Interactive Personal Storytelling: An Ethnographic Study and Simulation of Apartheid-Era Narratives

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ABSTRACT
This paper reports on a digital storytelling project which seeks to create interactive storytelling of personal experience narratives. We begin with an ethnographic study of two resident storytellers at the District Six Museum, Cape Town, Noor Ebrahim and Joe Schaffers, who tell audience their personal Apartheid-era narratives. An analysis of their narratives and audience interactions led to the design a digital storytelling prototype in the form of a virtual environment containing two storytellre agents based on Joe and Noor. These agents simulated two interactions: *questions* in which users could ask the storyteller agents questions; and *exchange structures* where storyteller agents ask users questions. We evaluated the effectiveness of these in a controlled experiment (n = 101) and found that questions led to significant increases in narrative engagement (p=0.05) and interest (p=0.02) while exchange structures significantly improved narrative enjoyment (p=0.004), engagement (p=0.002) and interest (p=0.02).

Author Keywords
Digital Storytelling; Interaction Design; Ethnography; Discourse Analysis; Empirical Evaluation.

ACM Classification Keywords
H.5.2. Information interfaces and presentation (e.g., HCI): User Interfaces – interaction styles.

INTRODUCTION
Personal narratives are capable of conveying historical events in engaging and compelling ways [22]. Hearing these told first hand, by those who experienced them, is even more powerful since it not only makes others' experiences all the more relatable but offers listeners the opportunity to interact with the teller. In this paper we present our efforts toward designing digital storytelling which captures this quality. We collaborated with District Six Museum in Cape Town, which commemorates neighborhood segregation during South Africa's Apartheid regime. District Six was a multi-racial inner-city suburb which was declared a whites-only area during Apartheid. Properties were seized and most buildings, save for churches and mosques, and streets were demolished. Residents were relocated – often to government-built townships, where many still live. However, land developers refused to build there in protest and District Six stands empty today as an iconic example of the forced removals that occurred throughout South Africa. The museum strives to present the experience of the ex-residents. Two full-time guides, Joe Schaffers and Noor Ebrahim, are ex-residents who tell visitors of their experiences of living in, and leaving, District Six. They are regarded less as guides and more as resident storytellers. Unfortunately, the ex-resident community is ageing; when Joe and Noor depart, the opportunity to hear their stories in-person will depart too. Our work focuses on preserving personal storytelling such as Joe and Noor's. We conducted an in-depth ethnographic study of their storytelling with the aim of building and evaluating a prototype that mimicked the ways they interacted with audiences. This study's main findings were translated into a digital storytelling prototype design which we implemented and evaluated. We discovered interactions which significantly improved user's story experience as well as avenues for improving the design.

DIS '14, June 21 - 25 2014, Vancouver, BC, Canada

http://dx.doi.org/10.1145/2598510.2598597

BACKGROUND
We begin by presenting previous work which influenced and informed our research approach.

Digital and Virtual Storytelling
Broadly speaking, digital storytelling aims to capture, archive and present real-life narratives. Some work memorializes times and/or places [1, 36, 37], others enable story creation and sharing [2, 10]. Storage and sharing platforms have included online archives [1, 36, 37], mobile devices [2] and customized public displays [12]. Others have explored "memory boxes" where narrative recordings are associated with tangible objects [9, 34]. Conversely, virtual storytelling typically explores fictional non-linear

storytelling where users have varying degrees of influence [6] ranging from interactions that do not impact narrative outcome [23] to intervening or controlling story characters [5, 11, 24, 31]. These are presented as in virtual reality (VR) or augmented reality (AR) environments [3, 28] and draw from classic drama and narratology theory [6]. While real-life storytelling has been explored extensively in linguistics and anthropology, few virtual or digital storytelling projects have drawn from these fields. Our work is an intersection of digital and virtual storytelling since we wanted to present real-life stories so that users could interact with, but not alter, their content.

The Structure of Narratives

Probably the best known narrative structure analysis is Propp's study of classic plots in Russian folktales [30]. One of the best-known analyses of personal experience narratives' structure is that of Labov [13, 14, 27, 29] who analyzed stories elicited in interviews. These stories typically comprised the following sequence of verbal clauses, each of which answered a specific question:

- ***Abstract***: signals the start of, and sometimes, summarizes, the story; *"What is the story about?"*
- ***Orientation***: context and events leading to the complicating action; *"Who, when, where, what?"*
- ***Complicating Action***: the main event, often a disruption to events so far; *"Then what happened?"*
- ***Evaluation***: the reason for telling the story; usually a commentary on its noteworthiness; *"So what?"*
- ***Result***: eventual outcome; *"What finally happened?"*
- ***Coda***: signals the end; *"And what happened then?"*

Complicating actions and evaluations are essential for conveying personal experiences. The other clauses provide optional elaboration. Clauses tend to follow the above-listed order except that orientations and evaluations may appear throughout a narrative and stories may feature "narrative preconstructions": multiple orientation clauses relaying events or context leading to the complicating action [14]. Across multiple retellings of narratives, Chafe [7] and Norrick [25] observed that storytellers expand or shorten clauses depending on audience reactions. But, narrative structure remained "substantially intact from one telling to the next" especially for frequently retold stories [25].

