Enabling Critical Self-Reflection through Roleplay with Chimeria:Grayscale

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ABSTRACT
The human-computer interaction (HCI) field includes a long-standing community interested in designing systems to enable user reflection. In this work, we present our findings on how interactive narratives and roleplaying can effectively support reflection. To pursue this line of inquiry, we conducted an exploratory, cross-sectional study evaluating an interactive narrative we created, Chimeria:Grayscale. To address issues present in prior HCI studies on the topic of reflection, we grounded our system design methodology and evaluations in theories drawn from clinical psychology and education. The results of our study indicate that Chimeria:Grayscale, the interactive narrative we created by operationalizing our system design methodology, enabled our study participants to critically self-reflect.

CCS Concepts
• Human-centered computing → Human computer interaction (HCI); • Applied computing → Law, social and behavioral sciences; • Information systems → Multimedia information systems;

Author Keywords
interactive narrative; learning; reflection; roleplay

INTRODUCTION
As a design outcome, reflection has garnered significant academic interest over the years. The resulting body of research spans a diverse set of application areas including: personal informatics [8, 27], health [28], and education [34].

In this work, we present our findings on how interactive narratives and roleplaying can effectively support reflection. To pursue this line of inquiry, we conducted an exploratory, cross-sectional study evaluating an interactive narrative we created, Chimeria:Grayscale [22]. Chimeria:Grayscale seeks to enable users to critically self-reflect on issues of sexism in the workplace by having them roleplay as a newly hired employee at a toxic workplace. To evaluate our interactive narrative, we conducted an exploratory, cross-sectional study during which participants (N=31) experienced Chimeria:Grayscale, and, afterward, completed a survey. The results of this study suggest that Chimeria:Grayscale enabled our study participants to critically self-reflect on the themes of the narrative.

Despite the centrality of reflection to prior HCI studies on the topic, designs theoretically grounded in cognitive or learning sciences are largely absent from the literature. For the most part, prior work has relied on the implicit assumption that, “by providing access to data that has been ‘prepared, combined, and transformed’ for the purpose of reflection, reflection will occur” [5]. Not only does this assumption lack a theoretical basis, its direct application to a system design may lead users to experience the backfire effect [33], a phenomenon where a person presented with counter-attitudinal evidence outright rejects this evidence and adheres more strongly to their current beliefs. Prior studies have also struggled with the evaluation of reflective outcomes [5]. Without a clear theoretical framework, it is difficult to precisely identify reflection in others. Furthermore, this lack of precision makes comparing results between published works a challenging exercise.

To address these issues in our work, we grounded our system design methodology and evaluations in theories drawn from clinical psychology and education. Though we also drew from other sources, our work was primarily informed by Yardley-Matwiejczuk’s roleplay induction principles [43] and Mezirow’s Transformative Learning Theory [30]. The former offers guidance on designing effective roleplays and, the latter provides a concrete method for evaluating reflective outcomes.

The rest of this paper is organized as follows. We summarize related literature, introduce our theoretical framework, and provide a case analysis of Chimeria:Grayscale. We conclude by presenting and discussing the results of our user study.

RELATED WORK
This section summarizes related literature on reflection, roleplay, and games.

Reflection
Fleck & Fitzpatrick [12], Baumer et. al. [5], and Baumer [4] have each published excellent overviews of the work on reflection conducted within the academic HCI community. As such, we shall not reproduce those works here. Instead, we shall focus our discussion on individual research efforts with aims similar to our own.
With few notable exceptions, published HCI research related to reflection pays little attention to the important task of scaffolding the reflection process. This, in our opinion, is an oversight given the significant effect scaffolding has on reflective outcomes. As stated by Slovák et. al. [41] in their work on developing a framework of sensitizing concepts for designing technologies that support reflection, there is a “need to scaffold the reflection process, rather than assuming the ability to reflect is a trait that can be readily triggered by providing the relevant information.” Further, they demonstrate this need through the analysis of two case studies.

MAHI [28] is an example of a system that scaffolds the reflection process by design. The goal of this health-monitoring application is to help individuals newly diagnosed with diabetes to acquire the reflective thinking skills required for managing their condition. To meet this goal, MAHI provides users with on-demand access to diabetes educators willing to guide them to reflect meaningfully on behaviors recorded by the system. Over time, users who make use of this service learn how to reflect on their own behavior without guidance, thus, realizing the intent of the designers. Mamykina et al. included the service in the design of MAHI for the express purpose of scaffolding the reflection process.

