Preservation Planning for Emerging Formats at the British Library

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ABSTRACT

The British Library and the other UK Legal Deposit Libraries have been collecting various forms of born-digital digital publications since 2013 as part of what is known as Non-Print Legal Deposit (NPLD). In 2017, the UK Legal Deposit Libraries established an Emerging Formats project to look at selected types of content that were potentially in scope for NPLD. At the beginning of 2018, the British Library's digital preservation team commenced research, as part of the project, into the preservation implications of some of these new forms of publication. Over the course of three months, the project analysed a small sample of interactive narrative works and mobile eBook apps from the Apple store. The evaluation revealed specific characteristics including: the automated personalization of narrative content; the integration of images taken by device cameras; movement-driven behavioural changes to item displays; the use of third party content to drive narratives forward; and, game-like features with a high dependency on visual, illustrated displays. Engagement with content experts underlined the significance of the interactive elements, suggesting that any subsequent preservation plans need to take this into account. Accompanying technical analysis using the Library's format sustainability assessment framework identified issues around DRM (digital rights management), proprietary environments, and the use of third-party content. Whilst further research is clearly needed to validate the findings beyond the initial sample size and to resolve the technical challenges identified, other more conceptual questions remain about such matters as ownership, authority, provenance, versioning, and personalization. Engagement with content providers will be key to resolving all of these in a satisfactory manner.

CCS Concepts

• **Information Storage and Retrieval→Digital Libraries -- Collection.**

Keywords

Digital preservation; significant properties; preservation planning; non-print legal deposit; mobile apps; interactive narratives; interactive fiction

1. INTRODUCTION

The British Library and the other UK Legal Deposit Libraries (LDLs) have been collecting born-digital publications as part of Non-Print Legal Deposit since 2013. To date the content collected has mainly comprised eBooks, e-Journals and archived websites. As the publishing world does not stand still, the Legal Deposit Libraries have begun to consider the collection of new forms of digital publications, collectively known as 'Emerging Formats'. This paper describes activities undertaken by the digital preservation team and other colleagues at the British Library to support the collection and preservation of emerging formats.

2. CONTEXTS

2.1 Non-Print Legal Deposit (NPLD)

The British Library is one of six UK Legal Deposit Libraries, together with the National Library of Scotland, the National Library of Wales, the Bodleian Libraries at the University of Oxford, Cambridge University Library, and the Library of Trinity College Dublin.

Legal deposit has existed in English law since 1662, providing the right for designated libraries to receive copies of UK-published print works, including books, journal articles, notated music and maps.

Since April 2013, this right has been extended to cover publications created in digital formats. The primary legislation supporting the extension of legal deposit to non-print items was passed by the UK Parliament in 2003. After a decade of planning and negotiation, the Legal Deposit Libraries (Non-Print Works) Regulations 2013 came into force on the 6th April 2013 [1]. For the first time, the regulations enabled the LDLs to claim digital publications as part of legal deposit provisions [2].

In 2015, the British Library set out its strategy to 2023, describing its purposes and priorities. The curation and preservation of born digital UK publications formed one of those priorities, with the Library describing this work as transforming "what it means to be a national memory institution" [3].

2.2 NPLD content types

The content covered by the first phase of Non-Print Legal Deposit (NPLD) implementation included eBooks and e-Journals; additionally, the British Library's Web archiving activities were

scaled-up to include an annual capture of the entire UK Web Domain. Content and associated files and metadata are collected directly from the web or deposited by publishers with the British Library, which has established workflows to facilitate ingest, preservation, storage, discovery, and access, as well as for the provision of catalogue records to the other LDLs, which are then integrated with their own catalogues. Access is provided on site within reading rooms at all of the LDLs, at designated terminals, in line with the requirements of the NPLD Regulations.

However, the publishing landscape does not stand still; it has continued to evolve at a rapid pace since the NPLD Regulations first came into effect. Developments in the software applications, hardware, and formats used to create and provide access to digital publications have resulted in a moving target for the LDLs. In response, the British Library and the other LDLs need to determine their responsibilities for collecting content created and made available in new and innovative types of format, and to make these works available to users as part of their legal deposit obligations.

The second phase of implementation of NPLD, which is currently underway, addresses content types that were out-of-scope for the first phase. This includes born-digital music notation (e.g., sheet music) and geospatial datasets. Sheet music is currently being acquired in PDF, although it is possible that other notation formats might be collected at a future stage, e.g. MusicXML or the proprietary format used by the Sibelius notation program. With regard to geospatial datasets, the British Library, on behalf of the UK LDLs, has been receiving geospatial data for some years from the main UK national mapping agencies, i.e. the Ordnance Survey and Land and Property Services Northern Ireland. The earliest datasets were received in NTF (National Transfer Format), but snapshots of Ordnance Survey MasterMap data has been received more recently in the Geography Markup Language (GML) format [4]. The UK LDLs have developed a new platform for discovery and access to digital maps received under legal deposit [5].

Also included in the second phase of NPLD are content types that did not easily fit into existing categories. These born-digital publications are more complex in nature and are understood to create significant challenges for end-to-end collection management activities. Collectively, these are known as "Emerging Formats."

2.3 The NPLD Emerging Formats project

The Emerging Formats project was initially a one-year project instigated by the LDLs to explore changes in the digital publishing industry that could impact the collection of more complex digital publications both now and in the future [6, 7].

For the purpose of the project, emerging formats were understood to have the following characteristics:

- Emerging Formats refers to publications that have no print counterpart and exist solely in digital form;
- Emerging Formats refers to the non-standard nature of digital publishing;
- Emerging Formats relates to the hardware and software used to realise the content, as well as the hardware and software needed to render the content and make it meaningful to end users;
- Emerging Formats refers to capability. For example, a format may have existed for some time, but the LDLs did not previously have the capabilities to support published works created in such a format.

