2 ***Relatable Role-Play (RQ2b).*** In their review of SDT in games research, Tyack and Mekler describe the motivational factor of relatedness as "a sense of reciprocal care, value, and belonging in relation to other social figures and collectives" [86]. In HCI, for instance, relatedness is typically stimulated when multi-user platforms afford prosocial interactions between people (e.g., cooperative video games) [72]. In contrast, digital stories provide a "single-player" experience that inherently does not support direct social interactions with other people. However, some have argued that relatedness can still be achieved through this medium when it supports emotional connection, exploration and discovery [2, 17, 87], such as through the act of perspective-taking [26]. We add to this work by exploring how the relatability of the main character's perspective contributes to feelings of relatedness (see RQ2b).

A recently developed framework of character appeal defines relatability as "any parts of the character's personality that the audience might be able to identify with" [58]. Identification theory has long endorsed that relating to a story character's identity – but also their situation – can increase immersion and behaviorally relevant impacts like persuasion [14, 37]. However, similar to studies investigating the value of the provision of choice, research focused on parametric exploration of character relatability (e.g., by varying demographic details to either match or contradict the reader's identity) have shown mixed results [12, 15]. For instance, Cohen et al. [15] concluded that the demographic traits they manipulated, "while important to readers, were irrelevant to the story." They further explain that "similarity will create identification ... if the similarity being examined was especially salient within the context in which the narrative was read" and that sharing this trait with others "will become the basis of a meaningful bond." Meaningfulness is a theme that arises repeatedly in discussions of self-identity, self-determination, and well-being [2, 14, 17, 85], and has been described as a major driving force for voluntary engagement with narrative content [15]. In fact, prominent SDT scholars found that "players rated as their most meaningful games those that were more story-based, and that were particularly associated with the satisfaction of relatedness needs and the need for insight" [68].

Perhaps unsurprisingly, "in the vast majority of role-playing games, players must adopt the perspective of someone who is not them" [31]. This focus on unfamiliar perspectives is appropriate within the context of learning because "role-playing games are deeply related to constructivism, in which learning happens through hands-on experimentation with new situations, and to socio-cultural learning theories, in which learning takes place through the adoption of new social roles" [31]. In the case of the educational interactive narratives discussed in Section 2.3, readers are presented with a relevant situation (e.g., an ethical dilemma [27]) and ideally acquire healthier behaviors by navigating through better and worse story choices and outcomes. Comparatively

little work has empirically explored the potential learning benefits of *only* presenting readers with a commonly relatable mental/behavioral issue (e.g., IS), especially when the story lacks prescribed solutions. Here, we explore how this kind of story could be useful for providing the insight that readers intrinsically desire, specifically through feelings of relatedness [68].

All of the above work suggests that, if a reader does not relate to a character in a meaningful way, they will experience weaker feelings of relatedness compared to reading a story from the perspective of a more meaningfully relatable character. Properly testing this theory requires multiple versions of the same story where the only difference between them is that the same events are viewed from different characters' perspectives. Where previous studies varied character demographics and failed to see an effect, in this study we chose instead to vary relatability through a contextually meaningful trait (i.e., presence of IS). In this way, we push the boundary for what has been explored with respect to the impact of character relatability on engagement and impact (see RQ2b).

3 *PSEUDO-SCIENTIST*: A STORY ABOUT IMPOSTER SYNDROME

A common symptom of IS is feeling alone in the experience, which can complicate attempts to be vulnerable and seek help. Thus, we aimed to create a story that would help readers with IS feel less alone, in the hopes that they would then feel better able to communicate with other people about their problem. All of the educational interactive narratives discussed above were designed with the intent to instruct the reader through a range of more and less ideal behavioral examples. In contrast, we decided to craft a story focused less on idealized instruction and more on faithful representation (though some of our endings featured healthier outcomes than others). As discussed above, IS can be caused by vastly different life circumstances and be experienced along with various mental health challenges. Thus, our decision to focus on conveying experience rather than instruction avoids prescribing irrelevant or even potentially detrimental instructional content.

Relatable content can be used to purposefully engage an intended audience within serious contexts, e.g., in the case of activism [55]. Therefore, the story content of *Pseudo-Scientist* is carefully curated to emphasize key features of IS as they might be experienced by an undergraduate STEM student. Our character design process mainly relied on existing research literature that characterizes IS in order to incorporate, for instance, common symptoms of IS and specific circumstances that can cause it [7, 11]. However, the story also required other specific academia-related details involving the plot, setting, and character design that were largely inspired by the personal experience of the first author and reinforced by other members of the research group. The story revolves around two undergraduate women from different socioeconomic backgrounds who are volunteering for the same STEM research lab and trying to navigate their own versions of self-doubt about their careers. To homogenize readers' capacity to relate to the main characters, the character-focused descriptions purposely emphasized their feelings rather than their identifying features (except for their names and gender). One character is Regina, a competent but frazzled junior who suffers from IS but is not yet aware of it. The other character (who we designed to serve as Regina's complement) is a confident and supportive senior named Sterling who has experienced IS in the past and successfully acquired help to overcome it.

Created using the Twine authoring framework, *Pseudo-Scientist* is designed so that it can be experienced from either character's perspective, with no difference in the basic plot that is shared between the two versions. The basic plot involves Regina trying to ask Sterling for advice on whether to accept an offer for a more challenging and rewarding position in the lab. In the interactive versions of the story, readers can explore multiple endings with a range of better or worse outcomes for each character (see Figure 1). The first half of the story, which includes a preface and the first half of the conversation, heavily features optional "aside" passages that reveal the main character's private thoughts and feelings. Continuing to provide access to the main character's mental processes, the

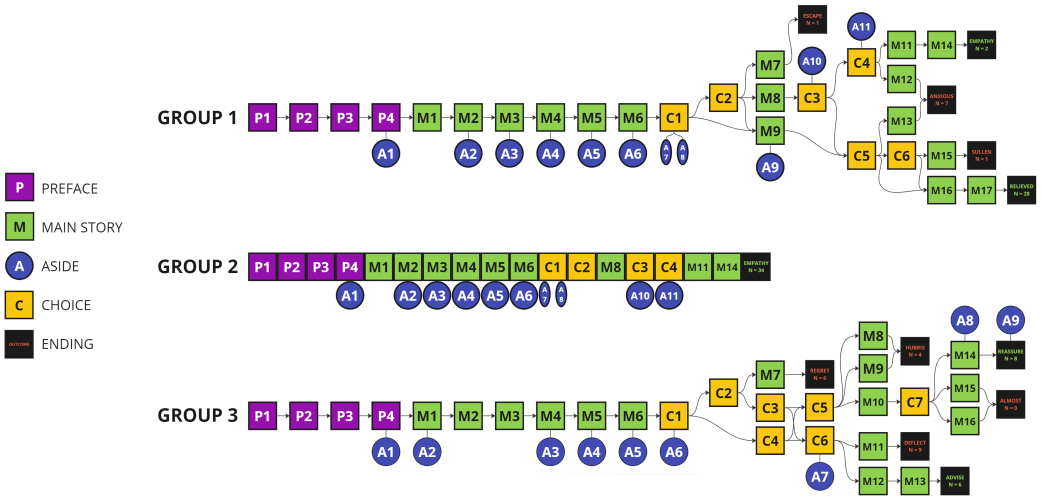


Fig. 1. Overview of passages for all three versions of *Pseudo-Scientist*. Group 1 read the interactive branching story about Regina (top, 42 passages). Group 2 read a single passage (center) that concatenated all 28 passages (including asides) that lead up to Regina's most ideal ending. Group 3 read through Group 1's interactive story but from Sterling's perspective (right, 42 passages). Fishbone narrative structures (asides) are used in the first half of the interactive versions of the story, which gives the reader access to their character's inner monologues through the first half of the conversation. Branching structures (choices) are employed in the second half of the story to allow the reader to drive dialogue with and reactions to the other character. The ending passages use color text to indicate the valence of the outcome and the number of participants who arrived at that passage on their first pass through the story.