More recently, Saksono et. al. [38] investigated how storytelling and reflective prompts can effectively support reflection for families with young children. As part of a theoretically grounded study evaluating this approach, parents and their children engaged with a low fidelity prototype based on a story book for children. Reflective prompts and parents both played a part in scaffolding reflection throughout the study. Results revealed opportunities and challenges within story-driven, wellness-centered family reflections.

Roleplay
Educators sometimes employ roleplay¹ as a pedagogical tool for helping students acquire a deeper understanding of subject material. To use roleplay effectively, educators must understand their students’ dispositions and carefully design roleplay scenarios with that information in mind. With proper preparation, roleplays enable students to engage with and reflect on related subject material both during and after the experience. Through this reflection, students achieve the desired learning outcome: an improved understanding of the subject material.

Roleplay has been used in this way to educate students from a wide range of disciplines. For example, in their working paper on negotiation pedagogy, Susskind and Corburn [42] provide an overview of their approach to designing and conducting roleplays that enable students to reflect on their negotiation skills and, thereby, improve them. Similar guidelines have been published for teaching communication skills [23], international relations theory [1], urban planning [37] and more.

Games
The terms serious games, games for change, impact games, and more have all been used to describe games designed for a purpose other than entertainment. Chimeria:Grayscale exists within this milieu. Because none of these labels completely captures our aims in designing systems for reflection, however, we prefer to describe it as an epistolary, interactive narrative that addresses issues of sexism in the workplace. While there has been substantial debate about both the nomenclature and best design practices for such games, there is little debate that creating such systems is a vital and growing area.

Though lacking theoretical grounding in theories of reflection or roleplay, there are some notable examples in the literature of games with goals or methods similar to those of Chimeria:Grayscale. These include Time Mage [44], a game designed to promote patient self-efficacy during hospital stays, and Missing: The Final Secret [3], a game for teaching players how to recognize and curtail their cognitive biases. Our previous works, Mimesis [21], a game that explores themes related to racial discrimination, and Chimeria:Gatekeeper [19, 20], a game that explores themes related to impression management and social stigma, also have similar reflective aims to those of Chimeria:Grayscale.

THEORETICAL FRAMEWORK
At a very high level, the theories and methods described in this section were all employed in this study in service to the creation and evaluation of a high quality roleplay experience as would be judged by experts in the fields of education and clinical psychology. In doing so, we sought to produce one of the primary outcomes of successful educational and therapeutic roleplays: reflection.

Critical Self-Reflection
As noted by Baumer et. al. [5], few papers in the HCI literature provide an explicit definition of reflection to readers. Those that do tend to cite Schön’s reflection-in-action and reflection-on-action [40].

In this work, we depart from tradition by adopting Mezirow’s notion of critical self-reflection. This notion is perhaps best understood in the context of Dewey’s definition of reflection. Dewey [10] defines reflection as “active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusions to which it tends.” Building on this definition, critical self-reflection can be defined as a type of reflection characterized by an individual’s reexamination of the presuppositions that inform their own beliefs, thoughts, and actions. [30]

Our motivation for grounding this work in Mezirow’s notion of critical self-reflection is twofold.

First, although not addressed in our study, we are interested in the potential of reflection for effecting conceptual change. Transformative Learning Theory [29, 31, 32] describes a process driven by critical self-reflection whereby an adult’s presuppositions change to accommodate new information or perspectives. During the multiple stages of this process, shown in Figure 1, an individual reflects on a fundamental challenge

¹The terminology around roleplay varies by discipline. Some disciplines use the word simulation instead of roleplay.

²We also describe Chimeria:Grayscale as a critical-computational system to better communicate its goal of social critique through reflective engagement. [17]
As stated previously, these works tend to not provide a clear definition of roleplay from the perspective of a clinical education. Yardley-Matwiejczuk [43] provides us with a conceptualization of roleplay across fields is beyond the scope of this paper, we will highlight a few conceptualizations of roleplay that particularized content is drawn from the participants’ plans.

