Designing Sugaropolis: digital games as a medium for conveying transnational narratives

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ABSTRACT
In this paper, the authors present a case study of 'Sugaropolis': a two-year practice-based project that involved interdisciplinary co-design and stakeholder evaluation of two digital game prototypes. Drawing on the diverse expertise of the research team (game design and development, human geography, and transnational narratives), the paper aims to contribute to debates about the use of digital games as a medium for representing the past. With an emphasis on design-as-research, we consider how digital games can be (co-)designed to communicate complex histories and geographies in which people, objects, and resources are connected through space and time.

Keywords
History; Historical Gaming; Transnational narratives; Game design; Practice-research

INTRODUCING SUGAROPOLIS
The trade in sugar cane characterised the transformation of Scotland from an agricultural society to a modern, globalised society, powered by factories, shipping, manufacturing, and mass consumption. In Greenock (Inverclyde, Scotland), people and places converged around the sugar industry. The importance of sugar to the town led to Greenock being labelled 'Sugaropolis' in the mid-19th century. As Greenock became a global hub for sugar refinement, it attracted a diverse community from around the world. This included Italian ice-cream makers, German scientists, and labour migrants from Scotland and Ireland displaced by the Highland Clearances and Irish Famine. Sugar had a transformational effect not only on the town, but also on Scotland more widely, impacting upon issues of gender, class, wealth, and diet.

Yet not all people benefitted equally from sugar (Mintz 1985). The sugar industry created a class of wealthy shipyard and refinery owners, whose residences in Greenock's West End still dominate the town's post-industrial landscape. The vast

accumulation of wealth by factory owners and merchants contrasted sharply with the working conditions and salaries of workers. Workers' salaries often included sugar rations and sugar provided at least one-sixth of a worker's daily calories, and even more for his wife and children. Internationally, the movement of peoples and goods connected Scotland to the more ruthless consequences of 19th century sugar trade and industry: to the slave trade, and to plantations in the West Indies.

Local consequences of the trade must be understood in relation to these global interactions, which involved a transfer of material as well as symbolic values depicted in transnational narratives of wealth, superiority, and status. By 'transnational narratives' we mean the circulation of understandings, meanings, and ideas that are expressed in various written sources, including archives, letters and stories, but also by 'following the thing'. (see p. 11) These narratives can reiterate dominant ways of knowing (e.g. about slaves as objects rather than people) and forms of power (e.g. the financial power of shipyard and sugar refinery owners, which was often amassed from slave work on sugar plantations), as well as potentially resisting them.

Exploring the social, economic, health and ethical consequences of Greenock's sugar industry is complex: particularly so when the intention is to convey intricate historical and geographical information within a museum setting for intergenerational education. It is this interdisciplinary challenge that led us, in partnership with colleagues from the Inverclyde Heritage Hub[1], to investigate the potential benefit of using digital games as a medium for exploring Greenock's sugar industry.

Developing a game on this topic presented three research problems. First, how to distil the complexity of this history (the movement of peoples, goods, and money; the interaction between global trade and local history and development) into play without overburdening the player with information. Second, how to approach the more brutal aspects of this history (the connection between sugar in Greenock and the trade and exploitation of slaves in the West Indies) in an interactive medium whilst considering the ethical implications of player action. And third, how to achieve the above whilst also considering site-based constraints on gameplay within educational and heritage settings: digital games that can be played at home, but that are also viable as installations in a museum exhibit and of practical application in outreach with schools.

To address these questions, we aimed to design two prototypes for our partners at the Inverclyde Heritage Hub. Our methodology was practice-based, utilising a co-design approach in which our academic expertise (game design, human geography, and transnational narratives) informed an iterative game design process undertaken by two teams of developers. In developing these games, our ambition was to produce new digital content to be considered for inclusion in the 2018 re-opening of Greenock's McLean Museum and Art Gallery. Our long-term objective is to assist with the development of digital maps and games in support of visualising the local and global heritage of Greenock's sugar industry, including how this industry connected a small town on the west coast of Scotland to the ruthless realities of the triangular trade, and how this trade in turn impacted on industry, class, and diet in Scotland.