In the first year of the project, the LDLs prioritised three main format types to investigate: 1) eBooks created as mobile apps; 2) structured datasets; and, 3) interactive narratives, including web-based interactive fiction. These formats were chosen as they were considered to represent content that: 1) could be identified as either "lost" or at significant risk of loss; 2) would be important for understanding the culture of UK publishing; and 3) could offer insight into the collection management of complex digital publications, which could be applied more widely [7].

One of the questions that the Emerging Formats project was designed to address was that of long-term preservation. As part of the project, the British Library's digital preservation team produced reports on preservation issues based on two of the formats identified: interactive narratives, and eBooks created as mobile apps. Reports were based on two complimentary pieces of analysis: workshops in which content experts were invited to explore sample content and comment on specific features or characteristics they found notable, and desk-based research on the technical characteristics of the sample content.

The first year of the Emerging Formats project ran from April 2017 to March 2018. The project has since been extended by another year in order to further develop initial findings and recommendations into more tangible outputs and undertake investigations into the third content type, i.e. structured databases.

3. PRESERVATION PLANNING FOR EMERGING FORMATS

The British Library has been ingesting and storing digital content for some decades. The Library's approach to preservation is defined in its Digital Preservation Policy, which is based on the view that preservation typically requires actions and interventions to be made throughout content lifecycles.

A key issue for the British Library is how to understand, anticipate, and manage these preservation planning actions and interventions at scale and over time.

3.1 Preservation planning

Preservation planning is one of the six functional entities of the influential Reference Model for an Open Archival Information System (OAIS) (ISO 14721:2012). The OAIS understanding of preservation planning includes a very wide range of activities, summarised by Lavoie as follows [8]:

"Preservation Planning is responsible for mapping out the OAIS's preservation strategy, as well as recommending appropriate revisions to this strategy in response to evolving conditions in the OAIS environment. The Preservation Planning service monitors the external environment for changes and risks that could impact the OAIS's ability to preserve and maintain access to the information in its custody, such as innovations in storage and access technologies, or shifts in the scope or expectations of the Designated Community. Preservation Planning then develops recommendations for updating the OAIS's policies and procedures to accommodate these changes. The Preservation Planning function represents the OAIS's safeguard against a constantly evolving user and technology environment. It detects changes or risks impacting the OAIS's ability to meet its responsibilities, designs strategies for addressing them, and assists in the implementation of these strategies within the archival system."

Becker, *et al*. [9] have contrasted the preservation planning approaches that focus on abstract, high-level policy with the practical need for plans that could be used "for preserving a specific set of objects for a given purpose." Preservation planning at this level should be able to test and evaluate alternative approaches, e.g. at collection level, and provide a means of activating and documenting the outcome. The Planets project developed an

influential approach to developing preservation plans, including the Plato decision support tool [10], while follow-up projects have researched the development of more integrated technological environments, like the SCAPE Planning and Watch suite [11].

At the British Library, preservation planning activities have previously focused on developing a deeper understanding of the Library's collections (and for NPLD content, the shared collections of the LDLs) and the preservation risks that might be associated with them. For example, building on the prior work of the National Library of Australia [12], the Library has developed a framework for collection profiles that are able to capture aspects of its preservation intent for certain content types [13]. Another strand of work has been based on trying to understand the practical risks represented by particular file formats, based on those represented in the Library's collections [14].

More recently, the British Library has started to explore the system components needed for automated and integrated preservation planning at large-scale and for exceptionally diverse collections, as part of the Integrated Preservation Suite project (IPS). IPS is a three-year project to deliver the toolsets needed for the generation, testing, and implementation of preservation plans to mitigate defined and imminently manifesting digital preservation risks. So far, this has focused on the development of: 1) a representation information registry; 2) a repository of software; and 3) a system to create, manage and activate the plans themselves.

3.2 The evaluation of emerging formats

When planning the Emerging Formats analysis, the priority was to understand more about the content types that the LDLs were yet to acquire and to develop a better knowledge of formats and file-types that we had not yet had an opportunity to explore in detail. For reasons of timing, only two of the three content types were evaluated in the first year of the project, namely mobile eBook apps and interactive narratives.

In order to support this activity, content-analysis workshops were scheduled which used the five broad attributes -- 'content,' 'context,' 'structure,' 'appearance,' 'behaviour' -- first identified by Rothenberg [15, 16], but since used by others to evaluate digital content from a digital preservation perspective [17]. A small number of content experts were invited to each workshop and asked to explore sample content with these characteristics in mind, noting in particular any features which stood out as particularly significant, unusual, or meaningful. Observations were recorded in a template that included summary definitions of the five attributes, which were adapted from those developed by Knight for the InSPECT project [18]. Definitions included:

- Content: this could include: text, still and moving images, audio, games, software, etc.;
- Context: the environment in which the Content was created, or something external to it that might affect its intended meaning;
- Appearance: things that contribute to the display or rendering of the objects, e.g. important for visual or audible components;
- Behaviour: the ways in which the Content (and other attributes) might interact with other stimuli, e.g. with users, software, or with other sources of information;
- Structure: Information that describes the relationship between two or more types of Content, as may be required to reconstruct or render the object.

It was noted at the workshops, however, that defining "significance" was dependent upon many factors [19] and that the categories were there purely to support discussion of the characteristics of the works under evaluation, rather than a means of making definitive judgments about "significance."

Subsequent technical analysis of the content used a lightweight version of the Library's format sustainability assessment framework [14].