Interactions between Speakers and Listeners

While creating natural, robust human-computer interaction is a challenge, it is possible for domains of discourse whose interaction patterns are well understood [10, 35]. To this end, linguistic studies in human conversation offer lessons for designing intuitive human-computer interaction [35]. We explored linguistic understandings of human interaction in a variety of storytelling and conversational settings. In oral storytelling *coactive participation* is initiated by audiences and may lead to *banter* between storyteller and audience. *Questioning* is a form of banter initiated by storytellers posing questions to audiences [19]. During conversations, speakers intuitively apply *turn-taking* rules to negotiate speaking turns in way to that avoids gaps and overlaps in speaking [32]. Stretches of speech where a speaker "holds the floor" to the exclusion of others are *turn constructional units* (TCUs). At the end of a TCU there is a *transition relevance place* (TRP), where a new speaker may take the floor. TRPs often take the form of a simple pause. The floor may also be relinquished by posing a question or through a discourse marker – words such as "And", "But", "So" and "Anyway" which indicate the beginning or end of a TCU. Interrupting, or turn stealing, is considered bad behavior, as is silence when a response is expected [29]. Specialized interactions, like doctor-patient or teacher-student interactions feature pre-allocated turn-taking. Sinclair and Coulthard's [29, 33] discourse analyses of teacher-student interactions identified such a consistent interaction termed *exchange structures*. These consist of: initiation (*I*); response(s) (*R*); and feedback (*F*). Most often, teachers ask a question during *I* to which one or more students respond (*R)*. Usually students raise their hands or verbally bid to respond. During *F* teachers acknowledge and judge responses. Exchange structures may play out in a number of ways. If *I* receives no responses, teachers may re-initiate by question repetition or rephrasing or prompting for answers. To incorrect student responses, teachers may give negative, constructive feedback and wait, or prompt, for more responses. This pattern may repeat over multiple turns as teachers steer students towards correct answer(s). If a question has multiple answers, teachers may withhold the final feedback over multiple turns while listing student responses and prompting for mores responses until, eventually, concluding with summative feedback.

Simulating Museum Guides

Digital museum guides often take the form of audio or animated avatars on mobile devices carried around an exhibition space, providing content-sensitive information. Lim & Aylett [18] used a brief survey of tour guides' storytelling to design and create mobile guides which told different stories based on distinct 'personalities'. Yamazaki *et. al.* [38] studied video of art museum guides' explaining paintings to visitors to understand their non-verbal behaviors. Guides' gaze and gestures were coordinated around TRPs e.g. when finished speaking, their gaze moved from painting to audience, creating an opportunity for audience members to speak. Additionally, guides involved visitors by asking questions. They created a robot guide capable of detecting human faces and directing its "gaze" in the same way. It also asked "involvement questions", paused for a preset timeframe to allow visitors to respond and then delivered preset answers. At an art museum, 83% of visitors encountering the robot listened to a complete explanation and many responded to involvement questions. But, the robot did not parse visitor's answers and, so, did not respond to incorrect answers appropriately.

RESEARCH APPROACH

Our work was shaped by one broad motivation: preserving the experience of interactive personal storytelling. We wanted to design a digital storytelling system capable of delivering personal experience narratives more engagingly than static, passive talking head or video displays. We worked in three distinct phases starting with a thorough ethnographic study of experienced storytellers, Joe and Noor. Next, we used discourse analysis to understand their storytelling and interaction patterns and translated the most prominent findings into a digital storytelling prototype design. Third, we conducted a rigorous experimental evaluation of the designs embodied by the prototype.

STUDY ONE: STORYTELLING ETHNOGRAPHY

We studied Joe and Noor at District Six Museum for three months. We began with an informal interview with each storyteller in which we described that our goal was to observe their tours unobtrusively and learn about their storytelling (as opposed to critically evaluating it). We spent 3-4 days at the museum and eventually observed and took detailed field notes on 39 tours. We recorded and transcribed 7 of these, 3 of Noor's and 4 of Joe's. Discussing the full richness of our experience at the District Museum is beyond this paper's scope. Here we present a relatively succinct account focusing on (1) typical tours for each storyteller; (2) their narratives' characteristics and structure; (3) variation over different retellings; and, most importantly, (4) their interactions with audiences.

