

# Authoring Interactive Fictional Stories in Object-Based Media (OBM)

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## ABSTRACT

This paper introduces a generic framework for OBM storytelling. Aiming to function as a complete end-to-end reference for authoring OBM narrative content - from conception to realization - it proposes an integrated model that includes the three essential levels: conceptual, technological and aesthetic. At the conceptual level, we introduce a set of abstractions which provide a unified reference for thinking, describing and analysing interactive narrative structures of OBM content. Their recursive nature make our model stand out in terms of its power of expression. These abstractions have direct one-to-one operational counterparts implemented in our production-independent authoring toolkit – Cutting Room. This ensures that any specific story designs conceived within the proposed conceptual model are *directly* realisable as OBM productions. This isomorphic relationship between the abstract concepts and their operationalisation is another distinguishing aspect of our overall proposition. We have validated the model at the aesthetic level through the production of the interactive film *What is Love?*, experienced by over 900 people at the media art festival Mediale 2018 in York, UK, and evaluated through a dedicated questionnaire by 94 of them. As the foundations of OBM storytelling have not yet been established, we trust this paper constitutes a significant milestone in its development.

## CCS CONCEPTS

• Human-centered computing; • Applied computing;

## KEYWORDS

Object-Based Media, OBM, Authoring, Storytelling, Narrative, Interactive, Responsive, Non-Linear, Television, Film, Drama

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## 1 INTRODUCTION

The ways in which audiences interact with and around television content – the dominant medium for entertainment – has been transformed within the last decade [1, 53]. Consumption through time-shifted catch-up services (e.g. iPlayer, All4, Netflix, Amazon Prime Video, You Tube TV, Hulu, etc.) is a fast expanding practice (e.g. see [14, 40, 41]). Audiences have access to the programmes they want, when they want it. The rise in social media has also caused a dramatic shift in the consumption of audio-visual content, particularly with younger audiences [16, 37]. Audiences interact *with* and *through* content. However, more importantly for this research, they also do so whilst watching curated television content, using ‘secondary screens’ [45, 46]. For example, social media is commonly being used as a discussion platform during live debate programmes [15]. These new behaviours show that *interactive experiences* are being increasingly demanded in the context of traditional TV viewing. However, to date, interactivity *with* the curated content is only available as *choice* of content available *at the programme level*, not more granularly, and all the other forms of interaction, such as on social media, are more or less *fragmented* from and *have little impact* upon the television programme themselves, which remain predominantly fixed and linear. This is even more apparent with regards to *fictional narrative content*. Except for a very small number of examples (see the ‘Related Work’ section), there is no *interactive* fictional narrative content rooted in film and television.

In this context, we are asking the question: could there be an alternative form of curated narrative content, in which the productions themselves are flexible and able to interact with their audiences and the contexts in which they are viewed? This question has been asked by many, starting with pioneers such as Glorianna Davenport [35] and Janet Murray [38]. Yet, despite a number of successful research outcomes (see the ‘Related Work’ section), the industry status quo remained the same: linear stories, locked at editing time and immutable at viewing time. We conjecture that the reason for this has not been the form itself, but the inability of the existing technology to support experimentation and, more importantly, effective production and delivery of such content. Consequently, audiences had little appreciation of and little demand for such narrative forms. At a time when neither reasons are valid any longer, we, among others, are revisiting this question. We believe that the only method of properly answering this question and impact practice is through producing robust and comprehensive exemplars, putting them in the hands of the audiences and evaluating their responses. The Object-Based Media paradigm is a consolidated effort in this direction.

Object-Based Media (OBM) is the label created by BBC R&D [11] to denote television content, or, more generally, time-based media content, that is tailored to the viewer’s circumstances, preferences

and devices, that ‘understands’ one’s viewing habits and are able to flex to fit them. OBM content is made from the same ingredients as the traditional linear content – video and audio clips, graphics, text, etc. – called objects. However, as opposed to traditional content, they are *automatically* assembled into meaningful experiences to reflect viewer’s choices of profiles, rather than being locked into immutable linear programmes in postproduction. The label is relatively new, but the generic concept it denotes has existed under other denominations, including Shape Shifting Media [50]. The former is made from the production, whereas the latter from the viewing experience perspective.