second half focuses more on presenting the reader with a short series of choices to control how the two students navigate their first conversation with each other. We enlisted (in varying amounts) many choice idioms described in [50] (e.g., dead-end option, false choice, blind choice, dilemma). The choices led to better or worse outcomes with respect to Regina deciding whether and how to open up about her IS to Sterling. For both character perspectives, each choice offered is designed to shift the conversation either closer to or farther away from Regina revealing her true feelings aloud (for examples see Figure 2, top and bottom images). We anticipated that participants who chose role play as their mode of engagement would best achieve the intended interactive player experience consisting of, ideally, both identification *and* autonomy.

Three distinct versions of the story were created to investigate which design features are most responsible for intrinsically motivating readers to engage and learn (see Figure 2).

- To address **RQ1a/b**, we asked participants to read a story version that best emulates the design of a typical educational interactive narrative (see Section 2.3) – featuring choice-based interactivity from the perspective of a character with a relevant behavioral issue (e.g., IS). Thus, the first group of participants read through the interactive story from the perspective of the more relatable character, Regina.
- To address **RQ2a**, a second group of participants read through a linear version of the first story. According to SDT, removing choices from the interactive story would eliminate the main way for readers to experience autonomy, which may in turn lead to them feeling less motivated to engage with and learn from the content. To make this second version of the story, we used all passages (asides included) that lead to what we considered to be Regina's

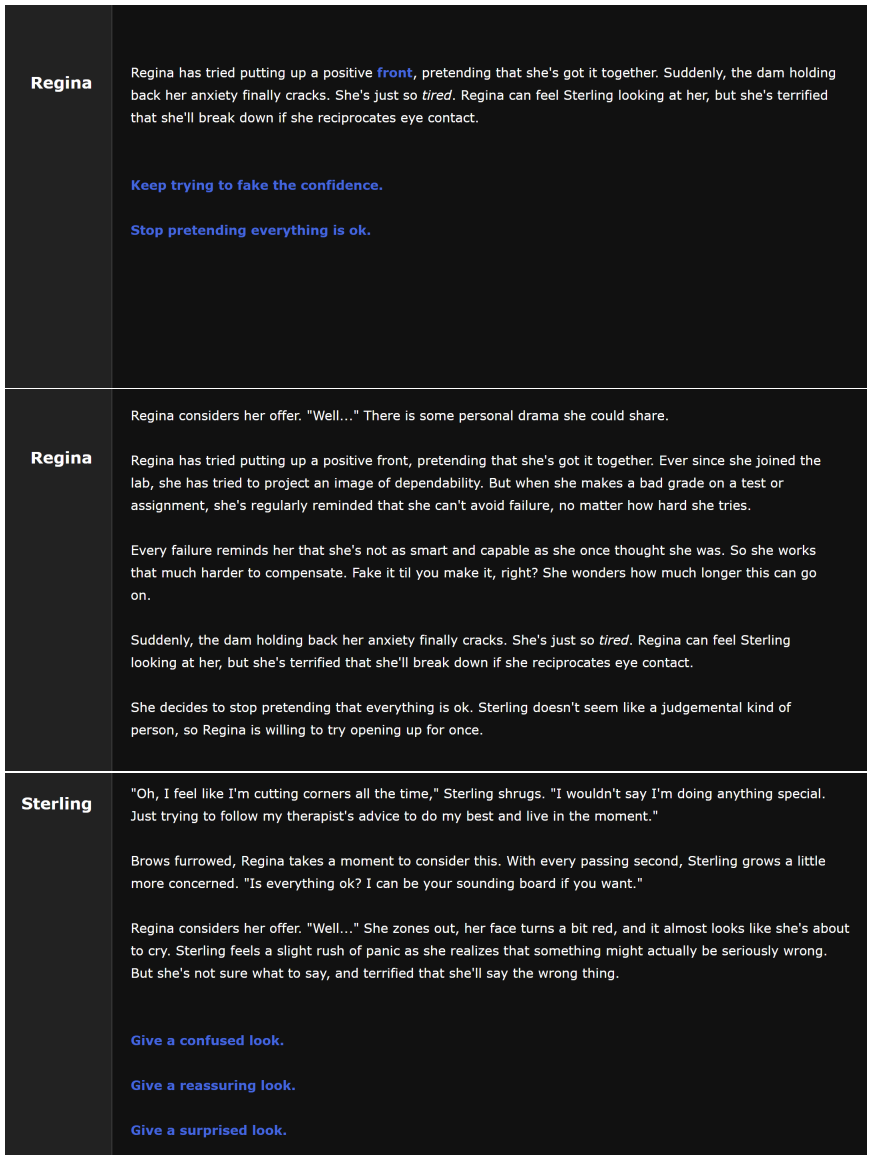


Fig. 2. Excerpts from each version of the story, all showing the same place in the plot. Top: interactive version from the perspective of the more relatable character, Middle: linear version of the Top story, Bottom: interactive version for the less relatable character. Blue text represents links to asides or choices that drive the course of the story.

most ideal ending, particularly because we expected it was the most likely ending to leave the reader with something positive to think about. By utilising this linear version of the story, we aimed to limit the possibility that any observed decrease in engagement or impact could by explained by the selected story content (although we recognize that this version could still evoke negative reactions). In other words, we wanted to ensure that removing the provision of choice was the only likely explanation for any measured loss in the story's efficacy.

- To address **RQ2b**, a third group of participants played through the interactive story from the perspective of the less relatable character, Sterling. This group comparison allowed us to investigate whether reducing access to relatable IS thought processes could interfere with the story's capacity to stimulate engagement and impact.

Ultimately, the results of this group comparison study can help guide purposeful design of narratives for similar learning applications.

4 METHODS

4.1 Study Design

This study was approved by the Institutional Review Board of the University of California, Santa Cruz (UCSC). Every participant was required to 1) play the interactive story and 2) complete a post-game survey about themself and their experience with the story.

4.2 Participants

All participants were recruited from an introductory General Chemistry course that was offered to UCSC undergraduates in the Spring quarter of the 2023 academic year. Two weeks before the conclusion of the course, participants were informed of the study through an announcement made in Canvas by the lead researcher. All students enrolled in the course were offered a small amount of extra credit toward their class attendance grade in exchange for completing all parts of the study. Participants were told that the purpose of the study was to playtest an interactive story designed to help people excel in college and their career. They then could self-opt into the study by following the provided link to the Qualtrics survey. After agreeing to a consent form in the survey, participants were provided with a link to a random version of the story and the post-game questionnaire. Participants were required to be at least 18 years of age (confirmed by signing the consent form) and have at least an advanced grasp of the English language.