4. INTERACTIVE NARRATIVES

Interactive narratives are an established content type in the non-digital world. The term is often used to describe text-based adventure stories in which the reader must choose from a set of predefined options to determine what happens next, and a single interactive narrative book has multiple possible storylines and endings. Books of this sort were extremely popular in the 1980s, for example the 'Fighting Fantasy' series'. In a digital environment the basic premise of the reader interacting with the story to influence an outcome remains the same, although there are significant differences in the way different types of interactive works can be delivered.

For example, there is a literary genre generally known as interactive fiction (or IF) that emerged from the world of computer gaming, specifically from role playing games and virtual worlds. From this perspective, Reidl and Bulitko [20] have defined interactive narratives as, "a form of digital interactive experience in which users create or influence a dramatic storyline through actions, either by assuming the role of a character in a fictional world, issuing commands to computer-controlled characters, or directly manipulating the fictional world state." The ability to change the outcome of a narrative is a key factor in these. Reidl and Bulitko note that, "the distinction between interactive narrative and other forms of digital entertainment is that interactive narrative systems afford the player to act in ways that fundamentally alter the direction and/or outcome of the unfolding storyline."

There has also been a focus on interactivity in the development of what is sometimes known as hypertext fiction (part of a burgeoning genre sometimes known as digital fiction). Hypertext fiction is built on theories of narrative that emphasise non-linearity and interactivity and, in its early years at least, had a theoretical basis in post structural textual models [21]. While elements of non-linearity and interactivity did exist in traditionally-published forms of literature, the development of hypertext fiction was facilitated by the ubiquitous availability of tools like the World Wide Web. Abril [22] summarises and explains how hypertext fiction moves beyond the perspectives on interaction between reader and text outlined by theorists like Walter Iser and Umberto Eco:

"Readers of print turn the pages and read following a given sequence. In hypertext, the reader must decide on the reading sequence and sometimes even engage directly with the text (and text here refers to a multimodal artifact that can include still or animated images, film, video, sound, etc. [...]). The new "hybrid" individual who uses such sites is no longer one who "interprets" in the sense of Iser or Eco. For instance, he/she may produce new material that can be incorporated online (for instance, a photographic picture captured through his/her webcam). The participant's input thus becomes crucial in interactive digital literature because now "the text is not only a readable text, but also a text to manipulate."

The specific type of web-based interactive fiction that was considered by the Emerging Formats project has much in common with hypertext fiction, not least in its experimental nature and the authors' willingness to play with elements of interactivity, if not (strictly-speaking) non-linearity. In fact, one of the works evaluated

(*Breathe*) is by Kate Pullinger, who was also one of the authors responsible for *Inanimate Alice*,[1] a pioneering series of web-based hypertext fiction in which the reader needs, "to click links and play mini-games to move between different episodes so that nontrivial effort is still required to read the text" [22].

One of the notable features of interactive digital narratives is the many different technological platforms used to deliver them. Tracing the history of digital fiction, Bell, *et al.* [21] note the important role played by software in driving and supporting the development of new, interactive features used by authors:

"While early versions of Storyspace, for example, were limited in terms of its color and sound capabilities, the Web and its ensuing technological developments offer authors a wider variety of modes of representation. The development of multimedia and hypermedia software such as Flash, Dreamweaver, and Quicktime (as well as standalone applications such as recent versions of Storyspace) has led to a wave of digital fiction that combines verbal text with graphics, pictures, animations, and music in increasingly dexterous ways."

This is the wider context in which the Emerging Formats workshops need to be understood. Authors, readers, and technological development are all combining to create new kinds of literature, and thus fresh digital preservation challenges for the institutions tasked with stewardship for this type of content.

4.1 The evaluated works

The four interactive narrative items evaluated by the Emerging Formats project were chosen by content experts and curators and were all published by Editions at Play, an initiative of the publisher Visual Editions and Google's Creative Lab. The Editions at Play website[2] describes these works as exploring the potential for a "new kind of book … [that] makes uses of the dynamic properties of the web," describing them as "data-led, locative, generative, algorithmic, sensor-based, fluid, non-linear, expandable, cookie-ish, personalised, proximal, augmented, real-time, time-sensitive, adaptive, collaborative, and share-y."

While based on web technologies (e.g. HTML 5), these items were all optimised for delivery on mobile devices, specifically smartphones or tablets. The resulting works often, therefore, make inventive use of device functionality, e.g. the touchscreen, the ability to change orientation, as well as features like the camera, microphone, and location tracking. With the latter feature, publications can also integrate with Web mapping services (e.g. Google Maps) to create an experience that is even more specific to the reader.

While some of the works were free to download, all required user registration. For the workshops, the works were downloaded onto a variety of devices, including iPads running iOS11.2, iOS9 and iOS5. In these cases, the content items were accessed using the Safari browser. Other devices used included smartphones (the main one used for subsequent evaluation was running Android 7), and content accessed via the Chrome browser. While based on web technologies (e.g. HTML5), the items had been optimized for delivery on mobile devices, i.e. tablet computers and smartphones. These items would also "work" to some extent on laptops or PCs, but not all functionality was always available.

The four works evaluated during the interactive narratives workshop were: 1) *All This Rotting*; 2) *Entrances & Exits*; 3) *A Universe Explodes*; and 4) *Breathe: A Ghost Story*. All were original works and recognizably literary in character, i.e. they broadly followed a textual narrative to which some interactive elements had been integrated.

4.1.1 All This Rotting

All This Rotting, by Alan Trotter, is described on the Editions at Play website as, "the book that loses its memory." The story is about loss, both of life and of memory. The content of the book is primarily a narrative text; alternative chapters tell a story from the perspective of two narrators, a son and his dying father.