In our approach, this form takes as reference the quality of linear film and TV storytelling and aims to preserve it, but extends the experience space with interaction. The main problem we see in its development is the tight interdependency between form and technology: the development of compelling productions require appropriate authoring tools, while the development of appropriate tools require compelling forms to respond to. Non-linearity opens up a creative space of orders of magnitude higher than its linear counterpart. Authoring multidimensional stories – story worlds – which could be experienced in meaningful and rewarding ways in any linear parsing at viewing time is far more complex than linear authoring (which is a very complex process itself!). It is a *qualitatively* different form of mediated storytelling. We conjecture that, apart from fortuitous cases, sustained and successful creative processes in non-linear storytelling *necessarily* require *dedicated* tools to support it. Furthermore, the tools have to have a good degree of generality in order to support a sustained process of experimentation and discovery. Otherwise, when examples are to be implemented in bespoke systems, the production costs are often prohibitive, and when finances around found, the production details are buried in low-level code. Dedicated production tools have to provide *the concepts with which authors think* – i.e. the objects with which interactive story worlds are structured and represented – and have to be able to *operationalise* them. This is why we trust our paper constitutes a milestone in the development of the OBM paradigm: we are presenting a conceptual framework, a toolkit that operationalises it – Cutting Room – and an exemplar production that validates the two – *What is Love?* – i.e. an overall view of an end-to-end research process in authoring OBM fictional narratives.

The questions which drove our research include: how do we conceive and think of non-linear story spaces that could result in meaningful and attractive linear story threads? In particular, what concepts, representations or structures could we employ to transform large stories spaces into comprehensible objects to the human mind? How do we express our thinking into something that the medium can operationalise itself? And how do we make interaction an intrinsic part of the story, rather than being a simple add-on? The first question is addressed through our proposition of a conceptual model, providing a generic and basic set of abstractions for the understanding, design and development of OBM productions. The second question is addressed through Cutting Room, a generic authoring toolkit able to operationalise our proposed conceptual model. The third question is addressed through findings from the evaluation of *What is Love?*

## 2 RELATED WORK

### 2.1 Interactive fictional stories

Although experiments started already in the early two thousands, there has been only a handful of interactive fictional stories carried by video that reached the audiences with some degree of success. *Switching (2003)* [48] is one of the earliest. Produced for DVD, its narrative ‘is structured around a circular system in which everything repeats itself’ [48], the viewer being able to jump back and forth in time and location. More akin to narrative games, the story is more emergent rather than told. *Late Fragment (2007)* [31], also for DVD, has a similarly emergent structure, in which the viewer has to piece together the actual story, by navigating, somewhat randomly, through the collection of narrative fragments. *Accidental Lovers (2006/07)* [2] is a production made for TV broadcast, which preserved the *telling* quality of the narrative experience. Broadcast 8 times, it offered, each time, a different narrative experience in response to the live audiences’ aggregated interaction provided through text messages sent whilst viewing. It had an astute narrative structure which optimised production costs with responsiveness. Some variation was achieved in plot through video content (61 available clips), but a lot more was provided in discourse, through voiceovers (864 available in total) [50]. It is an exemplary production illustrating the potential of interactive fictional stories and a basic reference for our work reported here. Although a documentary, we still mention *Inside the Haiti Earthquake (2010)* [23], as it ensured continuity in time of interactive film and illustrated deployment on another medium, the web. Employing an interaction model reminiscing choices used in narrative games, in narrative structures is not more than an explicitly represented branching model. *Karen (2015)* [24] takes the experience of interactive video narratives on apps. The story is recounted as a conversation between viewer and Karen over days rather than hours. It did provide a novel experience to what had so far been developed, but, in structure, it remained akin to choices made in narrative games, albeit possibly with a deeper model. *Her Story (2015)* [30], similar in structure with *Late Fragment*, takes the concept into a more sophisticated narrative structure space. Published as a game, it offers a more meaningful way of navigating the narrative fragments and a more complex and immersive narrative space. As opposed to *Her Story* and *Karen*, and despite being published as a game, *Late Shift (2017)* [32] is very much grounded in film. It provides a continuous experience, but it allows for viewer choice. The experience has a much stronger story *telling* aspect, than the others, in which the story has a more emergent quality. The interactions consist mainly of binary choices regarding the evolution of the plot, but there is also support for the viewer to explicitly look and move around in the space of some selected scenes. Its interactive narrative structures are complex, providing 180 decision points and 8 possible endings. Despite some continuity errors [42], it is another key exemplar for interactive fictional stories. *Bandersnatch (2018)* [4] is the best reference for this genre to date, in story as well as in audience reach. The experience is that of a high quality film, but, through the numerous choices given to the viewer, it appears to offer countless meanderings through the story space. This is due to the cunning authoring of the interactive narrative structure: 150 minutes of unique footage