In this paper, we present our reflection on the design of two game prototypes with content related to the histories and geographies of Greenock's sugar trade. This reflection draws upon materials relevant to game design practice, in addition to stakeholder feedback. Our aim is to contribute to academic debates on the representation of historical (and geographical) knowledge in games by focusing on knowledge that can be generated through practice-research in this domain (Gray and Malins 2004).

GAMES AS A MEDIUM FOR HISTORICAL KNOWLEDGE

There is a growing academic focus on games as a medium for historical practice and the representation of historical knowledge (Mol et al. 2017; Chapman 2016; Kapell and Elliot 2013; Whalen and Taylor 2008). Reasons for this exploration are often underpinned by pedagogical justifications, drawing upon evidence of the value of game-based learning (Boyle et al. 2016; Metzger and Paxton 2016). In this context, the representation of history within games can challenge players to think critically about the past, compare this learning to the present, and consider implications for the future. History games can thus look to impact on players meaningfully, from seeking to change attitudes (Kolek and Šisler 2017) to stimulating debate around morality, for instance videogame representations of the rules of war (Donald 2017).

The question of how history games allow for interaction with pasts in which barbaric, unethical, or immoral practices occurred has been raised by MacCallum-Stewart and Parsler (2007). They draw attention to Sid Meier's *Colonization* as an example in which carrying out genocide makes the game easier, and in which slavery is omitted altogether. On the one hand, brutal acts can be seen to be condoned, and on the other hand, these acts can be conveniently ignored or avoided. In the context of the current project, this problematic duality of condoning and avoiding was an important consideration within our iterative design and evaluation process.

From the perspective of design practice, the structural and aesthetic properties of history games have also been addressed in the literature. One commonly discussed approach to understanding games as a medium for history is to present the digital game as a form of interactive documentary (Galloway et al. 2007; Fullerton, 2008). This encompasses not only digital games, but also a breadth of interactive media that allow non-fiction narratives to be enhanced through the integration of action and choice: to, as Aston and Gaudenzi (2012) argue, design "ways to construct the real, rather than represent it." From this perspective, we treat the digital game as a form of simulation, which can in turn be used as a method for understanding the interactions within complex systems, e.g. international politics (Weir and Baranowski 2011). McCall (2016) distinguishes between historical-games, simulations of history, and the hybrid of simulation games. The last of these implies a focus on the game core (Mäyrä 2008) and in turn a need to treat the digital game medium as one fundamentally based on rules (Manovich 2001). This leads us to a unique proposition of games as a medium for history: that games allow us to simulate history, so that players are empowered to act within a model of an historical period (Schut 2007). Further still, we can consider the need to treat genre not as thematic (e.g. history as a game genre) but as formal: to consider what it is we want to explore (and teach) within history, and what genres of play afford the best opportunities to facilitate this (Kee 2008).

If games afford opportunities for simulating historical processes, then we must in turn consider that history games typically utilise counterfactual histories (MacCallum-Stewart and Parsler 2007; Apperley 2013). The introduction of player agency would suggest that, on some level, there must always be a degree of counterfactualism, given that the player is inserted as an agent into a world in which their action implies divergence from a strictly defined series of events. However, counterfactualism need not always be connected to player agency. Instead, as Rughiniş and Matei (2016) demonstrate, games can use the narrative genre of alternative history to allow players to be witnesses to- rather than agents of- history. Within the current project, we recognised this need to consider historical authenticity as being related to the truth of systemic interactions that the player can bear witness to and make sense of, rather than accurate portrayals of precise historical timelines or portrayals of real characters.

While most history games are designed for home use, research has considered site-based history games within heritage institutions. Of these, a common focus is on how games can be used to augment the physical spaces of the museum environment. In these examples, we see the digital game as a medium for engagement, enrichment, and signposting within the traditional museum space (e.g. Coenen et al. 2013; Yiannoutsou eat al. 2009). Augmented Reality (AR) game design and games that focus on narrative and exploration of place are recommended by Stoddard et al. (2015) in their study of game design for representation of immigration-based transnational narratives in museum settings. These approaches to game playing within museums align with pedagogical theories of museum-based education, which downplay memorisation of facts (e.g. from textbook education) and prioritise learner engagement through physical space, which in turn encourages dialogue, debate, and empathy (Barton and Levstik 2004). This work informed our design process as we sought to develop play experiences that could be integrated into museum settings, but that could still be well-received as history games played in other, non-educational settings.