The work has many of the display and navigation characteristics of a standard eBook, e.g. narrative pages are black text on a white background and the text is reflowable (thus the pagination varies according to device type and orientation). There is even a table of contents, although it is formatted to look more like a poem. The most notable interactive element of the work is its behaviour. Certain characters, lines or words in the text may 'wobble,' then disappear from the screen after reading, apparently triggered by moving the reading device, or on the user swiping upwards in order to move to the following page. The effect is of a dancing text that proceeds to disappear before your eyes, leaving (seemingly) random gaps in the page that remains. The structure of the work thus reflects its content, resulting in disorientation and loss.

4.1.2 Entrances & Exits

Entrances & Exits, by Reif Larson, is described by the publisher's website as, "the book that travels the world." It is a love story in which the narrator travels the world via a mysterious key found in a book store. The reader navigates the story via text pages interspersed with visual images from Google Street View, which need to be navigated in order to find the "door" into the following chapter.

As with *All This Rotting*, the story is essentially linear, but *Entrances & Exits* uses the Google Street View layer as a means of driving user interaction with the narrative. Street View images are sometimes overlaid with text and there is usually a circular icon that marks the 'door' into the next chapter. The table of contents at first is uninformative -- chapter headings are listed as 'location unknown' -- but these turn into geographical co-ordinates as the reader navigates their way through the story. The work is designed to be read in order, but it is possible to read chapters out of sequence (or to miss chapters out) through the table of contents.

The work is moderately interactive, in that the reader must explore the sequence of text pages and Street View images in order to progress through the story, although finding the 'door' to the next text page in the Street View images becomes more difficult as the book progresses.

4.1.3 A Universe Explodes

A Universe Explodes is a short story originally written by Tea Uglow. The original story is about a parent whose world is falling apart. It is 20 pages long (with a separate 'the end' page), and there are 128 words per page.

The unique thing about the work, however, is that a limited number of copies (100) can be passed on to new "owners," all of whom would be then able to create new versions of the work and to pass it on to other "owners" in turn. The principle has been explained in an article in *Wired* magazine [23]:

"A Universe Explodes is an experiment in what it means to own a digital book. Let us explain how this works, because it gets sort of

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complicated. Only 100 people own original versions of A Universe Explodes, *but each of those copies can be passed onto friends via email. The book, which has 128 words per page, can be handed off from friend to friend up to 100 times. There's a catch, though: Before an owner can give her version away, she must remove two words and add one to every page, creating a personalized limited edition of the book."*

There are, therefore, 100 primary versions of the work, each of which would, in theory, be able to produce up to 128 different sub-versions, all different. If the process were ever completed, the work would contain 100 different primary versions and up to 128 sub-versions of each of those, meaning that the work could potentially contain more than 11 thousand different representations of itself, each with different content and different author/owner data. As more words would disappear with each iteration, the work would gradually become less readable, and at the final stage there would be only one word left on each page.

The work uses blockchain technology (Ethereum) to manage "ownership," thus introducing a dependency on an external service provider that would need to be maintained if the provenance of different versions ever needed to be demonstrated.

The Emerging Formats workshop evaluated *A Universe Explodes* in read-only form. This means that the reader is able to view all of the versions of the story created up to the time of reading. The level of interactivity in the read only version is quite low: screen "swiping" moves readers between pages, and there is a "toggle" button at the foot of each page that enables comparison to be made between the original text and the version actually being looked at.

4.1.4 Breathe: A Ghost Story
Perhaps the most interactive of the items explored at the workshop was Kate Pullinger's *Breathe: A Ghost Story*, a work that been produced as part of the AHRC's Ambient Literature research project.[3] *Breathe* is a ghost story that is personalized to the location and surroundings of the reader. The work uses GPS and the inbuilt camera available on most mobile devices as a means to drive certain elements of the story.

Like the other items that were evaluated, *Breathe* is mainly a textual narrative intended to be followed in a linear way. There are 105 pages, although sometimes these are "shadowed" by additional pages providing commentary from a "ghost" narrator. The text does not tend to fill the screen, and is usually presented (at least at first) as black text on a white background. Other pages -- the "ghost" narrative -- use white text on a coloured background, usually pink, sometimes with a smoke effect overlay or with some kind of screen flicker. Occasionally images are used as part of the background, one of which is taken directly from the device camera.

In terms of behaviour, the reader is expected to interact frequently with the device in order to keep the primary narrative moving forward and also to be able to see the "ghost" narrative that underlies it. Typically, this means tilting the device if a corner of the screen fades to pink, or it may mean rubbing at the screen to reveal what else lies beneath. Text occasionally disappears or appears character by character.

The narrative itself is also personalized based upon the GPS data and external data sources. The text will include, for example, occasional references to nearby locations (e.g. the closest railway station, educational establishment, or café), or the text may change

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[3] http://ambientlit.com/

based on current weather conditions, using data from "Wunderground."

Breathe has many other features that cannot be described here. Of the works evaluated, it was the one that made the most use of interactivity. Some parts are clearly dependent on third party data sources, most of which are not made obvious to the casual reader. While the main narrative stays the same, the reader's experience of the story will differ depending on location and weather conditions. While there may be default versions available, e.g. for readers without GPS enabled, there are open questions with *Breathe* as to whether a "canonical" text is even identifiable, given that each reader's experience is likely to be different.