Second, we wanted an effective way of assessing user reflection enabled by Chimeria:Grayscale. As noted by Baumer [4], evaluating an individual’s reflective experience is challenging. Typically, quantitative and qualitative assessments of reflection in the HCI literature do not involve direct measurements of reflection. Instead, these assessments treat other, more easily measured outcome variables as indicators of the quality or quantity of reflection experienced by study participants. As stated previously, these works tend to not provide a clear definition of reflection to readers. Thus, the interpretability of results obtained by these indirect measures is questionable.

By adopting Mezirow’s notion of critical self-reflection, we are able to indirectly measure reflection via a validated survey instrument grounded in the exact same definition of reflection that we adopt in our work, namely, the Learning Activities Survey [26]. This survey instrument measures whether, and to what extent, a perspective transformation has occurred as a result of a transformative experience. Thus, we can use results obtained from administering the Learning Activities Survey to reason about the stages of perspective transformation, and, therefore, the amount of critical self-reflection, experienced by study participants.

Roleplay

The term roleplay has overlapping, but distinct, meanings in diverse areas including clinical psychology, education, games, theater, and more. While providing an exhaustive list of definitions of roleplay across fields is beyond the scope of this paper, we will highlight a few conceptualizations of roleplay related to this work from the fields of clinical psychology and education. Yardley-Matwiejczuk [43] identifies three major roleplay induction principles in her work: Personalization, Presencing, and Particularization. Personalization is a principle concerned with the process by which all facets of a roleplay scenario that a participant should be aware of are explicitly detailed to that participant. Presencing is a principle concerned with the process by which all facets of a roleplay scenario are granted a degree of familiarity and reality in the eyes of the participant. Personalization is a principle concerned with the degree to which particularized content is drawn from the participants themselves. There are a set of design guidelines (too numerous to reproduce here) associated with each roleplay induction principle.

As stated previously, using roleplay induction technique improves the quality of roleplay outcomes. Thus, when designing Chimeria:Grayscale, we operationalized each roleplay induc-
tion principle. By doing so, we specifically sought to increase user engagement with our interactive narrative and, thereby, the reflective impact of Chimeria:Grayscale on users.

The Embedded Design Model
In their work on using games as interventions, Kaufman et. al. [24, 25] found that subtly embedding persuasive content into games was more likely to succeed in changing the attitudes or behaviors of players than presenting the same content in their games in a direct, explicit fashion. After experimenting with different strategies for embedding persuasive content into games, they identified three such strategies that both trigger more receptive mindsets and circumvent existing psychological barriers with respect to a game’s persuasive content.

The three strategies, referred to together as the Embedded Design model, are: Intermixing, Obfuscating, and Distancing. Intermixing involves presenting a balance of on- and off-message content to make the former less overt or threatening. Obfuscating involves using framing devices that divert focus away from the game’s message. Distancing involves employing fiction to increase the psychological gap between players’ identities and the game’s persuasive content.

By implementing the Embedded Design model in Chimeria:Grayscale, we sought to increase the number of users who would reflect meaningfully on the themes of our interactive narrative. Though not addressed in our evaluation, we were motivated by a desire to prevent phenomena like the backfire effect [33] from manifesting in users.

Morphic Semiotics
In the field of semiotics, signs (images, sounds, words, objects, etc. that humans attribute meaning to) have been defined as the combination of a representation, the signifier, and that which is represented, the signified [39]. Signs come in systems. To illustrate this point, consider that the meaning of hand gestures can vary by cultural context. The "thumbs up" gesture can be friendly or rude depending on the sign system. Systems of signs have also been called semiotic spaces. As in Goguen [16], we shall use this term going forward.

Morphic semiotics [15, 17] provides a formal language for describing semiotic spaces and the relationships between them. Representations of semiotic spaces described using this approach have the desirable property of being amenable to computation. Additionally, they capture the key aspects and structure of that which is being represented.

Semiotic morphisms are mappings from one semiotic space, the source space, to another semiotic space, the target space. Given semiotic spaces \( P_1 \) and \( P_2 \), a semiotic morphism \( M \) from source \( P_1 \) to target \( P_2 \) can be denoted as follows: \( M : P_1 \rightarrow P_2 \). Semiotic morphisms are composed of three types of partial mappings: (1) sign types from the source space mapped to sign types in the target space, (2) sign constructors from the source space mapped to sign constructors in the target space, and (3) functions from the source space mapped to functions in the target space. The key idea behind these rules is that the quality of a semiotic morphism is determined by how well the structure of the source space is preserved in the target space.