is divided in 250 segments which can be juxtaposed in various combinations at viewing time, depending on the choices made by the viewer [44], which continue to be binary choices regarding the plot. *Bandersnatch* also showcased the potential for interactivity provided through streaming.

We are positioning our own production, *What is Love?*, in the same category as *Accidental Lovers*, *Late Shift* and *Bandersnatch*. It is less complex in narrative structure, leads to a shorter experience, and has reached much fewer audiences than all the others. However, it is valuable as it showcases and validates a *generic* conceptual model and corresponding toolkit for structuring interactive films, Cutting Room.

## 2.2 Research in interactive digital narratives (IDN)

Except for OBM and ShapeShifting Media [50], the research in interactive fictional storytelling with pre-recorded time-based media content has been rather limited in the interactive digital narrative (IDN) community. The field is hugely skewed towards story generation systems (e.g. see reviews in [3, 29]) – i.e. the automatic generation of plot, events, character actions, etc. in the context of narrative games – and the development of theoretical underpinnings for this new form sitting in between story and game [e.g. [27, 39]], rather than systems able to recount interactively a pre-determined story with a pre-recorded set of assets. A review of relevant approaches to interactive storytelling with video is provided in [28], which concluded that the vision for developing interactive video centric storytelling has long been more of a promise than reality, but that the opportunities for such developments are ever more present.

## 2.3 Research in Object-Based Media (OBM)

OBM has been researched and developed in different genres and from different perspectives with regards to both form of expression and technology. Early research reported in the period 2015-2017 developed prototypes illustrating the potential of the form. They included factual programmes, daytime TV and drama. In the former category, *Forecaster* [33] gives viewers the ability to select different layers of additional information, but they are all overlaid on a main immutable audio-video stream. In daytime TV, *CAKE* [17] gives cooking instructions following the viewer's pace of cooking monitored through smart devices, but with the programme pausing between each step of the recipe, making it more of a web than TV experience. In drama, *Perceptive Media* [22] was illustrated with a short dramatic scene that was able to adjust its visual qualities as well as the way it was edited in response to the viewer's personality profile. They all re-ignited the interest in interactive narratives grounded in film and TV and, as they were hard-coded in bespoke software implementations, they highlighted the need for more generic tools for experimentation. An attempt to develop tools for the production of OBM content was made in *Squeezebox* [6], but it was limited in scope to only news programmes and choice for only duration of viewing.

Another significant advancement in OBM has been achieved between by the end of 2018, within a large European R&D project focused on live entertainment [20], but positioned in *live* TV. With key case studies in sports, it aimed to allow audiences to personalise

their own multi-screen viewing experience, for example by selecting which data to see or which camera perspective to follow, issuing requests from secondary screens synchronised with the main screens [25, 34]. Content (text data, graphics, views) is dynamically assembled at viewing time on the basis of viewer choices, its aggregation being made on the basis of pre-authored templates [34], which essentially specify the layout of various possibly chosen objects – regions on the screen – in various possible combinations (e.g. where should the racers ranking be shown if the viewer chooses to see engine performance parameters). This research exemplified how OBM production could be moved from one-off examples to scalable workflows [18]. However, the focus on the approach was placed on the spatial composition of various streams and data objects on screens, rather than on the narrative aspects realised through the sequencing of content in time and on live coverages rather than on stories told with pre-recorded content.