The Resident Storytellers and their Tours

Noor was born in District Six and lived in a large house owned by his grandfather, an Indian immigrant. He left at age thirty-one for a "colored" designated neighborhood where he still lives. His tours focus on stories of his District Six childhood and he tends to speak to school groups aged 6 to 13. Noor started tours by introducing himself as an ex-resident and museum founder and pointing out, on a large District Six map, where his house was located. Most of his tours took place around a wall of his personal photos, where he invited audiences to sit on the floor while he sat on a bench and delivered numerous stories in roughly the same order in every tour. These included: how he came to write a published District Six memoir; his grandfather's life; witnessing the demolition of his District Six home; the declaration of District Six as "whites-only" and the story of a friend who, having married across race, had to live apart from his wife and children after relocation. He sometimes told of the segregation of public areas and services and illustrated these with stories of his sister, a head nurse, who could not touch white patients and how a childhood friend was refused help from a "whites-only" ambulance after a hit-and-run accident. Noor typically concluded tours by inviting audiences to ask questions. Joe grew up in Bloemhof Flats, a District Six apartment complex. He left aged twenty-seven and, for twelve years, lived in various townships before settling in a non-township neighborhood. Joe informed us that his tours were "academic" and focused on the enduring social impact of Apartheid. Indeed, he focused on Apartheid's history and legacy and told some stories about living in District Six and townships. He usually talked to student groups aged 14 and up. His tours always started at a set of panels containing varied information on District Six and Cape Town's townships. He told groups about District Six as a harmonious, cosmopolitan community, giving examples of the neighborly behavior he experienced in Bloemhof Flats. Next, he usually talked about Apartheid's ideologies and laws and the social consequences of government-built townships. Next he invited groups to sit at an exhibit on District Six's demolition. Referring to a variety of photographs here, he described the lost craftsmanship of the District Six's buildings, public signs used to designate public amenities to different races and described the experience of moving from Bloemhof Flats to a poorly built township. Like Noor, he ended tours by inviting audience questions.

Narrative Characteristics and Structure

We soon realized that Joe and Noor did not aim to shepherd visitors around the museum. They only ever gathered groups around two or three museum locations and encouraged independent exploration after tours. Furthermore, they tended to reference exhibits which held personal resonance for them. Their tour content was also very consistent –a core repertoire of narratives and explanations appeared in almost all tours and, in longer tours, they delved into a secondary repertoire [16]. This consistency gave us the opportunity to analyze core repertoire narratives over multiple retellings. We identified two narratives from Noor and three from Joe which appeared in every tour they gave. This yielded eighteen transcribed retellings upon which we conducted in-depth discourse analysis inspecting their verbal clause structure and the storyteller-audience interactions that arose. The narratives fit neatly into Labov's structure and often featured lengthy preconstructions which gave historical contextualization. Most narratives conveyed the emotional experienced of forced removals. In the following example, Joe describes the experience of receiving eviction notices; we have indicated the clause structure:

> ***Orientation:*** "Personal friend of mine who lived out in Sea Point, Tramway Road."
>
> ***Complicating Action:*** "His father received his notice, read the notice, coupla days later, walked out of the front door, and they found him hanging in the trees between Sea Point and Camps Bay."
>
> ***Evaluation:*** "One of many suicides (that) were committed by people, because they couldn't stand the fact, that they'd been totally destroyed, their lives had been totally destroyed, because of the color of their skin."

Narrative structure did not change much across retellings [17, 16]. While we had hoped to observe some dynamism in their storytelling, this matched [7, 25]'s findings on the structure of frequently retold narratives. This is not to say that all retellings were identical – minor variations did arise. Longer tours featured longer versions of narratives and, content adjustments were made based on the types of audiences e.g. with American groups both storytellers drew parallels between Apartheid and USA Segregation while local audiences often heard some content in Afrikaans (Joe and Noor's first language) [16]. These kinds of adjustments are referred to as *audience accommodation* [19]. Variation also resulted from storyteller-audience interactions.

Storyteller-Audience Interactions

Joe and Noor's tours mostly involved school and university student audiences and they took on a teacher role in these:

> "Ok, for the next hour I'm gonna be your teacher, hey? And you're gonna listen to me." (Noor)

Their interactions with audiences closely echoed the teacher-student interactions described by [33]. Furthermore, these interactions were incorporated in ways that allowed a natural return to storytelling after an interaction's conclusion. A key finding was that interactions always occurred *between* narrative clauses. Hence, clauses acted like conversational TCUs, while the spaces between them where TRPs.