4.3 Play Trace Data

The digital nature of the story allowed the research team to log the choices that participants made as they interacted with it. For every passage, a timestamp, player ID, and other identifying metadata was recorded. A random player ID was generated every time a participant loaded an instance of the story. Participants were required to submit their unique player ID to be eligible to earn the extra credit reward. The player ID could only be found at any of the endings (see black squares in Figure 1). In this way, the research team could 1) anonymously link participants' play trace data with their survey data, 2) guarantee that all participants were exposed to a set minimum amount of the story, and 3) calculate metrics about the session (e.g., play duration, number/type of choices, etc.).

4.4 Post-Game Survey

Participants were instructed to read the story and then answer questions about themself and their experience. The survey included questions concerning participants' demographics, experience with IS, and their experience with and impact from reading the story.

4.4.1 Character Relatability. In order to explore how character relatability affects engagement and impact (RQ2b), we intentionally designed the characters in *Pseudo-Scientist* so that undergraduate students with IS would find the character with IS to be more relatable than the other character who had overcome IS (see Table 2). To assess whether our character design met this requirement, we asked participants to rate how relatable each of the two main characters felt on a 5-point Likert scale ('Not at all' to 'Extremely'). Complementing this question, we also asked participants a short answer question for each character: "What was relatable about Regina/Sterling?"

4.4.2 Temple Presence Inventory for Engagement. Engagement is a critical aspect of the learning process [38], drastically influencing a learner's motivation to continue interacting with a system and the educational content [59]. To assess participant engagement with the story, the Engagement subscale of the Temple Presence Inventory (TPI) [45] was used. The TPI is an instrument that has been validated for use with games [46], and measuring game engagement [49]. Importantly, it has previously been used to assess readers' engagement with an interactive narrative themed around a serious topic [53]. More specifically, it was used to demonstrate significantly different levels of engagement between linear and interactive narrative content, and it has been shown to positively correlate with a change in readers' attitude [27].

4.4.3 Imposter Syndrome Questionnaire. To assess the prevalence of IS among the participants, the Young Imposter Syndrome (YIS) scale was included in the post-game survey [39]. This tool consists of eight yes/no questions that describe feelings associated with IS, with a score of 5 or higher indicating presence of IS. This relatively coarse scale is rarely used, with most other IS studies using the Clance Imposter Phenomenon Scale (though this tool is also criticized) [7, 48]. However, since we preferred to focus on obtaining qualitative results, a smaller tool with a lower cognitive load (YIS) was selected so that more short answer questions could be included with less concern about survey fatigue.

By completing the YIS questions, every participant should have become more familiar with the various feelings associated with IS. To understand how common of a term "imposter syndrome" is for early college students, the participants were asked if they had ever heard the phrase before. Then, to further homogenize the participants' understanding of IS, the research team opted to provide an explicit definition before asking the following questions. To assess participants' personal experience with IS, a series of questions were included exploring its duration (currently, in the past, never, etc.) and intensity (4-point Likert). Finally, participants were asked about their awareness of the prevalence of IS within their peer groups (balanced 7-point Likert agreement).

4.4.4 Story Impact. One of the key goals of this study was to assess whether *Pseudo-Scientist* can normalize and validate the experience of IS for undergraduates, ideally making them feel more connected to their peers. Thus, we sought to understand how the story could impact the reader's mood. Using a balanced 7-point Likert scale, participants were asked the following question: "Do you feel better or worse right now compared to how you typically feel (i.e., before reading the story)?" A follow-up short answer question asked participants to explain their response.

We did not design this study to be able to directly assess any behavioral outcomes, but we did probe participants about their intentions to communicate with others about IS in the future. Participants were presented with the following statement and asked to rate their agreement using a balanced 7-point Likert scale: "Because I read this story, I will talk to someone about imposter syndrome in the future."

4.4.5 Story Endorsement. Using balanced 7-point agreement-based Likert scales, participants indicated how much they endorsed the story as an educational resource. One question assessed whether they felt that the story was a valuable learning experience. The other question assessed whether they would recommend the story to others.

4.4.6 Demographics. IS can impact anyone at any time, but people with certain characteristics (e.g., involving gender, ethnicity, skill level) are often more susceptible. To enable statistical comparisons of the prevalence of IS between demographic groups, participants were asked to report their gender and ethnicity. Participants were then asked to rate their English proficiency. Finally, to confirm that the participants represented our target audience of early STEM undergraduates, they were asked to report their declared major(s) and year in school.

4.5 Qualitative Data Analysis

Two of the authors independently conducted thematic analysis [6] on all 107 of the qualitative responses to the two character relatability questions and the follow-up question to explain a change in mood. Themes were then compared and refined, and the coding process repeated until agreement was achieved for at least 95% of the responses.

4.6 Quantitative Data Analysis

Using SPSS, Kruskal-Wallis (KW) tests [60] (i.e., non-parametric ANOVA) were run to detect significant differences across the three test groups for all ordinal survey items. Using MATLAB, chi-squared tests for proportions and non-parametric Wilcoxon rank sum and sign rank tests were applied to post-hoc analyses where appropriate, with Bonferroni corrections for multiple comparisons. All relationships between ordinal variables were evaluated using non-parametric Spearman correlations (which are robust against outliers for large N), with correlation strengths described according to [20].

Survey Items	**Group 1** *Mean Rank*	**Group 2** *Mean Rank*	**Group 3** *Mean Rank*	**Kruskal-Wallis H** $\chi^2(2)=$	**Asymp. Sig** p
Total YIS Score	52.44	61.72	48.07	3.57	0.17
IS Intensity	50.87	53.29	58.29	1.14	0.57
IS Awareness	55.67	52.40	53.69	0.23	0.89
TPI Engagement	47.21	55.35	60.44	3.41	0.18
Regina Relatability	51.33	59.53	51.53	1.74	0.42
Sterling Relatability	51.69	62.24	48.41	4.31	0.12
Change in Mood	51.71	56.76	53.87	0.53	0.77
Intent to Communicate	53.36	50.31	58.43	1.28	0.53
Story Learning Value	49.44	55.19	58.04	1.68	0.43
Recommend to Others	49.90	57.38	55.32	1.29	0.52

Table 1. Group comparison tests for post-game survey responses.

5 RESULTS

5.1 Participants

Sampling from a pool of 405 students, a total of 107 students completed this study (85 females, 18 males, 3 non-binary, and 1 declined to say). Participants were overwhelmingly freshmen (N = 86, 80%), female (79%) and spoke English natively (N = 74, 69%). Reported ethnicities included White/Caucasian (N = 34, 32%), Hispanic (N = 34, 32%), Asian (N = 22, 21%), Mixed (N = 8, 8%), Middle Eastern (N = 4, 4%), Asian Indian (N = 3, 3%), Black (N = 1, <1%), or they did not say (N = 1).

Participants reported pursuing the following types of undergraduate degrees: biology (N = 54, 51%), science (N = 20, 19%), health (N = 12, 11%), chemistry (N = 6, 6%), psychology (N = 8, 8%), math (N = 7, 7%), engineering (N = 5, 5%), and physics (N = 2, 2%). Two participants did not report a major, while nine reported pursuing two majors. The vast majority (N = 98, 92%) of the participants indicated interest or experience in working for a research lab, showing that the participant pool largely had similar career interests to the characters in the story. Almost all of these participants reported that they want to work or volunteer for a research lab in the future (N = 84, 79%), whereas the rest were either doing so currently (N = 4, 4%), would do so soon (N = 8, 7%), or had previously done so (N = 2, 2%).

One group of participants was randomly assigned to read the interactive version of the story from the perspective of the more relatable character (Group 1: N = 39, 77% female). Another group read a linear version of the first story (Group 2: N = 34, 91% female). The last group read the interactive story from the less relatable character's point of view (Group 3: N = 34, 71% female).