Figure 2. Example architecture of an application created using Chimeria

When designing Chimeria:Grayscale, we used morphic semiotics to precisely map the ambivalent sexism framework to a model implemented in Chimeria. Thus, we created a semiotic morphism from the semiotic space of the ambivalent sexism framework to the semiotic space of Chimeria. In doing so, we sought to create a tight coupling between the ambivalent sexism framework and the content & behavior of Chimeria:Grayscale

CASE ANALYSIS
This section introduces Chimeria, the platform upon which our interactive narrative was built, and Chimeria:Grayscale, the interactive narrative that operationalizes our approach to enabling user reflection.

Chimeria
Chimeria was created as part of an NSF-backed project called “Computing for Advanced Identity Representation.”\(^3\) The goal of the project was to research identity technologies that enable imaginative self-representations and counter social ills through dynamic social identity modeling grounded in computer and cognitive science. To that end, the Chimeria system [18, 19, 20] supports the simulation of physical-world social identity phenomena in virtual identity systems and provides tools for authoring expressive systems that demonstrate such phenomena. Its identity modeling engine can simulate agents with multiple category memberships, gradient category memberships, and dynamic category memberships.

To create a more compelling interactive experience in Chimeria:Grayscale, we expanded the feature set of Chimeria’s authoring tools to include narrative branching. Previously, the platform defined narratives as streams of events. Individual narrative events could be configured to manifest in the stream of events in a variety of ways (e.g. fixed/variable number of manifestations, conditional manifestations). With our modifications to Chimeria, narratives can be defined as a tree of events such that a depth-first traversal from the root node to a leaf node constitutes a complete narrative experience. We

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leverage this feature in Chimeria:Grayscale to allow users to explore different aspects of the ambivalent sexism framework with each playthrough.

Chimeria:Grayscale
Chimeria:Grayscale is a single-player interactive narrative designed to enable reflection on sexism in the workplace. More specifically, the goal of the interactive narrative is to subtly convey and enable meaningful reflection on aspects of the ambivalent sexism framework as related to the contemporary workplace. See Figure 4 for an overview of the ambivalent sexism framework [13, 14]. As the Chimeria:Grayscale experience is fully unsupervised, related literature would label our interactive narrative as a single-person roleplay and, thus, a guided reflective experience.

Roleplay Scenario
The roleplay scenario is as follows. Players assume the role of a Human Resources manager who has recently been hired to work for Grayscale Inc., a fictional corporation with a toxic, sexist culture. As the narrative unfolds, players must navigate tensions between ethical behavior and career advancement through their email exchanges with characters in the story.

Players are granted agency within the roleplay scenario through their ability to interact with the Grayscale email client. Figure 3 presents a screenshot of this client. Player interactions are limited to reading emails and selecting responses to emails marked with **!** (i.e. important emails). Players can read through the contents of their inboxes at any time. They are only afforded the opportunity to respond to a single email at a time, however. As time passes within the narrative, the player’s primary inbox gets populated by email messages from coworker characters. When an important email arrives in the player’s inbox, the inflow of emails temporarily halts to allow players to select a response. Each important email within the narrative has an associated, unique list of responses for the player to select from. Once a selection is made, the inflow of emails resumes.

After one week has passed within the roleplay scenario, a final set of email messages arrives in the player’s primary inbox. This set of messages shows the player how their choices
We followed a few basic guidelines when applying the Particularization principle to the design of Chimeria:Grayscale. According to Yardley-Matwiejczuk [43], compared to other types of roleplays, single-person roleplays benefit most from the use of roleplay induction techniques. As Chimeria:Grayscale is a single-person roleplay, we expected that applying roleplay induction techniques to its design would have a significant, positive effect on reflective outcomes enabled by Chimeria:Grayscale.

When a roleplay is implemented as an interactive narrative, application of the Particularization principle is particularly straightforward. Necessary information about the setting can be communicated graphically to the player. For example, from the very moment Chimeria:Grayscale players start the interactive narrative, they know that the roleplay scenario is set in a corporate email client, and they know exactly what the email client looks like. In contrast, traditional roleplays would typically present such information to the player via an exhaustive written or verbal description.