Audience Questions

Some interactions were initiated by audiences who either waited for pauses in the storytelling. Most, however, raised their hands and waited to be called on resulting in this interaction: storyteller's acknowledgement of raised hand; audience member's question; and storyteller's answer. These interactions rarely led to back-and-forth banter. Most often, after answering a question, the storytellers returned to the narrative or, in the event of more raised hands, on to another audience question. There was a tendency for single questions to arise during narratives and multiple questions at the narratives' end, when the storytellers often invited multiple questions. If no one asked questions when invited, Noor especially, would hint at possible questions e.g. *"You can ask me anything about District Six... games, gangsters, you name it, right?"* Joe and Noor were quite familiar with commonly occurring questions and gave well-rehearsed, comprehensive answers while less common questions were met with brief answers and, questions they could not answer, with *"I don't know"* or *"I'll find out for you"*.

Exchange Structures

Occasionally, the storytellers initiated interactions by asking questions [17]. Almost every such interaction matched [33]'s exchange structures: a storyteller's initiating question, one or more audience responses and storyteller feedback. Exchange structures can follow a number of different paths, all of which we observed in Joe and Noor's tours. When audiences did not respond to an initiating question the storytellers re-initiated by rephrasing or repeating the question. Incorrect or incomplete answers where met with constructive feedback, prompting for more answers and, often, clues toward correct answers. And, where initiating questions had multiple answers, audience responses were listed before concluding with summative feedback as in the following exchange structure during Noor's story about his family home:

> *Noor:* "…the day, they bulldozed my home, I was standing there, I was watching them, right in front of me. What do you think? How did I feel?" ***(initiation)***
>
> *Child One:* "Sad." ***(reply)***
>
> *Noor:* "Sad." ***(feedback, listing)***
>
> *Child Two:* "Angry." ***(reply)***
>
> ***Noor:*** "Angry, angry, that's the word! Angry! We didn't wanted *(sic)* to go." ***(feedback)***

Joe and Noor used different kinds of initiating questions. Most common were questions testing the audience's grasp of narrative content so far. Less prevalent were questions about the audiences e.g. during a Joe-led tour to students from Cape Town's townships, he inquired where everyone lived and used responses to comment on various townships.

DIGITAL STORYTELLING DESIGN AND PROTOTYPE

Towards our goal of interactive digital storytelling, we focused on simulating the two interactions that featured most prevalently in Joe and Noor's storytelling. We realized that structuring narratives as a series of clauses would allow us to create natural spaces (or TRPs) where interactions could occur without introducing unnatural interruptions to narrative flow. For the interactions themselves we focused on audience questions and exchange structures. We created a prototype to embody and test these ideas. We did not want remove ther narratives too far from their originating context. Therefore, we chose to create a VE containing two storyteller agents, one based on Noor and one on Joe, together with the objects their storytelling incorporated. However, the interaction designs we used are orthogonal to a VR implementation and could be used in other kinds of implementations such as text-based environments or even video presentations of the storytellers. Moreover, we focused on simulating the interactions we had observed and not on producing high-fidelity virtualizations of Joe and Noor. The VE includes audience avatars that listen to the storyteller agents and participate in the interactions where appropriate. The storyteller agents recount the five narratives we analyzed in detail during Study One. Since these narratives' structure was consistent across retellings, we were able to create digital versions which were representative of how they were typically told by Joe and Noor. During the process of designing and building the prototype we consulted with Joe

and Noor and the District Six Museum. We presented them with early storyboards and arranged a demonstration session of a first version of prototype. These touchstones allowed us to ensure that Joe and Noor approved of how their likenesses and narratives would be presented and gather any feedback.

Figure 1 shows the VE upon start-up: the user is part of a virtual audience facing the storytelling agents and can move and look around using standard keyboard and mouse controls. The agents introduce themselves and, then, begin the first story. The prototype was built using Microsoft's XNA Game Studio and Blender 3D. Agent animations were based on Joe and Noor's typical gestures and movements. The soundtrack was composed entirely of recordings gathered during Study One. This allowed us to (a) present the stories as told spontaneously and (b) combine different retellings so that the agents presented, not one particular version of a story, but a composite version. Furthermore, the storyteller agents are surrounded by the museum objects typically referenced during the five narratives.

Figure 1. The VE upon start-up: audience avatars sit facing the storyteller agents, Noor (left) and Joe (right), surrounded by objects referenced during narratives.