5.2 Prior Experience with IS: Awareness, Prevalence, and Intensity

Almost all of the participants (N = 90, 84% of 107) claimed to have previously heard the phrase "imposter syndrome" before participating in the study. Relatively few were either not familiar with the term (N = 14, 13%) or were not sure (N = 3, 3%). No significant difference in YIS scores was found between the 3 test groups (see Table 1; KW test:$\chi^2(2)$= 3.57, p = 0.17). Nearly three quarters of the participants (N = 79, 74%) scored high enough on the YIS scale to be considered to have IS. Indeed, a comparable proportion of participants (N = 76, 71%) claimed to be currently experiencing IS. Nearly 7 out of every 8 participants (N = 93, 87%) claimed to have experienced IS at some point in their life (i.e., in the past and/or currently). Over half of the participants reported that they have experienced IS both currently and in the past (N = 67, 63%). Nearly 1 in every 6 participants (N = 17, 16%) appeared to have overcome their IS (i.e., they experienced it in the past but not now). Few participants were only currently experiencing IS (N = 9, 8%), had never experienced it (N = 7, 7%) or were not sure if they had (N = 7, 7%). When participants who had ever had IS (N = 93) were asked to rate the intensity of their experience, most answers were almost split evenly between the three highest options (somewhat: N = 32, 30%; moderate: N = 26, 24%; very much: N = 30, 28%). Only 5 participants (5%) said they had experienced IS to a small extent. No significant difference in IS intensity ratings was found between the 3 test groups (see Table 1; KW test:$\chi^2(2)$= 1.14, p = 0.57). Finally, the vast majority of participants (N = 95, 89%) indicated that they thought people around them experience IS. Some participants reported that they were not sure (N = 9, 8%), while just a few disagreed to some degree (N = 3, 3%). Again, no significant difference was found between the 3 test groups in terms of how much participants agreed that others around them experience IS (KW test: $\chi^2(2)$= 0.23, p = 0.89).

5.3 Experience with the Story

5.3.1 Engagement Scores. All participants on average reported that the stories were on the high end of moderately engaging (4.70±1.18 on 7-point scale). Interestingly, no significant differences in engagement were observed between the three groups (KW test: $\chi^2(2)$= 3.41, p = 0.18). Participants with IS experience (N = 93) reported marginally significantly higher engagement with the story than those with no IS experience (N = 14; IS: 4.80±1.14; no IS: 4.06±1.25; rank sum test: p = 0.057).

5.3.2 Character Relatability. Regina (the character currently experiencing IS) received comparable relatability scores across the three test groups (KW test: $\chi^2(2)$= 1.74, p = 0.42). Sterling (the character who had overcome IS) was also rated as equally relatable across the groups (KW test: $\chi^2(2)$= 4.31, p = 0.12). Confirming expectations that readers would find the character with IS more relatable, all three groups related significantly more to Regina than Sterling (see Figure 3, left; G1: $p < 0.001$, G2: $p < 0.001$, G3: $p < 0.001$). Compared to those with no IS experience (N = 14), participants with any IS experience (N = 93) related significantly more to the character struggling with IS (IS: 3.92±0.95; no IS: 3.36±0.84; rank sum test: p = 0.03).

The relationship between IS experience and character relatability was reinforced by our qualitative analysis (see Table 2). Nearly half of the participants (N = 48) described aspects of Regina's mental experience with IS as being relatable, e.g., her self-doubt (N = 26), comparison to others (N = 14), and feelings of inadequacy (N = 11). In contrast, only two participants reported relating to Sterling's experience with IS. Interestingly, both characters were most commonly relatable through

Features	Regina		Sterling	
Demographics				
Gender	female		female	
School Year	Junior		Senior	
Background				
Family Origin	rural		urban	
Family Education	no college		graduate degree	
Career Goals	STEM		journalism	
IS Experience	recent only		past only	
Relatable Characteristics				
	IS	(48, 45%)	situation	(33, 31%)
	situation	(46, 43%)	supportive behavior	(32, 30%)
	personality/perspective	(14, 13%)	personality/perspective	(27, 25%)
			nothing	(15, 14%)

Table 2. Story character features.

some aspect of their situation (Regina: N = 46, Sterling: N = 33), with Regina's situation being relatable to more participants. Relatable aspects of Regina's situation involved her struggle (N = 35) with her career (N = 34) and social life (N = 10), with most descriptions conceivably connected to IS (e.g., worry over the future or feeling too busy to connect with peers). Sterling's situation was also relatable through her struggle (N = 20) with her career (N = 12) and social life (N = 5), but the aspects described were less clearly related to experiencing IS (e.g., having a therapist, cutting corners, feeling uncertain how to advise friends). Sterling's supportive behavior toward Regina (N = 32) was almost as saliently relatable as her own situation (N = 33). Participants' focus on the characters' personality/perspective was comparatively lower for both characters (Regina: N = 14, Sterling: N = 27), although Sterling's personality received twice as much attention as Regina's. Interestingly, participants only ever identified Sterling as having no relatable features (N = 15).

To explore the relationship between character relatability and engagement with the story, Spearman's rank correlations were performed between each character's relatability scores and the TPI engagement scores for each group as well as all groups combined (see Figure 4). The more relatable character's scores (Regina) consistently positively predicted engagement with moderate strength for all three groups (Group 1: r_s = 0.51, p = 0.001; Group 2: r_s = 0.54, p = 0.001; Group 3: r_s = 0.51, p = 0.002). A similar correlation was found when all participants were considered together (r_s = 0.51, $p < 0.001$). The less relatable character's scores (Sterling) did not predict engagement for any of the test groups (Group 1: r_s = 0.17, p = 0.30; Group 2: r_s = 0.19, p = 0.27; Group 3: r_s = 0.31, p = 0.08). However, a mild positive relationship was found between Sterling's relatability and engagement when all participants were considered together (r_s = 0.22, p = 0.03).

5.4 Impact of the Story

5.4.1 Change in Mood. No significant difference was observed between the test groups in terms of a change in participants' mood (KW test: $\chi^2(2)$= 0.53, p = 0.77). Crucially, most of the participants reported that they felt better to some extent after reading the story (N = 61, 57% of 107). Nearly 1 in 3 participants said they felt no change in mood (N = 31, 29%). A small portion of participants said that they felt worse after reading the story (N = 15, 14%).

Participants were asked a follow-up question to explain their above answer. Importantly, the most common type of response (N = 39, 36%) revealed that participants felt less alone in their IS experience as a result of reading the story (Group 1: N = 12; Group 2: N = 14; Group 3: N =

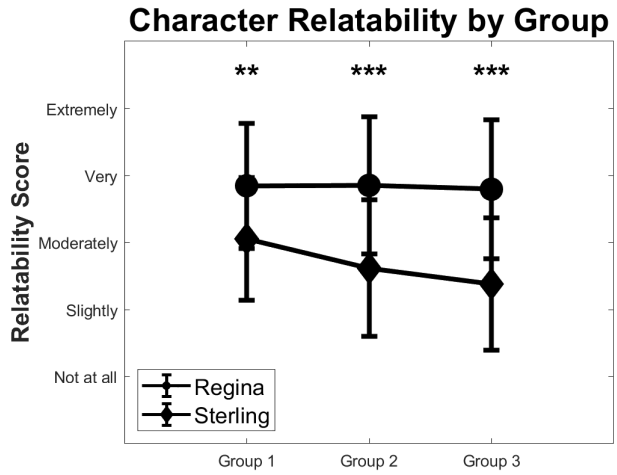


Fig. 3. Each test group found the character with IS to be significantly more relatable than the character who had overcome it (sign rank tests, Bonferroni corrected; ** indicates $p < 0.003$, *** indicates $p < 0.0003$). KW tests revealed no significant differences between the three groups for either character's relatability scores.