We followed a few basic guidelines when applying the Presenting principle to the design of Chimeria:Grayscale. The first guideline we followed states that players can become more immersed in a role if the setting contains elements they recognize as familiar. We sought to recreate the familiar in Chimeria:Grayscale by designing the email client to look as generic as possible. Of course, this approach assumes that players have some prior experience with email clients. The second guideline we followed states that players can become immersed in a role more easily if their role is communicated to them in the 2nd person. The very first email message that players can read in Chimeria:Grayscale orients the player to their role in the setting. To enable players to immerse themselves in their role more easily, we crafted this email in the 2nd person.

In accordance with the Personalization principle, we allow Chimeria:Grayscale players to personalize their experience at the email client’s login screen. Figure 5 presents a screenshot of the login screen. There, players may select the first name of the player character as well as an accent color for the interface. Though we offer few options for personalization, Yardley-Matwiejczuk [43] asserts that even a small amount of personalization can significantly improve the quality of a roleplay.

The Embedded Design Model

We implemented strategies from the Embedded Design model in Chimeria:Grayscale as follows. The Intermixing strategy was deployed when crafting the order of narrative events in Chimeria:Grayscale. Emails related to ambivalent sexism were interspersed among emails that either elaborate on the setting or set the emotional tone of the story. Due to IRB restrictions, we did not employ the Obfuscating strategy. The Distancing strategy was implemented by having players roleplay as someone other than themselves.

Semiotic Morphism: Ambivalent Sexism to Chimeria

By defining and implementing a semiotic morphism from the semiotic space of the ambivalent sexism framework to the semiotic space of Chimeria, we enable players to explore the ambivalent sexism framework through Chimeria:Grayscale. Let AS denote the above semiotic morphism. Chimeria:Grayscale implements AS in two parts. The first part, a computational model of ambivalent sexism in terms understood by Chimeria, captures the major ideas and structure of the ambivalent sexism framework. The second part, the set of important emails and associated responses that appear in Chimeria:Grayscale, captures nuances of the ambivalent sexism framework not captured by our computational model.

Our model of ambivalent sexism was defined in terms of Chimeria constructs: social categories and social category features. The model describes 4 social categories: ambivalent sexist, benevolent sexist, hostile sexist, and nonsexist; and 4 social category features: hostile sexism, complimentary gender differentiation, protective paternalism, and intimacy. Social category membership values are determined by functions of social category feature values. We derived the social category membership functions used by our model from the Ambivalent Sexism Inventory [13].

The model of ambivalent sexism we implemented in Chimeria forms the foundation for Chimeria:Grayscale’s narrative event and theme variability. As players select responses to important emails, fallouts are applied to the player character. Fallouts are updates to a Chimeria entity’s social category membership. Chimeria:Grayscale, then, uses its model of ambivalent sexism to classify the player character in accordance with the ambivalent sexism framework. Classification involves calculating the player character’s social category membership values as well as the player character’s historical trajectory of social category membership values. When the player character’s classification changes, the structure and content of the narrative transform to reflect this change. In this way, we enable players to explore aspects of the ambivalent sexism framework in tandem with their exploration of the narrative.

To better illustrate Chimeria:Grayscale’s narrative event and theme variability, we present several variations of one of Chimeria:Grayscale’s final email messages. The email is sent by Grayscale Inc.’s highest-level executives and contains
their evaluation of the player character’s job performance. Suppose that the player character has been categorized as a hostile sexist at the time this email arrives in their inbox. In this case, the content of the email will be as follows:

“Grayscale has concluded that morale at your branch might have been better if you had intervened more in your role as a temp manager of human resources. The current issues going on are the sort of things that lead to very bad press. Do something about this quickly or there will be consequences.”

The email content presented above shows that the highest-level executives at Grayscale Inc. are more concerned with avoiding scandals than treating their employees well. Suppose that, throughout the interactive narrative, the player character’s social category has frequently fluctuated between social categories. Further, suppose that the player character has been categorized as a hostile sexist at the time this email arrives in their inbox. In this case, the content of the email will be as follows:

“Grayscale is aware that some employees have expressed dissatisfaction with what has been described as the ‘lax’ way you have managed misbehavior in the office this past week. Don’t worry about it too much — people are way too sensitive these days. That said, we would recommend providing at least the appearance of greater empathy to our employees.