Questions and Exchange Structures

In Study One audiences' questions tended to be preceded by audience members raising their hands and waiting to be called on, or by the storytellers inviting questions at the end of narratives. We implemented *user questions* to simulate the former and *question opportunities* for the latter. And we implemented *exchange structures* wherein the storyteller agents initiated multi-turn interactions by asking a question. In Study One we identified the clauses and interactions comprising each narrative. In our prototype we considered a narrative as a series of the following types of components: non-interactive verbal clauses; interactive question opportunities and exchange structures. This arrangement ensured that interactive components never took place during clauses, and facilitated user questions. Figure 2 shows how the prototype mimicked hand-raising behavior. At any point during a story, the user may press the Space bar to 'raise their hand'. When they do so, a hand icon is displayed to indicate the user's hand is up. At the end of every narrative component, the storyteller agent checks for a "hand-up". If there was one, a user question interaction can occur before the storyteller agent moves onto the next component. During a user question, the storyteller agent acknowledges the hand-up and a typing dialog, shown in Figure 3, appears for the user to type and enter their question. Users may also press Escape to opt out of entering a question. The agents can answer a repertoire of questions, related to the five narratives. The Noor agent could answer 6 questions and the Joe agent 3. We used simple keyword matching to find appropriate responses to user questions. If no matching question answer is found, the agent responds "I don't know". During question opportunities the agent invites the user to ask questions saying something like "If you have any questions, raise your hand", and then waits for the user to press Space. If the user does not do this within a certain time, a virtual audience member asks a question instead. Thus, the agent does not wait on the user indefinitely. The agents also give question hints: if the user takes longer than a certain time to type a question or 'raise their hand' when invited, keywords are displayed for questions the agents can answer.

Figure 2. During the storytelling the user is reminded that they may 'put up their hand' to ask questions (top). When the space key is pressed, a hand icon (bottom) is displayed until the agent allows the user's question.

Exchange structures are initiated by an agent asking a question and the appearance of the typing dialog shown in Figure 3. The user may opt out of entering a response by pressing Escape. If this happens, an audience avatar responds instead. The exchange structures are associated with a terminating answer and a collection of non-terminating answers. For exchange structures with many

correct answers, the non-terminating answers are a mixture of correct and incorrect answers. Keyword matching is used to judge which answer a user's input most resembles. If the user enters a non-terminating or unrecognized answer, the agent prompts for another answer, saying something like "Try again" accompanied by the typing dialog. To ensure that this interaction does not cycle indefinitely, the user has three tries at answering a question before a virtual audience member supplies an answer. We recreated the exchange structures that arose in our transcripts of the five narratives making for seven exchange structures in total.

Figure 3. The typing dialog in which users enter user question and exchange structure input.

STUDY TWO: QUESTIONS & EXCHANGE STRUCTURES

We conducted a controlled experiment to test whether the interactions in our storytelling prototype improved user's experience of the five narratives. Our aim was to test the effect of questions and exchange structures.

Study Design

There were two independent variables:

- ***Questions (Que):*** In the *Questions* (*Q*) condition participants were able to input questions. The *No Questions* (*NQ*) condition did not offer this option.
- ***Exchange Structures (ES):*** In the *Exchange Structures* (*E)* condition the storyteller agents initiated exchange structure interactions. In the *No Exchange Structures* (*NE*) they did not.

Both variables involved questions – either asking or answering them – so there was the possibility of interaction effects between *Que* and *ES.* Hence, we used a factorial, between-subjects 2x2 design shown in Table 1. In the *Q* and *E* conditions, users heard additional content contained in the storyteller agents' answers to questions and exchange structure feedback. To ensure that participants in different conditions experienced equivalent narrative content, we included non-interactive questions in the *NQ* conditions by having the audience avatars ask questions to which the storyteller agents answered. Similarly, in the *NE* conditions participants could hear, but not partake in, exchange structures interactions between the storyteller agents and virtual audience. Thus, participants in the non-interactive conditions still heard all the same content as those in the interactive conditions.

	Exchange Structures (E)	***No Exchange Structures (NE)***
Questions (Q)	*Q+E*	*Q+NE*
No Questions (NQ)	*NQ+E*	*NQ+NE*

Table 1. Study Two's factorial 2x2 design. The left column represents the two levels of Questions (*Que*) and the top row the two levels of Exchange Structures (*ES*). We compared four prototype versions: questions and exchange structures (*Q+E*); questions and no exchange structures (*Q+NE*); exchange structures and no questions (*NQ+E*); and neither (*NQ+NE*).

Measures

Often the effectiveness of VE is judged by *presence*, which is the extent to which uses experience a VE as a real place. Presence is often measured using retrospective questionnaires [20]. In our work we were less interested user's presence and more in how effectively our prototype delivered narratives. Hence, we built on previous work on measuring *story experience* using a psychometrically sound questionnaire to judge a variety of factors related to storytelling [15, 21]. Based on this work, we created a questionnaire to measure the following dependent variables:

- ***Storytelling Realism (SR)***: how much the digital storytelling felt like real-life storytelling
- ***Enjoyment (Enj)*** of the narratives and storytelling
- ***Engagement (Eng):*** how well the storytelling captured and held attention
- ***Interest (Int)*** in finding out more about the narratives' broader context subsequent to experiencing the prototype. Here, this meant and interest in District Six and Apartheid history.