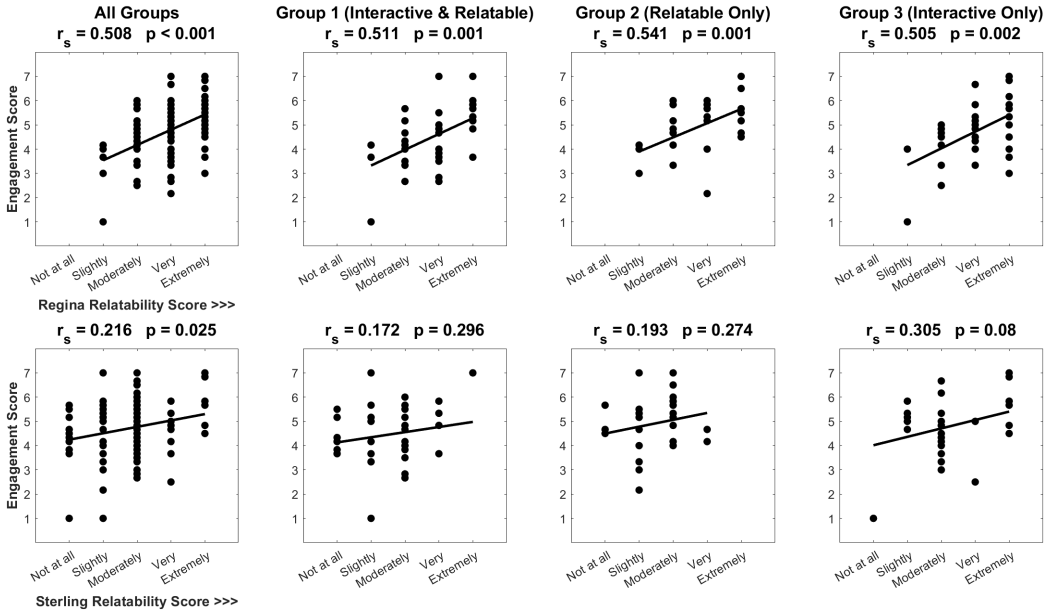


Fig. 4. Of the two characters, only Regina's relatability scores (top row) consistently predicted engagement scores for all three test groups.

13). These responses were always associated with a positive change in mood. The second most common explanation (N = 11, 10%) was exclusively associated with no change in mood. This group of participants explained that their mood was not impacted by the story because they did not feel that they learned anything. Reasons for not learning anything varied, e.g., either because the participant did not discover anything new about themself or IS, they had already overcome IS, or

(for many various reasons) the story did not feel emotionally impactful. The third most common answer (N = 7, 7%) was consistently associated with a negative change in mood. Participants stated that this response was due to the story reminding them of negative aspects and consequences of their IS. For example, some participants explained that reading the story made them feel more self-aware about having IS, while it made others recall bad experiences from their past. Most of the rest of the responses were associated with positive mood changes that were due to reasons such as learning more about IS or how to deal with it (N = 3), having a self-revelation (N = 3), gaining a new perspective (N = 2), receiving advice (N = 1), and feeling more relatable (N = 4), validated (N = 3), calm (N = 3), or hopeful (N = 1).

To explore the relationship between participants' engagement with the story and their resultant change in mood, Spearman's rank correlation was calculated for each character's mood change scores with TPI engagement scores for each group as well as all groups combined (see Figure 5). A relationship between engagement and mood change was not found for Group 1 (Group 1: r_s = 0.19, p = 0.24). However, these two variables showed a moderate strength positive relationship for both Groups 2 and 3 (Group 2: r_s = 0.57, p < 0.001; Group 3: r_s = 0.46, p = 0.007). A weak positive correlation was revealed when all participants were evaluated together (r_s = 0.39, p < 0.001).

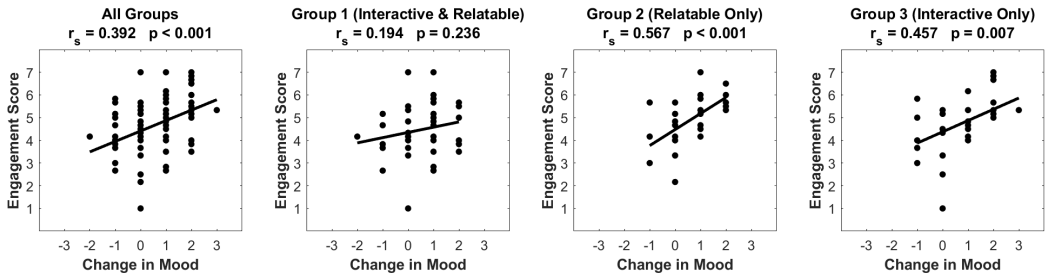


Fig. 5. Groups 2 and 3 showed a moderate strength positive relationship between engagement scores and change in mood. A similar result was found when all participants were considered together. Group 1's relationship was also positive but not significant.

5.4.2 Intent to Communicate about IS. No significant difference was found between the 3 test groups regarding future intent to communicate about IS (see Table 1; KW test: $\chi^2(2)$= 1.28, p = 0.53). Most participants (N = 60, 56%) agreed to some degree that they expected to communicate with someone about IS in the future as a result of reading the story. Just over a quarter of the participants were not sure (N = 30, 28%), and even fewer disagreed to some extent (N = 17, 16%). Importantly, participants who experienced any improvement in mood were significantly more likely to talk to someone about IS in the future compared to those whose mood had worsened (better mood: 5.00±1.03; worse mood: 3.93±1.33; rank sum test: p = 0.0035).

5.4.3 Story Endorsements. There were no significant differences between the 3 test groups in terms of how much participants endorsed the story, either for its perceived learning value (KW test: $\chi^2(2)$= 1.68, p = 0.43) or whether they would recommend it to others (KW test: $\chi^2(2)$= 1.29 p = 0.52). Nearly all of the participants agreed to some extent that reading the story was a valuable learning experience (N = 97, 91%). A few participants (N = 9, 8%) were not sure, and only one participant disagreed. Similarly, most participants agreed that they would recommend the story to others (N = 87, 81%). Some participants (N = 14, 13%) were not sure if they would recommend the story, and a few others disagreed to some extent (N = 6, 6%).

6 DISCUSSION

This exploratory study presents evidence showing that *Pseudo-Scientist* has a positive impact on undergraduate students with IS by helping them feel more relatable to their peers. Based on a systematic evaluation of core interactive narrative design factors (specifically, choice-based interactivity and character relatability), we developed a series of design recommendations to aid other designers in creating impactful interactive narratives. We anticipate that this story, as well as others designed with our recommendations and insights in mind, would be useful in supporting the mental health of academic communities at scale. In the following sections, we discuss how *Pseudo-Scientist*'s success is most likely attributable to its holistically relatable content, rather than its choice-based interactivity or main character relatability.

6.1 RQ1a: Impacting Mood through Learning

Because all three test groups were statistically indistinguishable across all factors measured, we decided to address RQ1a/b by evaluating responses from all participants (N = 107).