Overall, we are pleased with your performance. Keep it up. You’ll go places.”

The email content presented above further illustrates the management philosophy of Grayscale’s highest-level executives. It also shows how Chimeria:Grayscale uses the player character’s historical trajectory of social category memberships to alter the structure and content of the narrative. There are seven additional variations of this email. In the manner illustrated above, Chimeria:Grayscale alters both the structure and content of the narrative throughout the experience in response to player choices.

STUDY DESIGN
To evaluate Chimeria:Grayscale, we conducted an exploratory, cross-sectional user study. More concretely, we sought to answer the following questions:

1. What is the player experience like in Chimeria:Grayscale?
2. How much, if any, critical self-reflection on sexism in the workplace resulted from experiencing Chimeria:Grayscale?

Participants
We recruited participants from Reddit using the r/SampleSize subreddit. This community is dedicated to administering and participating in surveys ranging in purpose from casual to academic. Participants were not compensated in any way for their participation in our study.

Figure 6 summarizes the demographic information we collected from our study participants. 31 participants in total completed the study. Study participants were 18-36 years of age and skewed young. The gender composition of participants was 51.6% (16) male, 45.2% (14) female, and 3.2% (1) non-binary. The employment composition of participants was 42.0% (13) professionals, 42.0% (13) students, and 16.0% (5) unemployed.

Procedure
First, participants were asked to provide informed consent prior to participation in the study. Then, study participants were tasked with playing through Chimeria:Grayscale one or more times. Finally, after completing the previous task, participants were asked to complete a survey.

The survey consisted of an amalgam of validated survey instruments: the System Usability Scale (SUS) [7], the post-game and social presence modules of the Game Experience Questionnaire (GEQ) [36], and portions of the Learning Activities Survey (LAS) [26]. At the end of the survey, we also asked participants to provide us with basic demographic information.

The rationale behind our choice of validated survey instruments is as follows. First, the SUS was administered to measure the usability of Chimeria:Grayscale. We were interested in knowing if the usability of the user interface would distract from the roleplay experience. Next, the PGQ and SPGQ were administered to characterize engagement with the narrative and its characters, respectively. As engagement is critical to the success of roleplays and the GEQ was designed to evaluate game experiences, we identified these GEQ modules as well-suited for use in this study. Finally, as described previously, the LAS was administered as an indirect measure of the amount of critical self-reflection experienced by study participants.
As an aside, although we asked participants about how *Chimeria:Grayscale* affected their beliefs, we are not concerned with conceptual change in this work. We are primarily interested in the efficacy of *Chimeria:Grayscale* with respect to enabling reflection. Thus, we would consider the work a success if study participants showed strong signs of having reflected on the themes of *Chimeria:Grayscale*.

**RESULTS & FINDINGS**
This section summarizes the results obtained from the user study and our findings.

**System Usability Scale**
The System Usability Scale (SUS) produces a number between 0 and 100 that represents a composite measure of the overall usability of a system. Figure 8 presents the distribution of SUS scores obtained from our study. Participants gave *Chimeria:Grayscale* a usability score of 85.48 on average with a standard deviation of 16.19. According to Bangor et al.’s adjective rating scale [2], these scores ranged from “good” to “best imaginable.” These results suggest that *Chimeria:Grayscale*’s user interface is sufficiently usable such that it does not constitute a distraction from the overall experience. We attribute this outcome, in part, to our adherence to the roleplay induction principles of *Particularization* and *Presencing*.

**Game Experience Questionnaire**

**Results**
The Post-Game Questionnaire (PGQ) is a module of the Game Experience Questionnaire (GEQ). It measures how participants feel after they have stopped playing a game. It is composed of 4 subscales: *positive experience*, *negative experience*, *tiredness*, and *returning to reality*. The result of each subscale is a number between 0 and 4. Figure 7 presents a summary of the PGQ results. The survey results were *positive experience* (M=1.52, SD=0.93), *negative experience* (M=0.82, SD=0.58), *tiredness* (M=0.74, SD=1.10), and *returning to reality* (M=1.02, SD=0.78).