METHODOLOGY

Given that our research aim was to explore digital game design as a creative medium for the representation of histories and geographies of sugar, we adopted a practice-based methodology. Our main research method was iterative game design, based upon the game design process as discussed by Fullerton (2014). The design method we used integrated co-design into the process, enabling interdisciplinary input from across the project team into key decision-making meetings and play testing. This design method is illustrated in Figure 1.

Our aim was to develop two prototypes to facilitate a comparative analysis of digital game design for historical knowledge, controlling for game genre as an independent variable. To develop the prototypes, the project team developed two briefs and made these available to third year undergraduate students studying Game Design, Art, Programming, and Sound Design. As part of a team project module, students selected the briefs from a pool of options. All students therefore opted-in to their respective projects. The student teams developed the prototypes under the direction of the project team for approximately 6 months.

Brief 1 was selected by a team of eight students (one Designer, one Producer, two Programmers, three Artists, and one Sound Designer). Brief 2 was selected by a team of seven (one Designer, one Producer, two Programmers, and three Artists).
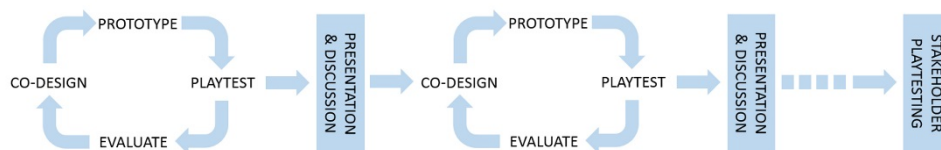

Figure 1: Design cycles involved co-design, prototype development, informal playtesting, and internal evaluation. At key stages, formal presentations to- and discussions with- the wider team were held. These informed the next design cycle. Structured playtesting was conducted with stakeholders (e.g. primary school pupils, museum visitors) after a series of co-design cycles.

Figure 2: The game design process considered a range of archival materials and sources.

Our approach was iterative co-design following an agile development methodology. The project team acted as game development mentors (Author 1, Author 2) and subject experts (Author 3, Author 4). The student teams met with mentors weekly for stand-up meetings, co-design work, and product evaluation, with development of the game concept design and digital prototype then carried out in sprints. The subject experts reviewed progress in scheduled Skype and physical meetings, contributing to co-design work, evaluation, and ensuring that information and narratives contained within the game worlds were consistent with historical and geographical research.

Our key stakeholders were our project partners at Inverclyde Heritage Hub. Working with our partners enabled access to local knowledge and archival materials (see Figure 2) relevant to the history of Greenock's sugar. Our research data included a range of practical materials pertinent to game development, including: pitch documentation and presentations, game design documentation, visual style guides, technical design documentation, audio design documentation, build versions, post-mortem developer evaluations, and promotional materials (see Figure 3).

In addition to design-research, qualitative evaluation of prototypes was conducted by staging playtesting sessions that were either public (e.g. Dare Protoplay in Dundee in July 2016 and Perth Museum and Art Gallery in August 2016) or invitation-only (Beacon Arts Centre, Greenock in February 2017). Stakeholders included school children, teachers, museum and galleries professionals, local historians, games professionals and students, and the wider public. At each event, the project and student teams collected qualitative data including observation of play and informal interviews.
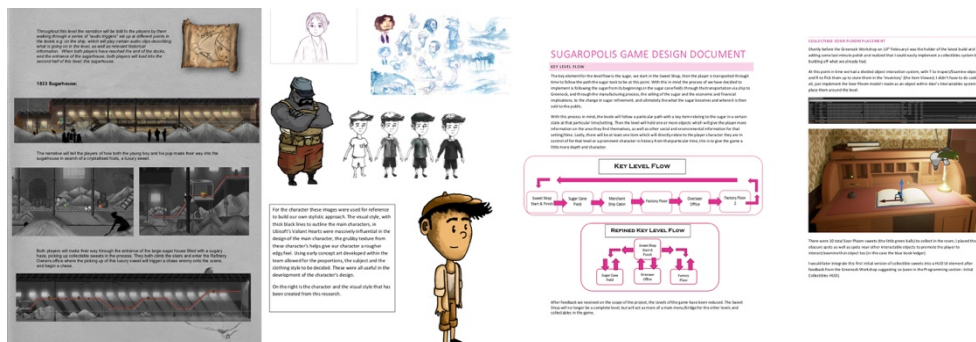