The narrative angle is the direction that drove our work, with the authoring toolkit Cutting Room – reported here – developed by the end of 2017 and deployed to productions such as *Living Room of the Future* [7, 47] and *What is Love?* [54]. The field continued to advance, thereafter, with the re-launch of the authoring toolkit StoryFormer (see the Authoring Tools subsection) for internal BBC use by the end of 2018, and deployed to research productions such as *Instagramification* [8], *Discover Your Daemon* [9], and, more significantly, to *Click 1000* [5]. Although *Click 1000* supports only basic interactions, such as skipping ahead to the sections of real interest and providing more detail about stories that pique the viewer's curiosity, it is a cornerstone in the development of the form due to its positioning by BBC as an interactive episode of the mainstream *BBC Click* programme.

## 2.4 Authoring tools

There are only a few tools specifically designed to support the authoring of interactive video narratives, which we are summarising here in the order in which they have been developed. The ShapeShifting Media Toolkit, also known as the NM2 Toolkit, resulted from R&D work carried out within a large European collaborative project [21]. Providing a comprehensive set of features for modelling interactive narrative structures, it was used, from 2006, in the authoring and delivery of *Accidental Lovers*, as well as of some smaller productions [50–52]. Although no longer in use, it has borne a significant influence upon the design of Cutting Room, as, probably, the most comprehensive system to date for modelling interactive narrative structures. Klynt [26] was launched in 2007, and it is now one of the few commercial products for interactive narrative production. It is easy to use, supports various types of media, and has immediate publishing capabilities on the web. However, with regards to interactive narrative representation its capabilities are limited to branching structures, being considerably surpassed by Cutting Room at this end. Twine [49] was launched in 2008 and is one of the main tools used in the development of narrative games, but it has been used, for example, in writing *Bandersnatch*. It is essentially a tool for structuring the writing of interactive stories, as it does not support time-based audio/video media. In structures, it only supports branching, being thus considerably surpassed by Cutting Room. CtrlMovie [19], completed in 2016, is the system

used in the making of *Late Shift*. It is presented in [19] as a generic tool, possible to be used in the production of other interactive films, but no other examples of use beyond *Late Shift* are provided. Our own Cutting Room, which is presented in this paper, follows in time, having been completed for (experimental) production at the end of 2017. StoryFormer, in its current shape, which is restricted to BBC internal use [12], was completed a year later, in 2018, and was used in the production of *BBC Click 1000*. There is continuity in concept and visual design between Cutting Room and StoryFormer. However, StoryFormer is less expressive with regards to modelling interactive narratives, being more or less limited to branching structures, expressed through variables and interactive elements [13]. However, as it is built on the foundations provided by the BBC's digital infrastructure, it illustrates how OBM could be incorporated in broadcasting production workflows. Although a research prototype, Cutting Room is a tool that provides the most comprehensive support for modelling interactive narrative structures, founded in a basic but powerful conceptual model.

## 2.5 Conceptual models

Conceptual models have been developed, essentially, from two directions: narrative theory (e.g. [43]) and computational approaches to narrative understanding and generation (e.g. [36]). The former normally consist of highly abstract concepts providing versatile analytical models, way distant from the pragmatics of conceiving, designing and producing interactive video-centric fictional narratives. The latter normally include computational models, such as formal logics, being often too technical and thus distant from the authoring process of interactive fictional stories. They are also normally employed in story *generation* in games, rather than in story-*telling* with recorded time-based media. One model that stands out is that provided through the Narrative Structure Language (NSL) [50], dedicated to the authoring of interactive TV and film and the foundation for the ShapeShifting Media toolkit. The core concepts remained the same in our model, but their inner structures concerning their ability to express various story response behaviours have been amended, also reflecting the capabilities of the new underlying technologies supporting (e.g. HTML5 and JavaScript).