Overall, the results from the PGQ module show that participants found their experience with *Chimeria:Grayscale* to be neither particularly pleasant nor unpleasant. In addition, participants were not particularly tired after playing the game nor did they have trouble emerging from the experience. For the most part, there was no statistically significant difference in results between participants according to gender. The exception to this appeared in the results of the *return to reality* subscale (p-value: 0.047). Male participants reported significantly less trouble returning to reality (M=0.71, SD=0.47) than female participants did (M=1.29, SD=0.91).

The Social Presence in Gaming Questionnaire (SPGQ) is also a module of the GEQ. It measures participants’ experience of and involvement with co-players or virtual characters. As *Chimeria:Grayscale* is a single-person roleplay, the results obtained from administering this module of the GEQ only apply to participants’ experience with characters in the narrative. The module is composed of 3 subscales: *psychological involvement (empathy)*, *psychological involvement (negative feelings)*, and *behavioral involvement*. The result of each subscale is a number between 0 and 4. Figure 7 presents a summary of the SPGQ results. The survey results were *psychological involvement (empathy)* (M=2.08, SD=0.86), *psychological involvement (negative feelings)* (M=1.21, SD=0.63), and *behavioral involvement* (M=2.55, SD=0.76).
Overall, the results from the SPGQ module show that participants experienced minimal negative feelings and a measure of empathy for characters in the narrative. In addition, participants felt that their actions and the actions of characters in the narrative were interdependent. This suggests that participants felt like they had agency within the narrative, a necessary quality for an effective roleplay. For the most part, there was no statistically significant difference in results between participants according to gender. The one exception was discovered in the results from the behavioral involvement subscale (p-value: 0.01). Male participants reported significantly less behavioral involvement with the narrative’s characters (M=2.25, SD=0.76) than female participants did (M=2.90, SD=0.46).

Findings
Our analysis of the GEQ results revealed a difference in player experience along gender lines. Male participants experienced less immersion with respect to Chimeria:Grayscale and less engagement with Chimeria:Grayscale’s characters than female participants did. We consider a few possible explanations for this observed difference in player experience. (1) The ambivalent sexism framework deals strictly with sexist attitudes towards women. As such, there is no instance during Chimeria:Grayscale where a male character directly suffers as a result of gender discrimination. Male participants may not have identified as much with the themes of the narrative as a result. It is possible that our results were, thus, skewed by our choice of model. (2) It’s possible that, having been socialized in a society in which sexism toward females is intrinsic, male participants were less troubled by the sexist nature of the setting [6].

Learning Activities Survey
It is important to note that we took a conservative approach to adapting the LAS for use in our study. The original LAS was tailored for use in classroom settings and has since been adapted for numerous use cases. In this study, we opted to not administer survey items from the original LAS that fell outside the scope of our study (i.e., those specifically related to classroom settings).

Results
The Learning Activities Survey (LAS) measures whether, and to what extent, a perspective transformation has occurred as a result of a transformative experience. Table 1 presents a summary of the LAS results. This summary shows the proportion of study participants who reached some stage of perspective transformation (i.e., Stage 1: 41.9%, Stage 2: 87.1%, Stage 5: 35.5%). Recall that progression through these stages is driven by critical self-reflection. The table further shows that participant reflections manifested as questioning one’s ideas about social roles, questioning one’s normal behaviors, or contemplating new behaviors. Figure 9 presents a plot of LAS response pattern frequencies. From this plot, we observe that no study participant responded with “No” to all of the LAS survey items (i.e., response pattern: 00000). Thus, all study participants engaged in critical self-reflection to some extent.

Findings
When interpreting the LAS results, there are a few important considerations one must keep in mind with respect to the process of perspective transformation. (1) Generally speaking, higher stages of perspective transformation are indicative of increasingly extensive critical self-reflection. (2) Individuals...
We assert that our approach is compatible with others used in interactive systems that support reflection. That being said, to promote users to reflect at key moments using reflective prompts. Researchers seeking to leverage potential synergies could push users to reflect at key moments using reflective Chimeria:Grayscale by the design of critical self-reflection has task flows involving user interaction, those task flows can in a wide range of contexts: online learning platforms, personal informatics applications, games, and more. If a system in a wide range of contexts: online learning platforms, personal informatics applications, games, and more. If a system embarking on the process of perspective transformation do not necessarily experience each of the stages in order.