Figure 3: Sample of design and production materials

SUGAROPOLIS CASE STUDY

As discussed above, to develop a comparative case study the team opted to develop two high concept briefs. The briefs shared two main design constraints: that each game should integrate knowledge on the histories and geographies of Greenock's sugar industry, and that they should be designed for application within a museum context. The main variation was the gameplay focus, which we treated as an independent variable. We elected to constrain each brief to a different genre of gameplay.

In the brief for Prototype 1, our emphasis was on *history through people*. The aim here was to explore the transnational narratives of Greenock's sugar industry by examining the people of this history. This in turn led to the selection of an appropriate gameplay genre: the game was constrained as a 2D side-scroller, in which all characters would be visible, and in which character interactions with the environment would allow for narrative exposition. To aid in this constraint, the identified design and stylistic inspirations for this prototype were *Never Alone* (Upper One Games 2014) and *Valiant Hearts* (Ubisoft Montpellier 2014).

The brief for Protoype 2 focused on *history through objects*. Prohibiting inclusion of visible characters, the aim with this prototype was to consider how transnational narratives can be represented through the display of- and interaction with- objects. To account for this, a shift in gameplay design was selected, constraining the prototype to a game developed in first-person 3D with focus on environmental exploration and object manipulation. The identified points of reference were first-person walkers such as *Firewatch* (Camp Santo 2016) and *Gone Home* (The Fullbright Company 2013) that utilise objects as storytelling devices.

As an additional point of game design comparison, the decision was made to consider multiplayer game design versus single player game design. Prototype 1 was developed to feature an option of 2-player gameplay. By contrast, Prototype 2 was required to be a single player experience. By imposing these design constraints, we were able to more fully explore the potential for digital game design as a medium for conveying history and transnational narratives and within museum and educational settings.

Prototype 1

The first prototype (shown in Figure 4) was developed in Unity for publication on Windows and Mac OS. Early iterations focused on developing the game as a traditional 2D platform game, but, given the emphasis on historical knowledge, further design iterations saw the game type evolve to become a 2D puzzle-platformer.

In the game, the player takes control of Campbell: a 12-year-old boy living in Greenock during World War 2. As Campbell, the player can run, jump, climb, and use strength to move obstacles. The second character is Bonnie, a West Highland Terrier. Bonnie can run and jump, but also balance on ledges that are too narrow for Campbell and distract adversaries. The game is structured as a series of scrolling levels with each level tracing movement backwards in time from 1940 to 1833 then to 1807, whilst remaining constrained to Greenock as a location.

The game can be played in either 1-player or 2-player co-operative mode, a decision that was made to appeal to social play both at home and in classroom or museum settings. In single-player mode, the player can swap between controlling Campbell and Bonnie to solve puzzles. In co-operative mode, player 1 controls Campbell while player 2 controls Bonnie. Early playtesting of the co-operative gameplay revealed opportunities for intergenerational play and learning, where a child could play alongside a parent or teacher to learn about Greenock's sugar history together.

Figure 4: Screenshot of the first Sugaropolis prototype, showing Campbell, Bonnie, and a refinery owner.

In recognising this opportunity, the team sought to develop level layouts and controls that would balance simplicity of control (for older players less familiar with digital games) whilst retaining puzzle challenges appropriate to older children. Our design philosophy through iterative development and testing was to create gameplay where the child player could help 'teach' the adult player how to solve puzzles and complete levels, whilst the adult player could recognise historical knowledge and help the child understand what was being shown or narrated.