4.2 Technical analysis
Independently of the workshop, desk-based research was undertaken into the technical composition of the sample content and its technical context, in order to identify potential areas of preservation concern and feed into any subsequent preservation planning exercise. Research used the British Library's own format sustainability assessment framework, a relatively open-ended approach that was designed to provide a nuanced understanding of preservation risks that can feed into a preservation planning exercise alongside other business requirements (e.g., storage costs and access needs) [12]. This lightweight analysis was not intended to produce published format assessments of the kind shared by the Library on the Digital Preservation Coalition wiki, but to highlight some initial considerations that could provide direction for more detailed research in year two of the project.

All Editions at Play books are websites, based upon HTML and delivered via HTTP, but are optimized for delivery on mobile devices (though typically only on more recent versions of iOS or Android). This optimization means that some characteristics did not render particularly well, if at all, on desktop browser software, e.g. Chrome. Therefore, its dependency upon delivery via a mobile device would need to be recorded in object metadata, e.g., so that objects could be presented for user access accordingly and without sole reliance on the format of the object. In order to better understand the implications of this, useful follow-up work might include the exploration of archived versions of web sites optimized for mobile access, e.g. via the UK Web Archive.

From a technical perspective, it is tempting to consider that web-based interactive fiction represents broadly similar preservation risks as other types of website. Aside from this, the main issue flagged by the assessment for further consideration was the integration of third-party content, in particular the use of blockchain technology with *A Universe Explodes*.

Additional work needs to be done to ascertain how works like these might work with the tools used for format identification and validation, and for metadata extraction. It was beyond the scope of this particular assessment to explore the technical structure of each book in detail, though noted that limited tagged bibliographic metadata was evident beyond the book title.

5. eBOOKS PUBLISHED AS APPS
eBook Apps are bespoke software applications, typically designed for use on mobile devices like tablets and smartphones. Their distribution as apps provides opportunities for incorporating significant amounts of interactivity as well as other innovative features. In fact, such apps are often compared with games, and the Google Play store specifically categorises eBook apps in that way

('books' in the Google play store are typically what we would term 'eBooks' and are delivered in PDF or EPUB format for access on any platform with an appropriate reader; 'books' in the Apple App Store are packaged differently and are typically a combination of software plus content).

A key characteristic of eBook Apps are that they are often only compatible with the specific technical ecosystem for which they have been written. Typically these are iOS for use on Apple devices and Android for use on other types of tablet computer or smartphone.

From a digital preservation point of view, the key things about eBook Apps are: 1) that they are tied to particular technical ecosystems and, 2) that they combine software program and content together in a single package.

5.1 The evaluated works

The project looked at a very small sample of three eBook Apps originally published by Touch Press (Faber) and Nosy Crow, and released through the Apple App Store. The items were: 1) Goldilocks and Little Bear (Nosy Crow); 2) T. S. Eliot's The Waste Land; and 3) Solar System (both Faber / Touch Press). All items were selected by content experts and curators and were chosen to represent different types of content that are currently available as eBook Apps.

The items were accessed on the same type of devices as used in the interactive narratives workshop, chiefly iPads running several different versions of iOS (iOS11.2, iOS9, iOS5). For the evaluation, each app was downloaded to the iPads via the App Store.

5.1.1 T. S. Eliot's The Waste Land

T. S. Eliot's The Waste Land app was launched in 2011, but has been updated several times since then. As of the time of the workshop (January 2018), the most recent version of the app was v.1.1.5 (August 2017), which for system requirements specified iOS10 or later.

The content itself is an integrated set of resources based on Thomas Stearns Eliot's *The Waste Land*, including the text of the poem with critical notes, a film of a synchronized performance of the poem by Fiona Shaw, six different audio recordings (also synchronized to the text), images of the manuscript poem (including handwritten edits by Ezra Pound) and 35 video commentaries. A Faber press release issued at the launch of the product stated the product "carefully respects the typography and integrity of the original poem, yet offers spectacular new ways to explore *The Waste Land*'s significance and influence."

The textual content of the app is not dissimilar to a critical edition of the poem, but it is fully integrated with additional images and multimedia content, most of which can be synchronized to the text. This 'value add' is a key benefit of this app, offering a suite of resources for the researcher. For a comparably low cost, the user has at their fingertips a complete range of core materials to undertake in-depth research on the poem. Without any of the problems of attempting to assemble all these resources in a more traditional way (e.g., going to a reading room / library, ordering items, searching different editions, etc.), it dispenses with the necessity to trace archives and manuscript material, sound recordings, performances and ephemeral material that supports the published work. It is also possible for readers to add their own annotations, which are then stored within the downloaded app. The version history of the app, available from the App store, suggests that new versions of the app both fix problems and incorporate new features.

In appearance, *The Waste Land* app presents in similar way to a website and can be navigated in a similar way. The app does not appear to use any specific features of a handheld device other than touch, suggesting that the identical content could easily be presented on a desktop PC and navigated by mouse or touchpad.

5.1.2 Solar System

Solar System, by Marcus Chown is an interactive reference work. It includes a range of content types, including: text pages, images (e.g., derived from space missions), three-dimensional images (e.g. rotatable and zoomable astronomical objects and an orrery), video, audio, as well as data derived from a third party (Wolfram Alpha). It also incorporates an 'exclusive theme song' by Björk.

The structure of the app was complex, with no index or chapter headings, or any clear suggestion as to how the app was supposed to be navigated (or whether it should be read in any particular order). This is probably because *Solar System* was intended to facilitate exploration and act more like an encyclopedia than a text book. A linear navigation feature (breadcrumb trail) eventually became apparent at the foot of the screen, but it was not labeled particularly clearly. The images of astronomical objects were coloured to represent the texture and shape of the original objects.

This was the oldest app to be examined; it was first released in 2010 and there were eight subsequent releases that either fixed bugs or updated the app for new versions of the OS. Version-based differences were evident in the display of third party data. It was noted that planets in the orrery section could be "spun" using a swiping movement and in more up-to-date versions of the app and OS, this also caused the iPad to vibrate.