## 3 CONCEPTUAL MODEL & AUTHORING TOOLKIT

### 3.1 Definition and Terminology

Aligned with the more generic definition of OBM, we define an *OBM narrative* as a story recounted essentially through time-based media which can *automatically (re)configure* itself for each *individual viewing* and *at the time of viewing* to best suit the context in which it is being experienced, taking into account, for example, characteristics of the device (such as screen size, connection bit rate, etc.) and/or of the individual viewing experience (such as time of viewing, age of the viewer, points of interest selected whilst viewing, etc.). An OBM narrative is *responsive* to the contexts in which it is experienced, including choices *explicitly* formulated by its active consumers and/or data *implicitly* available, inferred through other means. We regard OBM narratives as *necessarily* preserving the continuity qualities of traditional film, in meaning as well as in form. In relation to other terms used in related areas, OBM narratives are

*interactive, responsive, non-linear* and providing *personalised* experiences. In OBM, authors produce *overall* stories (story spaces, story worlds), each potentially leading to numerous *particular* stories (story threads, story paths) responding to individual viewings.

### 3.2 Approach and Architecture

Let us consider the workflow of filmmaking:

- *Writing*: outputs the script
- *Design*: outputs story boards, directorial decisions, pre-visualisations, etc.
- *Production*: filming schedules, directing and shooting; outputs the rushes
- *Postproduction*: colour correction, VFX, editing, etc.; outputs the final cut
- *Distribution*: provides the channels through which the final cut reaches audiences

Our approach to authoring OBM is founded in the editing process of postproduction. In traditional filmmaking, editors assemble the footage into linear and immutable sequences. In OBM, the editing process, or at least of part of it, is performed automatically, according to some logic expressed algorithmically by the creative producers. Obviously this impacts all the other elements of the development and production workflow, as well as the traditional workflow itself. However, what we focused on in this research automatic editing (postproduction).

The logics of most of the interactive films produced so far (see “Related Work”) have been directly implemented in low-level programming language – they have been *hard-coded* in algorithms. Such an approach introduces a huge overhead in the overall production process – programmers are required to translate between creative producers and complex programming languages. In our approach, we are exposing the authoring of the logic of the interactive narrative to creative producers and, distinctively from other authoring tools, we do this through a set of dedicated representation structures.

Figure 1 depicts the conceptual architecture we are proposing here for OBM. It emphasises the *representational* aspect of OBM authoring and, so, it details less of the issues related to distribution.

We regard authoring and distribution as separate and sequential processes, but they employ the same major functional components: a *narrative engine*, able to operationalise the logic of each particular story in each particular viewing; a *composition engine*, able to aggregate the media assets into the continuous audio-visual stream, as instructed by the narrative engine; the repository of *media assets*, representing the atomic ingredients for each particular story that can be compiled automatically.

The most important statement made by this architecture is the *factoring out of the story logic* from the other aspects related to production and distribution, which, for each production, is captured explicitly as a *distinct object* in the narrative engine. The *story logic* captures all the possible ways in which the overall story can be told, given all the possible data inputs provided by viewers themselves or extracted automatically from the viewing context. The *narrative engine* is able to operationalise each story logic into particular versions of the overall story. During each viewing – distribution process – the viewing interface provides various data

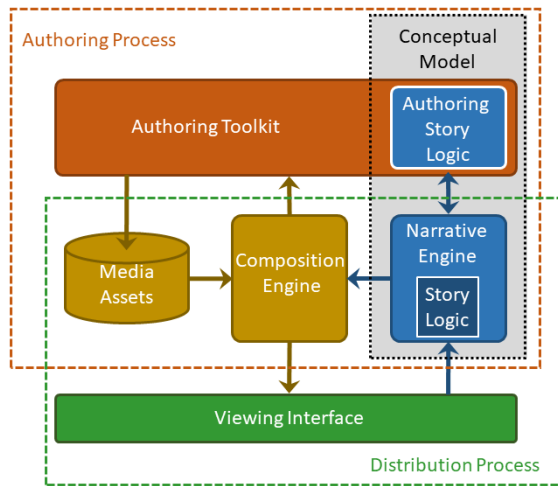


Figure 1: Conceptual OBM System Architecture

inputs to the narrative engine. In response, and on the basis of the overall story logic, the narrative engine dynamically compiles the corresponding particular story. This is made in the form of *playlists* – i.e. *descriptions* of the way the media assets are to be composited. This is an iterative process. The narrative engine goes as far ahead in time in the compilation of the next playlist fragment as is possible, given the data inputted up to that point. The compilation pauses where it encounters a decision in the story logic that depends on data not yet provided. As soon as new input is available, a new playlist is computed. Playlists are passed onto the *composition engine* which loads the necessary assets from the media repository and renders them into the corresponding audio-visual stream – the actual particular narration.