6.1.1 ***Relatable Content Improved Mood by Enhancing Awareness of Others' Similarity.*** SDT elucidates the value of exploration, learning, and growth for promoting feelings of well-being [73]. Supporting this, we demonstrate how the act of learning about IS (specifically with respect to the self and/or peers) was a particularly salient predictor of participants' resulting mood. First, it was encouraging to see that the majority of participants (57%, N = 61) experienced some improvement in mood after reading *Pseudo-Scientist*. Critically, our qualitative analysis interpreted that most participants who reported an improvement in mood (N = 39, 61% of 61) said that this was because reading the story made them feel less alone in their feelings of IS. This realization was often connected to how well the story faithfully reproduced their own mental experience with IS. More specifically, many participants who related strongly to the theme of the story experienced a revelation (or enhanced awareness) that others around them must be able to relate to what it feels like to have IS. For example, one participant with intense and chronic IS wrote:

> *"The way Regina's thoughts were written were eerily similar to my own at times. It really drove the point that more people deal with this than we may think." (P70, Group 1)*

Similarly, another participant who only recently started experiencing a moderate amount of IS stated:

> *"I feel like this story has made me feel seen and reminded me that everyone has experienced imposter syndrome and I am not the only one. " (P63, Group 2)*

In addition to echoing this sentiment of the story's authenticity, another participant with moderate chronic IS further shared how specific feelings inspired their new perspective:

> *"I feel that reading a story in which the character had similar feelings of self-doubt and worry about finding balance in her life allowed me to understand that the others may face the same struggles that I am having, which makes me feel less alone." (P7, Group 1)*

Yet another participant who had chronic IS explicitly explained how reading the relatable content helped her mood improve:

> *"I feel as though many other students can relate to this story as I do, which makes me feel a little better." (P43, Group 3)*

According to these responses, the story represented IS in a way that was highly relatable to undergraduate students, and did so by relating to both the characters and other meaningful story content. We conclude that our intentional narrative design (specifically, to faithfully represent many aspects related to the experience of IS as an undergraduate) was critical for both connecting

emotionally with readers and subsequently helping them connect meaningfully with relevant others.

6.1.2 ***Relatable Content Improved Mood Through Self-Reflective Learning.*** While the story clearly inspired participants to develop a stronger connection with their peers, we also found evidence that it was capable of helping them gain a more objective perspective about their own relevant feelings – similar to the benefits provided by narrative therapy [24]. For instance, P70 (quoted above) also wrote:

> *"[The story] also highlighted some of the irrationality of this kind of thinking."*

Despite claiming to have never experienced IS, another participant described how the story enabled them to engage in healthy self-reflection:

> *"The story offered me insight and allowed me to think inwards about myself, which is always a positive thing to do." (P71, Group 2)*

Further representing *Pseudo-Scientist*'s breadth of potential for supporting mental well-being, another participant who reported experiencing mild chronic IS described how reading the story led to an important self-discovery:

> *"I'm happy I decided to do this because I've recently been starting to unravel why I feel like I'm not as smart as other people even though I've proven time after time I am and this introduced that what I'm feeling may be imposter syndrome." (P9, Group 3)*

P9's reaction specifically shows that, in addition to helping people who are already familiar with IS (e.g., P70), the story could also be used to introduce the concept to those who may unknowingly experience it (and thus don't know to seek help). In summary, the above results emphasize that learning something new (e.g., about oneself, someone else, or IS in general) was a crucial driver of an improvement in mood after reading the story.

6.1.3 ***Relatable Content Did Not Change Mood When Learning Was Absent.*** Supporting the above conclusion, many participants who reported no change in mood (N = 11, 35% of 31) indicated that this was because they did not feel like they learned anything new by reading the story. For example, as one participant with intense chronic IS explained:

> *"I thought it was a good story, but it didn't change my life as I already knew about impostor syndrome." (P72, Group 3)*

Another participant who only recently started experiencing intense IS implied that their knowledge of IS is accompanied by a sense of helplessness:

> *"As a pre-med I already know what the syndrome is. That doesn't mean though that I can change everything because I know of it's existence." (P48, Group 2)*

Although these participants seem to be comfortable with *Pseudo-Scientist*'s portrayal of IS, this particular response highlights the story's limitations for providing educational guidance beyond improving awareness.

6.1.4 ***Self-Reflection Could Worsen Mood When Learning Was Absent.*** It is especially important to understand why the story made some participants feel worse than before, particularly since they were also less likely to intend to talk to someone about IS compared to those who felt better. For context, most of these participants (N = 12, 80% of 15) were experiencing IS at the time of the study. Many of these participants explained that the story amplified their existing feelings of stress and anxiety. For example, one participant with chronic IS said:

> *"It brought the problems up that are buried in the back of my mind." (P62, Group 2)*

Another participant with chronic IS attributed their worsened mood to their heightened sense of self-awareness:

> *"I'm more consciously aware of how I feel about myself right now." (P91, Group 3)*

These types of responses indicate that, while the story was successful in stimulating empathetic feelings in the reader, the emotional experience did not lead to some kind of relieving revelation. Supporting this theory, we did find one participant who elaborated that they initially felt negative feelings that eventually shifted to an improvement in mood after experiencing learning:

> *"It made me feel uncomfortable at first because it was very personal, but after sitting with it I feel better knowing that I am not alone with these struggles." (P66, Group 2)*

Failing to experience this valuable revelation is especially unfortunate since it may be due to the fact that anxiety and depression are well-known to interfere with the learning process [62]. This outcome may have been exacerbated by our study design. We did not provide participants with any information to prepare them for the exact nature and content of the story. It is possible that some students' mood would not have been so negatively impacted if they knew more about the story's theme before reading it, especially considering that the study was conducted during a relatively stressful time of the school year (i.e., with end-of-year exams looming). For example, as one participant whose mood worsened explained:

> *"I just feel as though this research has opened my eyes to something that I wasn't really trying to think about." (P77, Group 2)*

As a result, we expect that incorporating the story into a more structured learning experience (e.g., couched within a workshop or a more extensive online learning module) could be even more effective at helping readers ultimately develop a positive change in mood and potentially behavioral outcomes as well. The fact that participants who felt better after reading the story were more likely to want to communicate with others indicates the value of resulting mood on future behavior – a topic which we discuss in the next section.

6.2 RQ1b: Supporting Communication with Others about IS

As previously discussed, many people with IS either do not know that they have it or struggle to talk to others about their problem and so do not seek the help they need. Though we could not directly assess participants' willingness or ability to communicate with others about IS, we did find evidence for the potential of *Pseudo-Scientist* to support this outcome. Indeed, we found that more than half (57%) of all the participants intended to communicate with someone about IS as a result of reading the story. To contextualize this encouraging result, we explored the qualitative responses for relevant explanations. We found that the highly relatable nature of the content had additional value beyond just helping participants realize that they are not alone in their experience of IS. Specifically, the story's faithful representation of IS was also interpreted by the participants as a form of communication support, and this could be accomplished in multiple ways. For example, the story's accurate portrayal of IS could help people with IS figure out how to better articulate their feelings to others. One participant who only recently began experiencing a moderate amount of IS wrote:

> *"Being able to read how I have felt before, it was explaining how I felt in a way I didn't realize could be explained." (P3, Group 1)*

Focusing less on the value of the story's descriptive clarity, another participant with strong chronic IS instead reflected on how it helped her feel more communicative by stimulating soothing emotions:

> *"I feel more calm, in a way I want to talk to someone about how I feel." (P21, Group 2)*

Aside from helping the reader feel more *able* to communicate, another apparent benefit of the story's normalization of IS feelings was to increase some participants' *willingness* to communicate with others about their IS. Demonstrating this connection explicitly, one participant with moderate chronic IS stated:

> *"Knowing that other people out there share the same feelings that I deem invalid shines light on the fact that I should communicate and talk it out with others because they are actually valid." (P89, Group 1)*

Another participant (who in a separate answer explained that she had never talked to anyone about IS because she was scared to, but now planned to do so in the future) remarked on how dissemination of the story at scale could help students with IS expect to feel better understood:

> *"The story was exceptional, and I strongly believe that every student should read it, as it can greatly contribute to their understanding of diverse perspectives as students in a large university setting." (P59, Group 1)*

This comment showed that the story could provide further communication support by acting as a hub of public focus and discussion. Reiterating this point, another participant stated that the story can be envisioned as a valuable source of communal understanding:

> *"It helps to know that multiple students in my college will be given a similar story, that we can hopefully all relate to and share our experiences anonymously. For example one of my friends who I look up to, as she is very knowledgeable and a faster thinker than I am, told me that she would be participating in this study. It helps to know even people like her can relate to these imposter like feelings." (P56, Group 3)*

This quote especially underlines P59's point that the story could support communication about IS by guaranteeing public awareness and understanding of the problem. With this kind of desirable outcome in mind, it is unsurprising that an overwhelming majority of participants felt that the story provided a valuable learning experience that they would recommend to others. All these results together suggest that, in a hypothetical academic community where everyone has earnestly read our story, students can assume greater confidence that they can find someone to talk to who will be able to understand what they are going through.

In summary, our current work has demonstrated the potential of a digital story designed for relatability as a viable tool to enable better communication and community support around IS. Though students would be able to have unrestricted access to *Pseudo-Scientist*, we envision that the story would also be a valuable supplemental resource for facilitating communication in workshops on IS that are organized by institutions. Again, by providing a story that allows readers to have a shared perspective on what it can be like to have IS, sufferers can be reassured that they will be safe from their fear of exposure because they do not necessarily have to describe their own feelings to others directly. Ideally, this would encourage better engagement and learning with the workshop activities for those who need it.

6.3 RQ2: Relatable Narrative Can Be Sufficient for Guiding Emotional Learning

Answering RQ1, the above analysis has provided strong support for the value of *Pseudo-Scientist* as a tool for supporting undergraduate students' emotional learning and mental well-being with respect to IS. However, this study was also designed to explore whether key interactive narrative design factors – specifically choice-based interactivity and character relatability – were required for achieving these positive effects. Statistical analyses revealed no significant differences between the three test groups with respect to any of the measured benefits. More specifically, participants were equally engaged and impacted regardless of 1) whether they were allowed to drive the course of

the story through choices (Group 1 vs. Group 2) or 2) whether they found their character's internal thought process relatable (Group 1 vs. Group 3). Participants' qualitative responses (both good and bad) strongly indicated that it was their ability to relate heavily to the content of the story that ultimately drove their positive experience, endorsements, and outcomes. Here we discuss how our null results make sense within the context of the story's primary educational intent: to describe a private mental experience in order to support greater emotional understanding between the reader and their peers.

6.3.1 ***Choice-Based Interactivity (RQ2a).*** Our study results indicate that the removal of choice-based interactivity had no measurable effect on the story's engagement and impact. In serious games, choice-based narratives are often leveraged as a cost-effective means to deliver engaging instructional content (see Section 2.3). Branching narrative designers craft a range of both good and bad endings to increase educational opportunities, and the act of navigating the story through choices helps players better analyze a complex situation through direct manipulation and intentional exploration [9]. However, as explained in Section 3, the design intent for *Pseudo-Scientist* was to provide a detailed representation of IS, and we purposefully avoided including content that was overtly instructive (e.g., methods to overcome IS). Many participants who read the linear version of the story reported learning (e.g., about the existence of IS in themself or others), showing that this content had an educational effect that was sufficiently conveyed without the provision of choice. Thus, we conclude that the choice-based interactivity we integrated into *Pseudo-Scientist* was not a necessary investment to accomplish our primary goal of conveying the experience and ubiquity of IS.

There are various reasons that might explain the above conclusion. First, it could be that any feelings of relatedness generated by the story were considerably stronger than the feelings of autonomy afforded by the style of choices we provided, making the provision of choice comparatively less salient and impactful. For instance, all participants who read Regina's perspective were thoroughly exposed to her IS-related thought processes during the first half of the story, potentially emphasizing the reader's focus on this aspect of the story. Complementing this theory, the apparent salience of Sterling's supportive behavior highlights participants' perception of the story's pro-social plot (i.e., a conversation between friendly, well-meaning peers) that models healthy and desirable behaviors involving relatedness. Alternatively, though our current analysis revealed no evidence of autonomy need frustration, it could be the case that the style of choice-based interactivity we designed failed to be particularly engaging. The fact that we did not match our provision of choice with intentionally instructive outcomes may have generated both need satisfaction (autonomy) and frustration (competence) with opposing effects on engagement that could have canceled each other out. Though ambiguity over the story's challenges and goals can help boost engagement through increased affordances for interpretation [16], our null results suggest that this impact (if it occurred) was too small to measure. Purposefully omitting a clear challenge or feedback into the story permitted us to explore a simpler design space, but the possible interactions between autonomy and competence suggest that these two factors are not readily delineated from each other. Further work is required to explore whether a version of the story that includes choices designed to more explicitly support competence can provide additional benefits for engagement and impact.

6.3.2 ***Relatable Role-Play (RQ2b).*** Our study results indicate that participants could experience the interactive story from the less relatable character's perspective and still feel comparably engaged with and impacted by the story. We interpreted this to mean that exposing the reader to the more relatable character's internal thought process was not the primary driver of the story's success. Supporting this interpretation, we found that any IS-related situation a character was

navigating (including evaluations of the self, like self-doubt or inadequacy) was generally more salient than their personality or other mental traits. Our correlation results were particularly useful for complementing this evidence. For all three test groups, engagement was moderately correlated with the more relatable character's relatability scores (see Figure 4, top row). Conversely, the less relatable character's relatability scores did not predict engagement for any of the three groups (Figure 4, bottom row). Overall, these correlation results indicate that participants did not need to read the story from the more relatable character's point of view in order to discern that she was *meaningfully* relatable. Therefore, we conclude that reading *Pseudo-Scientist* from Regina's perspective was not necessary because other aspects of the story (e.g., plot, conversational content) were able to sufficiently convey her relatable problems with IS. This result may help explain why previous studies have failed to show an effect of demographics on story impact [12, 15].

According to SDT, the intrinsic motivational need for relatedness is "satisfied when others recognize and support one's self and when the person feels able to connect with, feel significant with, and be helpful to others" [72]. Our story clearly inspired many participants to feel understood, less alone, and (by extension) more relatable to their peers. We argue that these feelings ultimately fostered a sense of relatedness that supported the expectation of relatively more positive social interactions in the future – a prospect that intrinsically motivated participants to engage with and learn from our story. While motivation through relatedness is typically accomplished using *direct* social interactions (e.g., cooperative play), we provide a rare explicit demonstration for how it can also be achieved *indirectly* using only a linear narrative. Thus, we demonstrate that narrative designers may not need to invest in certain expensive design features (e.g., interactivity) to increase reader engagement with a serious topic as long as the story itself is 1) capable of inducing relevant feelings of relatedness and 2) those feelings are sufficient for producing the desired positive outcomes. These effects illustrate how Theory of Mind – or beliefs about the self and others – can be leveraged in narrative for educational purposes [78].