5.1.3 Goldilocks and Little Bear

The third item explored at the workshop was an interactive children's story, *Goldilocks and Little Bear*, one of a series of similar titles offered by the publisher Nosy Crow, and intended for young children. The inclusion of apps such as these is important from a research perspective because it allows comparisons between how tales such as "Goldilocks" change through time, how publishing for children has developed, and how technology might influence those changes.

The app is an illustrated exploration of the Goldilocks story, using touch, the device camera, microphone, and gyroscope, all allowing reader interaction with the story. One notable feature was that rotating the device 180 degrees switched the story from the perspective of Goldilocks to that of the Little Bear. There were, therefore, two storylines in the app, which could be read independently or sequentially, or the reader could switch between the two while reading.

Goldilocks and Little Bear is heavily illustrated and has many "game-like" features. Colourful, cartoon-style illustrations and animations fill most screens, and the app is obviously intended to be fun and appealing to its target audiences. Textual content is represented in speech bubbles or narrative, and there are options for audio, e.g. for narration, soundtrack, and sound effects. A cartoon-like location map aids navigation between screens and through the story.

The app was highly-interactive. The reader is expected to explore each scene by swiping within the page, not just tapping on navigation arrows. Some of the characters can be moved by swiping them in particular directions, e.g. to get them sat on chairs, to open cupboards, to change their clothes, or eat. The app sometimes uses the device's camera and microphone, e.g. to make the reader's face appear in a mirror, or to enable the cooling of hot porridge.

The app could not be downloaded onto the legacy iPad running an older version of iOS than that recommended.

5.2 Technical analysis

The technical analysis for mobile eBook apps was more tightly defined than for interactive narratives and therefore more detailed. All apps had been designed for an iOS environment and were packaged as *.ipa files. An *.ipa file is an iOS application archive file which stores an iOS app. *.ipa files can only be installed on iOS devices, though modifications to the file would allow some to be accessed on simulators.

IPA files are compressed archives in a ZIP format, containing content files and metadata. Renaming IPA files as ZIP files allows anyone to unpackage them to examine the contents. The *Solar System* *.ipa file, for example, contains the following:

- Meta-inf (folder)
  - com.apple.FixedZipMetadata.bin (file)
  - com.apple.ZipMetadata.plist (file)
- Payload (folder)
  - SolarSystem.app (folder)
    - ..multiple content folders
    - ..multiple content files
- iTunesArtwork (file)
- iTunesMetadata.plist (file)

The Payload folder contains the app data. The Metadata.plist file contains various metadata including name of the app, the apple ID associated with this version of the app, name of creator, version, purchase date, genre etc. Apps are consistently bundled in this structure to conform with Apple requirements. XCode can be used to validate IPA files. Xcode is an integrated development environment for macOS containing a suite of software development tools developed by Apple for developing software for macOS, iOS, watchOS, and tvOS. This is an unknown tool for preservation purposes so would require investigation. IPA files can be identified by Apache Tika but do not (yet?) have a PRONOM entry, so cannot currently be identified by tools dependent upon PRONOM.

Apps must be validated with XCode prior to acceptance within the AppStore. This suggests that all content types packaged within the app should be accessible on a contemporary and standardized, contemporary iOS deployment. That said, some apps are more complicated than others – *Goldilocks and Little Bear* being a good example, when compared to *The Waste Land* – and it is possible that complex apps would incorporate features which become outdated more quickly than simple apps. Content will frequently include links to external content that is unlikely to persist in a stable manner over time, for example the Wolfram Alpha data in the *Solar System* app; such linked content may or may not be significant to the integrity of the app.

The review/feedback mechanism within the App entry on the App store will typically identify any issues that users have when using the app. It may therefore be valuable to capture the App store page for each App preserved, and to do so at the point of archiving.

As noted previously, IPA files can only be installed on iOS devices. iOS is a closed and proprietary mobile operating system created and developed by Apple Inc. exclusively for its hardware. This is a severe limitation from both preservation and access perspectives. Furthermore, Apple IDs have public/private keys associated with them. The appleID of the authorised user is stored in the metadata.plist file, alongside data relating to the user's public key. This issue would need to be appropriately managed within a reading room access environment.

6. DISCUSSION

One thing that both interactive narratives and eBook apps have in common is their potential for supporting interactivity. This is, of course, not unique to these content types, and would also be apparent in other kind of digital resources that would already be in scope for Non-Print Legal Deposit (e.g., some websites or content produced in newer versions of some eBook formats like EPUB3). The challenge of preserving interactive content remains, however, regardless of whether the delivery format is HTML5, IPA or EPUB3 (or even a CD-ROM).

In order to consider our longer-term approach to preservation planning, one option would be to explore parallels with other kinds of interactive content, for example, videogames or digital artworks.

On digital art, Abbott [24] has compared interactive artworks to the performing arts in that they can be characterised by their ephemerality, their variability, and their interactivity. On interactivity, she comments that "interaction itself is a performative activity, requiring an audience to willingly suspend their belief (deliberately ignoring the technology of the proscenium or computer screen) in order to engage with the work in an active and ultimately rewarding way." There are parallels here with some of the content items looked at in the project workshops, although the aim there seems less to be for the reader/audience to suspend belief, but for the story to be delivered through direct interaction with trusted technology that has known and understood behaviours (e.g., screen swiping).