Integrating historical knowledge into play: Class and diet

As our focus here was on history through people, we sought to represent social class distinctions through character design. We did this by including refinery owners as adversaries. A clear distinction is drawn between the player character Campbell, who is represented in each period as being from a lower / working class family, and those industry leaders who are reaping the most wealth from the sugar trade. The goal is to avoid refinery owners when trespassing in the docks and in the refineries (which can be accomplished by creating distractions using Bonnie). Being caught by a refinery owner triggers a reset to checkpoint. Within gameplay, then, we sought to draw attention to segregation of class and disparity in wealth and focus player attention on witnessing the social and economic transformation of Greenock through the eyes of a child (e.g. witnesses to- rather than agents of- history).

The emphasis on inequalities between peoples is extended through exploration of the environment, which exposes disparities in accommodation, possessions, and diet. Given our target younger audience with this game, we prototyped and then integrated collectibles as a means of exploring these class disparities within gameplay. For instance, the player(s) collect items of clothing, or sugar-based sweets and foods that were appropriate for each period and consumed by different classes and genders. Collectibles unlock text that can be read on screen during play (e.g. explaining class or gender distinctions, facts about the transnational movement of goods and people, connections to the peoples of the West Indies) or saved and then read later.

Figure 5: Example of our approach to designing cinematics

Additionally, we sought to integrate real-time narration into play through audio triggers. For many aspects of the design, it was clear in our prototyping that visual representation of people was not sufficient to communicate the more complex transnational narratives that underpinned Greenock's sugar history – particularly so as this is a history that is not well-known by Scottish youngsters. Narration was kept purposefully short and descriptive of facts. To preserve suspension of disbelief, this narration was recorded in a regional accent.

Transnational narratives: Linking Greenock to the triangular trade

We iteratively designed and prototyped in-play historical knowledge with an ambition of engaging fully with game design as a medium for exploring transnational narratives. Yet we found it more challenging to integrate the links to the West Indies and the slave trade directly into level design within our chosen genre and gameplay. In this sense, we encountered limitations in how digital games can truly allow players to act within a model of a historical period that involves subjugation and enslavement of peoples. We did work this in through descriptive facts relating to the triangular trade and the other global locations linked to Greenock through sugar, using the collectibles system. However, to delve more deeply into the brutality of the slave trade, of plantations, and of the harsh realities that translated into increased wealth and changes in diet in Scotland, we saw the need to use an alternative device. After concepting different ideas, we settled on a narratological device: cinematics (see Figure 5).

The aim with our cinematics was to educate players on the more sensitive topics – particularly the slave trade – in a manner that suspended player agency momentarily. Design concepting that considered integrating these narratives into level design demonstrated problems, both in terms of the potential trivialization of sensitive topics around race, class and the brutality of early capitalism, and the potential for players to skip over these facts to continue play. As noted earlier, it is problematic when history games avoid the realities of slavery or genocide, or otherwise allow players to engage actively in these events. In our approach, we regarded cinematics as the most balanced design decision. To ensure that the cinematics did not feel detached from play, we designed the cinematics to communicate the regression back in time to each new level, setting up the historical context of each new scene. But simultaneously, we used narration within the cinematics to provide the wider context of Greenock and Scotland's role within the triangular trade, to highlight the political and social debates happening in Scotland in each period, and ultimately to expose how Scotland's growth as a centre for industry was built upon human injustices across the globe.

Prototype 2

The second prototype was developed in Unreal Engine 4 for publication on Windows. With this project, our early design research focused on paper prototyping of the walking

sim genre within a museum setting. Given the single-player and narrative-focus nature of the genre, our main design challenge concerned translation of what is typically a lengthy immersive story experience into a concise yet meaningful museum experience. Consideration of existing museum-based games indicated short play lengths (~1-5 minutes), which presented the most immediate design problem for a single-player game in our selected genre (where most games have stories that are told over 2-4 hours of gameplay).