The most and second-most common LAS response patterns observed in our study (i.e., 52% and 19% of participants, respectively) indicate that most participants, upon reflecting on their Chimeria:Grayscale experience, agreed with their previous beliefs without question. We consider a few possible explanations for this outcome. (1) The beliefs of these participants may have already been compatible with the ambivalent sexism framework. Thus, after experiencing Chimeria:Grayscale, there was no need for them to resolve a disorienting inner dilemma. (2) Chimeria:Grayscale simply did not engage these participants as well as those that did question their beliefs. Curiously, despite not having questioned their beliefs, the LAS indirectly ranked the reflections of these participants reflected quite high (e.g., perspective transformation Stage 2 or 5)

Participants who questioned their beliefs (i.e., response patterns 1xxxx and x1xxx) were more varied in terms of the characteristics of their reflections than their non-questioning counterparts. For example, participants in this group were observed as being in perspective transformation Stages 1, 2, or 5. Further, among these study participants, the ratio of participants who considered acting in a different way from their usual beliefs to those who did not was 2:3. Also, though most participants who questioned their beliefs concluded, upon reflection, that they still agreed with their previous beliefs, one study participant concluded the opposite: that they no longer agreed with their previous beliefs. Though the questioning and non-questioning groupings of study participants appear to have different characteristics at first glance (e.g., likelihood of considering new behaviors), we lack sufficient data to verify this hypothesis through statistical methods at this time.

DISCUSSION

As all study participants reported having engaged in critical self-reflection to some extent, we claim that Chimeria:Grayscale succeeded in enabling reflection. This outcome suggests that our approach to supporting reflection through interactive narratives and roleplay has promise.

Further, we believe that our approach could support reflection in a wide range of contexts: online learning platforms, personal informatics applications, games, and more. If a system has task flows involving user interaction, those task flows can be designed as interactive narratives that scaffold and enable critical self-reflection via roleplay, as demonstrated concretely by the design of Chimeria:Grayscale.

We assert that our approach is compatible with others used in prior work. For example, similarly to MAHI [28], an interactive system like Chimeria:Grayscale could be paired with an on-demand staff of experts to further scaffold user reflections post-experience. Another example: similarly to Saksono et. al. [38], an interactive system like Chimeria:Grayscale could push users to reflect at key moments using reflective prompts. Researchers seeking to leverage potential synergies could, with care, adopt a combined approach when designing interactive systems that support reflection. That being said, to properly evaluate the generalizability of our approach, further research is required.

Limitations

Our study had a few notable limitations. First, the scale of the study was rather small. Thus, the should not be considered absolutely conclusive evidence. More research is needed to verify the effects observed in this study. Second, the study was not designed to capture nuances about participant reflection. For example, our survey did not ask study participants to share details about their preexisting beliefs, their reflective process, or how Chimeria:Grayscale affected their beliefs. Analysis of any one of these data points would have improved the study. Finally, our results were obtained from a single source: validated survey instruments. If we had instrumented Chimeria:Grayscale, we could have verified our survey results with Chimeria:Grayscale traces.

Future Work

Our next step related to this work is to conduct a follow-up study of Chimeria:Grayscale that addresses all of its current limitations. Farther into the future, we intend to research how, or if, our approach should change to enable meaningful reflective outcomes for increasing numbers of concurrent users. In addition, we intend to investigate how interactive systems that operationalize our approach might fit into educational settings (e.g., massive open online courses). Finally, the differences along gender lines revealed by this study point to the challenge of designing experiences that are equally effective across users. Going forward, we will use Chimeria:Grayscale as a research platform for exploring strategies that address this challenge.

CONCLUSION

Systems that support reflection have helped with addressing important problems in health, education, and more. To investigate how interactive narratives and roleplaying can effectively support reflection, we conducted an exploratory, cross-sectional study evaluating an interactive narrative we created, Chimeria:Grayscale. Our results show that we successfully enabled our 31 user study participants to critically self-reflect on the themes of our interactive narrative. Although more research is needed to verify the effects observed in this study, our results suggest that our approach has promise. This work marks a step towards realizing our long-term vision of implementing interactive systems that play crucial roles in ecosystems of computer-supported reflective practice.

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REFERENCES