Abbott argues [24] that interactive art should not be understood as a set of discrete objects, e.g. a particular type of monitor, or files containing code, but more as an open-ended system of communication facilitating interaction between creators and audiences (as well as potentially with live data or networks). She comments that, "it is these very characteristics and complexities that make documentation and curation of both performance and interactive media artworks so challenging." There are additional challenges for any attempt to claim "authenticity." Abbott concludes that, "simply put, there is no single 'authentic' version of a work which depends upon user actions to come alive." An earlier paper by Abbott, Jones and Ross makes much the same claim [25]:

"The idea of capturing a static snapshot as a faithful (or even reasonable) representation is somewhat incongruous. Moreover the possibility that one viewpoint or interpretation could be valued over others and presented as the single authoritative account by virtue of being archived is strongly opposed."

So, what is to be done? Abbott's [23] solution acknowledges that capturing interaction requires documentation of both intent and manifestation of a work in order to avoid misrepresentation, to reflect variability and adaption over time, and to acknowledge variation in human and machine behaviours. Amongst other things, this documentation could include information that could enable future reconstruction or adaption of the artwork.

The long-term preservation of videogames (or computer games) has also long been acknowledged as a problem, not least because they are typically based on software and have significant technical dependencies on hardware, peripherals and (on occasion) networks. Winget [26] has reviewed the literature on the preservation challenges of videogames, specifically massively multiplayer online role-playing games like "World of Warcraft." Many of the preservation challenges that she identified were not even primarily technical. For example, Winget argued that the concepts of

"significance" and "authority" developed for evidential archives was likely to have have less relevance for games [26]:

"For example videogames are often "tampered" with, as in the case with different kinds of game modifications, and while "corruption" is a strong term, many games are released as "buggy," with patches and new releases being the norm."

Winget adds that the users of games have diverse needs and goals, with some wishing to play the game on a modern console with familiar peripherals, others wishing for an experience akin to playing the game on older machines, and others wanting to access the game's code.

Like Abbott, Winget noted the importance of generating sufficient documentation, arguing that, "it will be impossible to preserve videogames without the existence of structured documentation that describes the game's technical components as well as the context in which it was played." She does, however, acknowledge the significant representation challenge that games pose for those trying to preserve them and what they represent [26]:

"Until very recently, the information science community has treated videogames as artifacts, which have technical solutions to specifically technical problems"

This, however, ignores the essentially interactive aspect of interactive software. These interactions can be technical, e.g. with hardware, software, code libraries, network infrastructure, etc., but can also be social -- which will be much more difficult to capture. Winget's ultimate conclusion [26] is similar to Abbott's, arguing that we need to reconceptualise artifacts as primarily spatially situated: "their content thus becomes less important than does their placement within real space, the precise description of their creation, and the particulars of use." Whilst we have not explored the concept of authenticity in depth in this paper, we might infer from Abbott and Winget's observations that, in cases where interactivity is a dominating feature of a work, the preservation objective perhaps should be to provide the user with an authentic experience rather than an authentic object *per se*. This is not to say that the work presented should not be authentic, but that the ultimate goal is to build on this so as to provide the ability to also experience the object in an authentic manner.

We must however accept that the interactive nature of the works explored in this analysis is relatively limited, particularly for interactive narratives. In the small number of examples studied during the Emerging Formats project, the user or device clearly has the capability to influence the display of information on screen, but there were limited opportunities for the user to influence the works to the extent that it makes a difference to the actual narrative. This may be characterised as a difference between 'passive' and 'active' interaction. Within our sample of interactive narratives, the object with the most active interaction was clearly *A Universe Explodes*, where the user ('owner'?) must select words to add or delete, and thereby impact on the narrative presented not only to them but also to subsequent users. *A Universe Explodes* may even be conceived of as two separate items – the first is the editable version that can be 'owned', even if only temporarily; the second is the read-only version that most users would have experience of. The latter would certainly be less challenging to preserve from a technical perspective. Further studies are needed to explore sample content with a wider range of interactivity, such as Inkle Studio's *80 Days*

narrative, which has won several storytelling and gaming awards, but which is not web-based and is written using the 'ink' open source scripting language, designed specifically for writing interactive narratives.[4] *Sorcery!*, for example, from the same studio, introduces an element of 'choice' into the works so that user behaviour impacts on the direction of the narrative and on the ultimate story that is told. It is based on an adventure game book from the 1980's of the same title, published by Penguin Books, and the user experience is akin to that of a game, combining textual narrative with role playing, imagery, map exploration, combat and sound. The line between works like these and games is more blurred than with the four interactive narrative works in our sample, but the same observation may be made for the eBook apps. How then do we draw the line between an interactive narrative, an eBook app, and a game? Is it even useful to do so? More work is needed in this area also, for example to better understand the distinction between different genres and the contexts in which such distinctions may be meaningful and helpful, or artificial and unhelpful.

From a curatorial perspective, there would also seem to be value in exploring other aspects of emerging formats, such as the impact of the rise of eBook apps on traditional collections. The recent renaissance of fine press editions and artists' books may be, in part, due to a response to eBooks and apps. In many respects, the emergence of the eBook and the app subtly informs the development of those collections.[5]

Preserving interactivity is about more than just the preservation of content items itself but needs to encompass the wider contexts of creation and use, some of which may be able to be captured via documentation. How this will scale to larger amounts of content captured within the LDLs metadata infrastructures, or how this might be delivered within the context of NPLD remains to be seen. These are undoubtedly issues that will arise in the next phase of the Emerging Projects project.

7. CONCLUSIONS

Acknowledging the limited sample size for both types of content, it is fair to say that both eBook Apps and interactive narratives will provide significant challenges to preservation planning, both from a technical and conceptual perspective.