To address this, we quickly recognised the need to include neither a story arc nor progressive levels in our game, and instead focus on developing a first-person, narrative-driven experience comprised of individual scenes that could be experienced in any order (or not at all). These scenes are accessed from a hub scene: a sweet shop in Greenock (a scene that presents young people with the most familiar legacy of Greenock's sugar: the establishment of sugar-based consumer food products in Scotland). Unlike the first prototype, our approach to this prototype was to move players through space rather than time and focus on objects rather than people. Game scenes include industrial and domestic environments in Greenock, the West Indies, and aboard slave and cargo ships. While each scene takes place within a given period (all in the 19th century), we designed scenes with the intention of drawing more attention to the diverse spaces connected to Greenock's sugar industry, contrasting Scotland with the West Indies, commerce with industry, and power and wealth with subjugation and class.

In the game, the player assumes the role of several different characters dependent upon the scene that is selected (for instance, playing as Edward Lyle II, founder of Edward Lyle & Sons which later became the more familiar 'Tate & Lyle', within the overseer's office scene – Figure 6). All scenes are small and enclosed, constraining the 'walking' aspect of the genre and instead focusing gameplay upon exploration of the player's immediate surroundings. In each scene, the player is given freedom to move around and interact with all the objects presented to them. The player can leave a scene whenever they want: they do not need to complete all the objectives or collect all the objects from a scene before they are permitted to move to the next scene (this was a key design decision when prototyping for museum settings and audiences). Players can, however, explore each scene fully to collect and unlock information, with all information tied directly to objects (rather than narration or NPCs). Upon completion of a scene, players are presented with a short quiz about the transnational stories of the scene's objects: a design decision made based on feedback from educational stakeholders.

Integrating historical knowledge into play: Living history
Our overall approach to this prototype was to take inspiration from the living history method of historical education with emphasis on the reproduction of historical spaces. Our design goal was to produce well-researched spaces that fully immerse players and generate a sense of authenticity.

However, with this, we distinguished between authenticity as perceived by the player (which we term suspension of disbelief, and which can incorporate counterfactual histories), and authenticity as accurate and faithful reproduction. While we did not embrace the genre of alternative history, we did see value in allowing scope for creative interpretation of past spaces in order to generate scenes that would a) simplify historical knowledge to aid player comprehension, in line with our research questions, and b) be of a scale, composition, and layout that would facilitate integration into museum settings (e.g. reducing time needed to explore game scenes, and drawing connections to other artefacts in the physical exhibition space)

Figure 6: Screenshot of the second Sugaropolis prototype.

Extending this, we would argue that the scenes in Prototype 2 are not only reflective of historical knowledge pertinent to Greenock's sugar industry, but also aesthetic experiences that encourage player engagement and interaction. These are scenes filled with furnishings, notes, records, and other materials that collectively represent what Baudrillard describes as the 'atmosphere': the "systematic cultural connotation at the level of the objects" (2005/1968 p. 49). Our design process drew upon the archival materials, texts, and stakeholder input made available to us, with a view towards integrating these as historical knowledge, but also engaging with what Boym (2001) describes as restorage nostalgia. As discussed by Sloan (2016), this approach of utilising a nostalgic inclination towards the past has the benefit of encouraging intrinsic player motivations to explore spaces. In this sense, then, our design process revealed a need to balance accurate historical knowledge (selection of appropriate props, integration of accurate records and texts, accurate descriptions of objects and their uses) with immersion within restored spaces that acknowledge the value of designing a nostalgic atmosphere through a system of historical objects.

Transnational narratives: Following the object

In our interdisciplinary research collaboration, our wider research borrows or otherwise utilises a range of methods. One of the approaches we are concerned with is the 'follow the thing' ethnographic method, which stresses the value of tracking the movement and biographies of commodities. In this project, that commodity is sugar. But we can extend this to following other commodities (including money).

We sought to take inspiration from this ethnographic method by embedding knowledge of the transnational narratives of Greenock's sugar industry into individual objects found in game scenes. Here, we connect the spaces (and peoples) of the game via the stories of objects: where they came from, what they were used for, what value and meaning they held for different people. Our design concept here was to 1) present players with virtual objects that contain discrete stories pertinent to individuals, and, more importantly 2) use objects as a means of connecting spaces and engaging players with transnational narratives: to show what a particular object meant in the hands of a refinery owner, a merchant, a factory worker, a plantation owner, or a slave toiling in a plantation in the West Indies.