We also collected the following control variables which might influence participant's story experience:

- ***Existing Knowledge (EK)***: how much participants knew about forced removals and District Six.
- ***Interest Tendency (IT)***: participant's tendency to show interest South African history and personal experience narratives.
- Demographic data: age, gender and nationality

These were all measured using Likert-type items rated on scales from 1-7. We analyzed the adapted scales for validity, using inter-tem correlations, and for reliability, using Cronbach's alpha coefficient (α). A Cronbach's value of 0.8 or greater indicates good reliability, while 0.7-0.8 indicates acceptable reliability [8, 26]. The 3-item *SR* scale was valid (all items correlated significantly) and reliable (α = 0.7). The 3-item *Enj* scale was valid and reliable (α =

0.7). The 5-item *Eng* was valid and reliable ($\alpha = 0.8$). And, the 8-item *Int* scale was valid and reliable ($\alpha = 0.9$). *EK* and *IT* were both measured using 3-time scales which were valid and reliable ($\alpha = 0.7$ and $\alpha = 0.8$, respectively). The questionnaire also elicited qualitative feedback. We asked participants to identify their favorite narratives along with reasons. Since some narratives contained more interactions than others, we were interested in seeing whether they preferred the more interactive stories. The questionnaire also asked participants to note their overall likes, dislikes and general comments.

We additionally wanted to track how participants interacted with the storyteller agents. Specifically, whether they made use of opportunities to ask questions and responded to exchange structures' initiating questions. And, we wanted to assess whether the agents responded to questions and exchange structure inputs successfully. So, for questions, we logged: the number and content of participant's questions; whether the storyteller agents recognized questions; the number of times question input was cancelled; and number of timed-out question opportunities. For exchange structures, we logged: the number of responses input by participants; the number of times they opted out of inputting a response; the number of exchange structure inputs the storyteller agents recognized; and the number of exchange structures for which participants were able to provide terminating answers.

Sample and Procedure

We drew a sample of students, from various disciplines, at our university. We advertised our "District Six storytelling study" via flyers and lecture announcements. We were aware that our prototype simulated interactions observed between the storytellers and young audiences and were curious to see was effective with an older audience. Participants signed up voluntarily and were paid 50ZAR (about $5) for 45-60 minutes. The data of 5 participants was excluded due to technical issues making for a a total sample of 101 with 25 each participants in *Q+E*, *Q+NE* and *NQ+NE* and 26 in *NQ+E*.

We set up a quiet room with four computers with similar hardware specifications and identical 17-inch LCD displays. This setup accommodated up to four participants per session, who could not see each other's displays. Each session covered a single experimental condition, which was determined before participants arrived, ensuring random assignment to conditions. Next we explained the storytelling VE's navigational controls and the interactions that participants could expect. Each time we explained a set of controls or interaction, we allowed participants time to practice in a training VE until they felt comfortable. The training VE consisted of two adjoined rooms, similar to those in the storytelling VE. Sample question and exchange structure interactions were text based which allowed participants to practice while hearing the experimenter's instructions. To eliminate bias effects, we created the impression that the sessions did not differ from each other by only training participants in the interactions that were part of that session's experimental condition. Next we provided the users with a short contextualizing text which briefly explained the history of forced removals and District Six and that they would be hearing the stories of two ex-residents named Joe and Noor. The choice to provide this contextualization was another idea gathered during one of our prototype demonstrations at the District Six Museum. At this point, the storytelling VE was visible on everyone's displays. The experimenter explained that the two standing figures represented Joe and Noor. Participants were asked to put on the headphones provided and press Enter when they were ready to begin. They were then allowed to experience all five narratives in the prototype while the experimenter sat quietly in the room. Once all five narratives were complete the prototype exited automatically and participants were handed the questionnaire to complete.

RESULTS

Here we report on the effect of questions and exchange structures on story experience as well as results from usage logs and qualitative data.