The exercise identified a wide range of content and behaviour that can be associated with mobile eBook apps, some of which clearly relies on the handheld nature of the device for optimum user experience. The mobile eBooks apps considered in this assessment all originated from the Apple Store, and therefore displayed a tight dependency on iOS devices. This is a limiting factor from a technical perspective, especially when it becomes necessary to access content on devices and operating systems other than those which they were designed for. Whilst there is an iOS emulator in the Apple SDK, engagement with the software vendor would be needed prior to any further investigation of this as a preservation solution. Furthermore, any hardware-based element of the solution would require those same features as available in Apple devices of the time (camera, gyroscope). These dependencies should be identified and documented, e.g., within the Library's IPS implementation, so that they could be maintained over time and used to inform access choices. The use of public key encryption within the downloaded apps poses another challenge in delivering

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[4] https://www.inklestudios.com/ink/

[5] Works such as *Ash* by Rachel Hand go some way to illustrate this: http://blogs.bl.uk/english-and-drama/2018/03/sic-thus-it-was-written-rachel-hands-ash.html.

content to anyone other than the licensed individual. Both of these issues – the proprietary nature of the environment and embedded DRM - are likely to require engagement with Apple to resolve them, alongside research into how the NPLD Regulations and Copyright Law might support such conversations.

Several other challenges and uncertainties have been identified for which we have, as yet, no firm conclusion. For example, how might we manage the user expectation for personalization / user generated content (e.g., the user annotations added to *The Waste Land* app), in light of the need to maintain a 'clean' and unaltered copy for preservation purposes? How do we handle the issue of multiple versions, particularly when different versions incorporate different functionality or different versions have been produced for different platforms? We might even ask what even constitutes a UK publication or publisher – in the case of these mobile eBook apps, is Apple the publisher or simply the delivery platform? If the latter, then who should we engage with in order to acquire the content and in which form should we seek to acquire it in order to most efficiently mitigate the risks outlined above, whilst still acquiring an 'authentic' copy of the work? The makers of apps may not see themselves as publishers either, but as content creators more akin to music or film "producers." This may raise issues in terms of framing our relationships with them as potential collectors of their products and how their content is acquired.

Analysis of the interactive narrative works featured in the project raised similar issues. It was clear even from the small sample that a wide-range of content and behaviour can be associated with such works, from hidden text that is revealed only when a device is tilted, to 'wobbling' and disappearing text that represents mental decline, automated personalization, and the integration of developing technologies, such as Blockchain, to generate and record metadata that itself reflects the experimental nature of works. These are all dynamic features that serve to draw the reader into the story and engage them in different and unusual ways compared to a traditional printed text.

However, the limited range of characteristics and features displayed in the interactive narrative sample set make it difficult to extrapolate with any certainty any meaningful conclusions about how 'interactive narratives' should be preserved. Considering only our sample of four web-based interactive fiction items, there are sufficient and obvious correlations with preserving other web-based content (which can display similar if not greater variations in content and behaviour), which suggests a similar technical approach might satisfy at least a base requirement for capture that can then lead to preservation. That said, there are clear dependencies on third party databases that would require investigation, such as the blockchain data in *A Universe Explodes* and the weather / location data in *Breathe*. Identifying the extent of personalisation and third-party dependencies may prove challenging at scale, noting also the possibility that a reader may never knowingly experience or be able to explicitly identify all of the personalisation in a work [27]. The fact that the content was designed for delivery on a mobile device is interesting though perhaps not defining - many of the features can be delivered via a browser on a PC, using either a full size touchscreen or a mouse to simulate the 'swipe' behaviour' (note that any testing via a web browser referenced in this report was limited to Chrome running on a Windows PC or Surface). Personalised data can also be incorporated via a PC the same way as it can a mobile, using for example an attached camera, speakers, or location request. The user experience when using a PC is different, but is it sufficiently different to be wholly detrimental to the overall experience? What should be the real focus of the preservation effort – the experience, the content, the interactivity? All of the above? These are yet more questions that require further consideration.

The technical preservation risks associated with this type of content are, for the most part, the same as those associated with any type of web-based content, which itself may also include use of peripherals such as device camera, personalisation based on location, and interactivity through notifications. The British Library's web archiving team are currently investigating the feasibility of using its existing web archiving toolset to capture and render this content. If the output is satisfactory and this type of content can be considered as websites, then are they really 'emerging formats' that manifest new challenges? The answer may depend on the extent of the level of technical complexity and dependencies associated with the object rather than its genre or content type.

The analysis undertaken within the project has provided some valuable pointers for subsequent preservation planning exercises. Interactivity is clearly a shared feature of the works, regardless of whether it is passive, active, simple, or complex. Curatorial observations during the workshops consistently acknowledged the inherent value of this interaction to all works. Considering also the observations of Abbott [24] and Winget [26], this suggests that preservation plans for these objects should incorporate specific actions to preserve interactivity, which means not just preserving the ability to recreate the interactive element of the works, but also documentation about them. This is consistent with the OAIS concept of Representation Information and could easily be captured in an RI structure, though the challenges of working out – and capturing – the right representation information remains substantial.

Despite all of the observations in this paper, the project team is confident that a technical solution for the preservation of this content is achievable, at least for the seven content examples analysed in this paper. Access restrictions imposed by the NPLD Regulations remain a challenge for delivery, particularly if object characteristics require that content be accessed on a mobile device. Legal issues relating to the proprietary elements of the content environments, use of third party content and DRM will also require further investigation, as will capture mechanisms. The other interesting questions for all of our emerging formats remain not so much the technical ones but those about ownership, authorship, provenance, citation, authority, the concept of 'definitive' versions, and value. These must all be explored in more detail alongside engagement with the producer community, to ensure that the challenges we explore here can be resolved in a mutually acceptable way.

8. ACKNOWLEDGMENTS

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