6.4 Design Implications

6.4.1 ***Choice-Based Interactivity.*** In essence, we have demonstrated how a narrative that the reader interprets as relatable and representative of their "true self" can heighten awareness of the fact that others have had similar experiences, and that this can inspire meaningful reappraisal of one's identity with respect to that of others, a community, or a culture [87]. Though the provision of choice has been shown to increase identification with characters [29], our analysis indicates that participants frequently identified with the story regardless of whether choice was provided. Since Regina's perspective was designed to be relatable to readers with IS, we think it is likely that the choices we afforded did comparatively little to engender further meaningful identification with the character – especially considering that most of the relevant information about the characters and story could be acquired in the non-interactive portions of the text. Interactive narratives themed around serious topics overwhelmingly employ choice-based interactivity to *explicitly* educate readers about the possible connections between actions and consequences [47]. If we had incorporated more explicit challenges throughout the story and choice points (e.g., enabling exploration of ways to overcome IS), we expect we would have achieved stronger engagement and impact. However, supporting Cole and Gillies' observations about eudaimonic gameplay [17], our study emphasizes the value of narrative for supporting shifts in self-perception and social perspective specifically through *implicit* emotional learning. Thus, we encourage narrative designers addressing serious topics to carefully consider whether readers need to engage more in emotional or behavioral learning to achieve the desired outcomes. If the former, we advise that investments in choice-based interactivity may not be necessary for achieving the desired impact. Since our story design failed to help some readers experience feelings of relatedness, we also caution that implicit

learning may not guarantee a positive result for all readers. Providing content at the end of the story that more explicitly encourages self-reflection may help mitigate this risk.

6.4.2 ***Relatable Role-Play.*** Traditional linear narrative has been extensively studied and is well-known to be valuable for conveying understanding of and empathy with human experiences [42], and our work certainly supports this view. Our participants' qualitative responses confirm that designing a narrative so that it faithfully represents the perspective of interest is crucial for achieving the desired connection with and impact on the intended audience. When designing *Pseudo-Scientist*, we recognized that crafting the right content for our audience would require consideration of a variety of narrative design factors. First, we decided to engage in a co-design process with people who had extensive experience with IS (i.e., the authors of this paper) to create a story that would be easily recognizable for undergraduate students specifically. Next, knowing the ubiquity of IS, we anticipated that our undergraduate audience would be demographically diverse. Because we intended the story to be deployed at scale, we took great care to minimize the ways in which specific details might make the story less relatable to subsets of our diverse audience. In particular, we designed the main characters so that they would be relatable to anyone with IS, revealing only their gender demographic (out of necessity). Then, to allow the characters to retain some layer of depth, we also included a few relevant details about their origin stories (e.g., coming from a rural or suburban upbringing as it relates to being prepared for academic challenge). We spent considerably more effort on describing the characters' feelings and circumstances fueling their desires. Crucially, we represented these concepts not only in each character's internal monologues, but also within the plot, setting, conversation, and third-person behavioral descriptions. Perhaps because we minimized describing the characters' physical characteristics, we found that participants related most heavily to elements of the story involving IS, including its subjective experience, relevant situations, and the value of pro-social behaviors. Considering that prior research has failed to show a reliable effect of demographics on character identification and impact [12, 15], it is possible that relaxing this constraint (i.e., by giving the characters more specific physical identities) would not interfere with engagement and impact. However, there is necessarily a point at which incongruence with the main character can interfere with focus on the story and self-reflection. Therefore, we recommend that narrative designers emphasize adding specificity that is directly related to the topic throughout all aspects of the narrative. However, we caution that, if the goal is to deliver an impactful narrative experience at scale, narrative designers should carefully consider and balance the specificity of the story's design in order to emotionally connect with as much of the desired audience as possible.

6.5 Study Limitations

The participants self-selected into the study and thus may not faithfully represent the average undergraduate experience. For instance, we found that a significantly greater proportion of women completed this study (79%) compared to the proportion of women in the class (65%; chi-squared test: $\chi^2(1, N = 512) = 7.52$, $p = 0.006$). Indeed, according to the YIS scale, women (81%) were almost twice as likely as men (44%) to be currently experiencing IS (chi-squared test: $\chi^2(1, N = 103) = 8.76$, $p = 0.003$). Importantly, men and women did not have significantly different engagement scores (men: 4.65±1.15; women: 4.76±1.19; rank sum test: $p = 0.71$). Even though participants' gender did not affect their engagement with the story, our study sample suffers from limited gender representation that may complicate the generalizability of our results. Additionally, most of the quantitative survey items were not validated and provided a coarse ordinal measurement. It is possible that we did not see significant differences between our test groups because our chosen measurement instruments may not have been sensitive enough to detect them. However, the consistency of our correlation results provide compelling evidence supporting our arguments that is further reinforced by our

qualitative analysis. Next, a control condition wherein a fourth group of participants read through a linear version of the story from the less relatable character's point of view (essentially making this a 2x2 study) would have been valuable to support our conclusions. Without this group, it is possible to argue that stimulating feelings of either autonomy or relatedness alone were sufficient to drive engagement and impact. However, the qualitative data does not support this interpretation of our results. Finally, any intentions declared by the participants about changes in their future behaviors are only probable and not guaranteed. A more rigorous longitudinal study would be required to confirm the story's efficacy for inducing real and lasting changes.

6.6 Future Directions

Our work opens up many potentially lucrative avenues of future investigation. Though we have demonstrated the potential for our story to stimulate communication about IS, further work is required to confirm these results. As mentioned in the previous section, a longitudinal study would be valuable for understanding the story's capacity to induce persisting improvements in behavior. Second, as we have already described, we expect that this story would be a valuable resource to integrate into workshops themed around IS. Third, we are interested in understanding how our story could help younger people who are not yet as familiar with IS (e.g., high schoolers) to develop healthy preventative and prosocial behaviors. Fourth, we received some feedback suggesting that images or sound would make the story more engaging, so we would like to explore whether a visual novel version of the story could stimulate significantly more engagement and impact. Finally, in response to the continued ambiguity over the value of choice-based interactivity, we intend to write and test new versions with plot and options that better support competence (e.g., intentionally teaching healthy behaviors).

7 CONCLUSION

In this paper, we introduce a highly relatable digital story that can be easily deployed at scale to support the mental health of communities suffering from IS. We have identified specific design considerations that can be leveraged to foster positive outcomes like self-reflection, self-awareness, and relatedness which, in turn, can facilitate resilience and well-being. In particular, we demonstrate the value of incorporating contextually meaningful details within multiple facets of the story (e.g., characters, plot, setting) to deliver an experience that remains relatable across a diverse audience. Similarly, we show how the purported learning benefits of choice-based interactivity may not be necessary for designing emotional experiences that are sufficiently engaging and impactful. Finally, we reflect on an incredible challenge within educational narrative design to balance content specificity with the need for inclusivity. Our findings demonstrate exciting potential for a simple story to support health and success throughout academia and beyond. More broadly, we respond to recent calls for further exploration and a revision of SDT's relatedness by demonstrating expanded applicability within single-player narrative-focused contexts. Future work will explore generalization of our proposed approach across new settings, demographics, and layers of interactive design.

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