Story Experience

All the story experience scores were normalized to a number where 0 was the minimum score and 100 the maximum. Overall story experience scores were very high – storytelling realism (*SR*), enjoyment (*Enj*), engagement (*Eng*) and interest (*Int*) scores were all non-normally distributed with high means:

- ***SR***: 80.03
- ***Enj***: 83.97
- ***Eng***: 86.76
- ***Int***: 76.5

We used a series of general linear models to test whether questions (*Que*) and exchange structures (*ES*) were significant predictors of *SR*, *Enj*, *Eng* and *Int.* These models additionally controlled for participant's existing knowledge (*EK*), interest tendencies (*IT*), age, gender and nationality and faculty. We also tested for interaction effects between *Que* and *ES*. Age, gender, nationality, university faculty and ES had no influence on any of the story experience scores. *IT*, on the other hand, was a significant predictor consistently while independent variables, *Que* and *ES,* were significant predictors for some scores:

- ***SR*** ($F = 3.87$, $R^2 = 0.17$, $p = 0.003$): only *IT* was a significant predictor ($F = 11.02$, $p = 0.001$). The regression coefficient ($t = 2.78$) between *IT* and *SR* indicated a positive relationship i.e. high *IT* scores predicted high *SR* scores.
- ***Enj*** ($F = 4.41$, $R^2 = 0.12$, $p = 0.006$): *IT* ($F = 5.94$, $p = 0.02$) and *ES* ($F = 4.14$, $p = 0.04$) were

significant predictors while *Que* was non-significant ($F = 3.15$, $p = 0.08$). There was a positive relationship ($t = 2.44$) between *IT* and *Enj*.

- ***Eng*** ($F = 8.85$, $R^2 = 0.22$, $p = 0.001$): *IT* ($F = 12.39$, $p < 0.001$), *Que* ($F = 3.92$, $p = 0.05$) and *ES* ($F = 10.53$, $p = 0.002$) were all significant predictors. There was a positive relationship between *IT* and *Eng* ($t = 3.52$).
- ***Int*** ($F = 35.33$, $R^2 = 0.52$, $p < 0.001$): *IT* ($F = 94.26$, $p < 0.001$), *Que* ($F = 5.72$, $p = 0.02$) and *ES* ($F = 6.0$, $p = 0.02$) were significant predictors with a positive relationship between *IT* and *Int* (t = 9.71).

Table 2 shows mean story experience scores in the *E* and *NE* conditions. The presence of exchange structures in *E* led to statistically significant, although effectively modest improvements in enjoyment, engagement and interest in the narratives. Table 3 shows the statistically significant mean differences in the *Q* and *NQ* conditions. Participants in the *Q* condition scored higher engagement and interest. It is worth remembering that across our entire sample, story experience scores were quite high, regardless of condition. Despite this, adding exchange structure and question interactions still resulted in statistically significant gains.

	***E* Mean**	***NE* Mean**
Enjoyment (Enj)	86.65	80.57
Engagement (Eng)	90.08	81.31
Interest (Int)	78.26	72.32

Table 2. The significant means differences in the Exchange Structures (E) and No Exchange Structures (NE) conditions.

	***Q* Mean**	***NQ* Mean**
Engagement (Eng)	88.4	83.14
Interest (Int)	78.36	72.34

Table 3. The significant means differences in the Questions (*Q*) and No Questions (*NQ*) conditions.

Usage Logs

The usage logs showed that *Q* and *E* condition participants interacted readily with the storyteller agents. They input a mean of 10 questions, rarely cancelled questions (mean = 0.32) and only allowed question opportunities to timeout 3 times on average. They entered a mean of 12 exchange structure inputs, spread over the 7 exchange structures and, they opted out of answering only 3 times, on average. Participants input the terminating answer for 4 of the exchange structures. Unfortunately, our implementation was not very successful at parsing inputs. On average, the storyteller agents did not recognize 65% of question inputs resulting in "I don't know" responses. And, 55% of exchange structure inputs were not recognized, resulting in further input prompts from the storyteller agents.

Observations and Qualitative Feedback

An overwhelming majority of participants gave positive feedback and inquired about the prototype's future availability at the end of the experiment sessions. During use some laughed (at the comedic narrative content), exclaimed and gasped audibly. Most kept their point of view focused on the storyteller agents or the narrative-related objects suggesting that their attention was on the narratives. Even though the interactions we simulated were drawn from Joe and Noor's interactions with school groups, the university students in our sample responded well to them. This could be due to the genuine engaging nature of Joe and Noor's storytelling or to being placed among a virtual audience of younger children. We did observe a handful of participants who appeared bored and spent much of their time moving around the VE, without focusing on the storytellers. With the interactions, we noticed that many participants heard "I don't know" responses to their questions. A few had more success when they used the question hints, though some took this to the extent of entering only the keyword hints, rather than full questions. A handful did something unexpected during exchange structures: instead of inputting answers, they typed input such as "I don't know" in response to the initiating question. We had not anticipated this, so the prototype did not respond appropriately. We also noticed misspelled inputs which the agents were not equipped to recognize. Sometimes participants knew correct answers, but could not spell them. Others used abbreviated text message style words e.g. "u" instead of "you". Qualitative feedback was both very positive and constructively critical. Below, we identify main themes.