Figure 7: Example of object examination

In a digital game, we found the approach of following the thing could bring benefits to heritage settings. After all, museum exhibits typically utilise objects as storytelling devices. But a digital game allows players to follow an object from space to space (and time to time): to see and understand an object in the various contexts in which it was used. Further, as museum objects cannot typically be handled and manipulated, the digital game allows players a deeper level of interrogation: picking up, rotating, and zooming in to objects to understand their properties more fully. We integrated these mechanics into our prototype (see Figure 7).

STAKEHOLDER PLAYTESTING

In addition to our co-design work, we structured playtesting into our evaluation of the two prototypes. The following summaries are derived from observations of player interaction with both prototypes at the events outlined in the methodology (Figure 8).

Figure 8: Stakeholder evaluation at Perth Museum and Art Gallery (top) and the Beacon Arts Centre, Greenock (bottom).

Firstly, in evaluating our selection of genre, we observed that players were generally capable of grasping the objectives, controls, and mechanics of both prototypes. This was more pronounced with younger audiences, including primary age and teenage players, who demonstrated no hesitation in progressing with play and understanding what was expected of them. With older audiences (including teachers, historians, archivists, and some parents), we found that Prototype 2 demonstrated more problems in terms of understanding both interaction with objects and player controls. We recognised that this could be a frequent problem with first-person 3D games in general, in that some older audiences who do not self-identify as gamers find the perspective and controls less intuitive. Further iteration of controls and signposting of interactive objects can address this, taking influence from notable recent entries in the first-person walker genre. However, we do see the advantage of selecting a 2D platform game for ease of control and player understanding in diverse settings and with a broad audience.

In evaluating genre in playtesting, we were most interested in whether players could relate gameplay action within the games to the historical knowledge we were trying to convey. As has been noted by Flanagan (2009), there remains a tendency within the wider field of serious games to rely upon narratological methods for engaging players, rather than attempting to focus facilitation of a serious message through play. While we did use a narrative shell to communicate the transnational narratives of Greenock's sugar, we also sought to design genre mechanics that linked to this knowledge.

In Prototype 1, we found that mechanics around level-based puzzles engaged players (particularly younger audiences), but that the embedded historical knowledge within puzzles was often missed. Here, then, we found it challenging to simplify complex histories and geographies of sugar into gameplay where the player's full attention on problem solving may be required. However, the conflict with refinery owners was more readily acknowledged by players of all ages as representative of a knowledge around class inequalities: players saw the player character as being representative of a lower class, and the refinery owners as being wealthy and of a different class. In play and in historical narrative, this message was conveyed. Gameplay around collectibles (where players collected items to unlock information) had the most success in linking play to learning. Players tended to focus on looking for all collectibles and would listen to triggered narration when an item was picked up. Fewer players would suspend play to read any information right away, but we did observe that parents and teachers tended to draw attention to unlocked information and raise this with younger players. This could therefore be considered a good mechanic for eliciting intergenerational play and learning.

In Prototype 2, we also observed engagement with the collectible mechanic (with hidden sugar sweets in each scene). Searching for items within a scene was successful as a means of encouraging players to explore the scene, particularly with younger audiences. We found that younger audiences were less driven to interact with other objects in the scene, perhaps as this was not tied as clearly to a clearly presented objective. The freedom to explore was more appealing to older audiences who spent some time interacting with and looking at objects in the scene. We therefore concluded that there was a need to better link these two drives: to have a clearer objective in interacting with objects and relate this to in-game achievement more explicitly, whilst also ensuring that object interaction is pleasurable and meaningful. Our use of end-of-scene quizzes was understandably of interest to educators and historians and did serve as a motivation for exploration of scenes. Whilst not a mechanic typically associated with the first-person walker genre, players' positive responses to the quiz demonstrated an opportunity to better integrate player testing of knowledge (appealing to education settings and educators) with core elements of first-person walkers.