The Narratives Stood Out

Most feedback focused on the narratives themselves, describing them as entertaining, informative and captivating – a testament to Noor and Joe's skillful storytelling styles. In asking participants to select their favorite narratives, we hoped to glean whether they enjoyed the more or less interactive narratives. However, their choices were almost always based on narrative content and storytelling style. Participants heavily favored narratives with highly personal content and elements of humor – all things that arose purely from the recordings of Joe and Noor. Others favored narratives that resonated with them personally with some relating to Noor's cultural background and others with Joe's township experiences. A small number (9) *disliked* the narratives finding them "painful", "sad" or frustrating. Most general comments reflected impressions of the narratives. Many expressed amazement over Apartheid-era tragedies and appreciation for the humor and forgiveness imbued in the storyteller. Some said they gained an appreciation for post-Apartheid South Africa.

Questions and Exchange Structures

Nineteen participants enjoyed the ability to ask questions including being able to ask questions "at any time" and the question hints. But, the storyteller agents' limited question-answering abilities featured prominently in comments; some said the experience left them with many unanswered questions. This clearly shows where next our design could be improved. And, this first evaluation of our prototype gave us useful indications of where refinement is need. Logs showed that many participants asked personal questions about Joe and Noor, such as where they lived after leaving District Six. The storyteller agents' inability to answer such questions was incongruous to many participants. Participant's qualitative feedback also gave us a rich collection of suggestions for improving the question design itself. For example, employing hint phrases, rather than keywords, or providing a list of full suggested questions. Exchange structures also received better reviews; some said that the fact that the storytellers might ask them questions, kept them engaged in the storytelling. There was also some useful critical feedback there, for instance some wanted a way to replay the initiating question while others wanted a way to indicate that they did not know the answer to the initiating question. One unexpected finding regarding questions and exchange structures was that many (18) participants enjoyed observing interactions between the storyteller agents and virtual audience. Of these, 13 were in the conditions without interactive questions or exchange structures; they could only observe the storytellers and virtual audience interacting. It is possible that they would have liked to partake in these interactions, rather than being passive observers. A participant in the *NQ+NE* condition said that observing these interactions *"forced attention"* on the storytelling while another said *"…it kept my interest high as I had similar questions…"*

DISCUSSION AND CONCLUSIONS

The work described in this paper was sparked by an interest in preserving personal narratives in a way that simulated real storytellers. We used a multi-disciplinary approach, starting with an ethnographic study and discourse analysis of expert storytellers' personal experience narratives. This led us to focus on simulating the ways in which real storytellers interact with audience when telling a personal experience narrative this asking and answering questions. We created a prototype to embody these ideas and tested their effect story experience. Questions and exchange structures both significantly improved multiple aspects of story experience. Adding exchange structures led to statistically significant increase in enjoyment, engagement and interest in the storyteller agents' narratives. And, the ability to ask questions resulted in statistically significant gains in engagement and interest. This first evaluation shows clearly that our design also has room for improvement. Foremost, improving questions via increased question repertoires, guiding users towards asking answerable questions and providing scaffolding for this interaction. We have started work on this by collecting all the unsuccessfully answered user questions in the usage logs and recorded Joe and Noor's answers to these so that they can be added to the storyteller agents' repertoires. For exchange structures, we plan to allow users to repeat initiating questions, have the storyteller agents respond appropriately when users indicate that they don't know how to answer an initiating question. Eventually, we will deploy the improved prototype at the District Six Museum to see how museum visitors respond to it and how the design refinements improve the effectiveness of questions and exchange structures.

In conclusion, we successfully converted real-life storytelling recordings into digital narratives consisting of non-interactive verbal clauses and interactive questions and exchange structures. We believe our method of structuring narratives to accommodate these interactions can be replicated by others, particularly if they, like us, are able to record storytellers interacting with live audiences. While these interactions did not affect how real the storytelling felt, participants used them successfully and they improved various aspects of their experience of Joe and Noor's narratives. The ability partake in exchange structures increased enjoyment of the narratives while both questions and exchange structures increased engagement in the narratives and interest in finding out more about their contexts. Since questions came close to being a significant predictor of enjoyment, we are confident that, with an improved implementation, questions would also increase enjoyment.

ACKNOWLEDGMENTS

Our thanks to the District Six Museum, especially Joe Schaffers, Noor Ebrahim, Bonita Bennett, Chrischene Julius, Margaux Bergman, Mandy Sanger and Linda Fortune. Research partially supported by a SA NRF Grant.

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