In terms of single versus multi-player game design, we observed that the latter enhanced social interaction, with more players discussing play and talking about what they were learning. This included social interaction not only between players, but also spectators. Players of Prototype 2 by comparison were more focused on play, were less likely to speak about what they were doing, and less likely to engage with spectators. An important consideration here is that co-operative play can, relative to single-player, increase empathy (Greitemeyer 2012). When addressing issues of difficult or challenging historical pasts, this feeling of empathetic engagement with the game and with other players can be useful in approaching issues such as slavery in a sensitive manner, particularly in a school or museum setting where younger audiences can be encouraged to discuss (during play) the more problematic and challenging aspects of our history.

Lastly, as we tested the prototypes in heritage spaces, we were able to evaluate their potential value as part of a curated space, considering factors such as player focus, willingness to play a digital game in a social space, and quality of experience when a game is played for a brief time. For both prototypes, we found that players were able to follow the games despite noise distraction, but it was evident that players could not engage with game audio unless they were wearing headphones. Narration was missed, and in turn we found that communication of historical knowledge was often limited. At the same time, wearing headphones appeared to create feelings of detachment or unease. This was particularly true of Prototype 1 when played in co-operative mode, as the players were not able to speak to each other. Consideration for audio is therefore crucial for these settings, as increasing speaker volume is not a simple solution. Better use of visual cues and signposting is one approach, or thoughtful curation of digital games within museum exhibition spaces.

We found that the social setting presented few problems, as players were able to engage with both games. Many attendees seemed content to watch others' playing whilst remaining engaged as a spectator. This is an important consideration for curation in heritage settings, impacting on selection of screens (e.g. larger screen sizes or use of projectors to allow players and spectators to gather in front of a digital game). We'd therefore recommend those working on history games within museum settings engage with the developing literature on games exhibitions and curation (Reed 2017).

CONCLUSION AND FUTURE WORK
In this paper, we presented our design-based findings in response to the challenge of designing games for the communication of transnational narratives. Our focus here has been on the case study of the Sugaropolis project. However, we believe that our approach to co-design and practice-led research within this context will be valuable to other researchers who are working in collaboration with the heritage sector to explore games as a medium for historical and geographical knowledge.

We set out to address three research problems: how the game design process can reconcile complex historical interactions whilst maintaining player comprehension; how to integrate the darker aspects of history into an interactive medium where player agency may raise ethical concerns; and how to design digital games that will retain functionality and player comprehension when played in museum and educational settings. Our findings demonstrate the challenges that exist with the above, particularly around integrating complex narratives into gameplay, but also highlight some potential design and curation solutions.

One of the main interventions we made was to constrain gameplay genre prior to the start of the design process. This in turn enabled us to compare how typologies of digital

play afford different strengths and weaknesses in communicating complex histories and geographies, and in integrating darker aspects of the past into play. Genre and single-versus-multiplayer design also allowed us to consider how these design decisions impact on the success of a game as a site-based medium.

We have focused here on design as a research method, drawing upon design data and playtesting. As such, our research has been highly qualitative. While this on its own has enabled us to tackle the design challenges posed within the paper, there is clearly now an opportunity to more fully test audience response to the games. Our next step will be to prepare the prototypes for the re-opening of the McLean Museum and Art Gallery, at which point we can aim to collect quantitative data accounting for audience engagement with each game.

Based on our findings and discussion with stakeholders, we have also identified other opportunities. First, we have identified a need to further develop our integration of archival and design research. To that end, we are currently working on a second phase of development, funded by the British Academy and Leverhulme, to extract new insights and understandings from archives in Greenock. This will involve design researchers working on site and participating directly in archival research. Second, we aim to more closely align design research with consideration of school curricula, developing digital game content that can be better integrated into classrooms. And lastly, this new phase seeks to explore technological aspects of game design. With many stakeholders and industry partners expressing interest in the potential of VR, AR, and MR game design for application in the heritage sector, our next phase of research will explore how immersive technologies can offer alternative approaches to game design for the examination of Greenock's sugar industry.

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ENDNOTES
1. The Inverclyde Heritage Hub is a centre for local history and heritage, encompassing archives, genealogical research, and access to newspapers. More details at: https://www.inverclyde.gov.uk/community-life-and-leisure/libraries/inverclyde-heritage-hub

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