The narrative engine is a production-agnostic component and therefore reusable in the development of any OBM production. It is able to operationalise the *representational structures* of the underlying *conceptual model*. These are the structures used to model the logic of any overall OBM interactive narrative. They have visual representations in the authoring tool – the *authoring story logic* component – and provide the means to creative producers to build story logics.

### 3.3 Representation structures

As our model targets the editing process, it consists of *conditional aggregation* structures. The *conditions* that are associated with the aggregation structures are made with reference to the standard *properties* of the media objects (e.g. duration), their associated *metadata annotations*, the *interaction variables*, which gradually get bound to specific values at viewing time, and *internal variables*, which capture aspects of the particular narrative being shown (e.g. whether an object has been played or not).

OBM narratives are ultimately made of *atomic objects*. They are direct representations of the media assets, including video and audio clips, elements of text, graphics, data, etc. Each atomic object has a unique reference to an element of content and various metadata annotations, describing its content and narrative functions, possible

to be used in the conditions of the story logic. There are also “empty” atomic objects, with no reference to content, which can be used in the design of the story structure or in script writing. We are not imposing any restrictions with regards to what can constitute an atom – anything, from a video clip of a few frames long, to a long clip with various data elements burnt into it. The more refined the atomic elements are, the higher the responsiveness of the production is.

Atomic objects are structured into more complex *narrative objects* through conditional aggregation structures. A distinctive characteristic which sets us work apart from others is their *recursive nature*. A narrative object is either atomic or is the result of the aggregation of other objects via one of the pre-defined structures. A complete production is also a narrative object.

Two principles guided our choice of aggregation structures: *expressiveness* – i.e. ability to capture complex logics as required by the development of comprehensive interactive productions; and *meaningfulness to creative producers* – to foster their creative thinking. The fundamental set consists of *conditional fork*, *selection group*, and *conditional layered structure*. The fork is an easy to understand concept, representing branching, whilst the selection group and conditional layered structure build on the notions of *bin* and *layer* in traditional non-linear editing systems.

A *conditional fork* links one origin object with any number of destination objects. Each link has a condition associated with it which, if evaluated to true at viewing time, represents a potential sequence from origin to destination in the playlist. Default rules accompany this structure, stating how to disambiguate, in case more than one link is enabled, or specifying a destination in case none is enabled (to ensure continuity). The *selection group* contains a set of narrative objects, either explicitly enumerated or implicitly defined, via an expression, and a selection condition which, at viewing time, evaluates to one or more objects from the set. If there is only one, it is the object that will be placed in the playlist when the group is interpreted. If there are more, default rules similar to the fork’s are applied. The *conditional layered structure* assembles objects to be played in parallel. It has a leading layer, which constitutes the reference and drives the reasoning, and additional layers which, through associated conditions, are enabled or not at viewing time. In addition, it provides for dynamic synchronisation through *trigger mechanisms* – events on the timeline of a layer can start or stop the playout of another layer. The *interactive object* is a special type of narrative object, designed to support explicit viewer interaction or extraction of data from other devices or platforms. It defines an interaction variable, which becomes bound to a specific value upon viewer or device interaction, or is defaulted to a value in the absence of an interaction. For viewer interaction, it also includes cues and acknowledgments, both with associated timings.

Reasoning with the story logic and interactive elements at viewing time is, essentially, a constraint solving problem: the narrative engine compiles fragments of playlists after the completion of each interaction object, going as far in the narrative space as possible – i.e. until it reaches a condition that has an unbound interaction variable.

Although targeting postproduction, the structures defined here serve also as design aids in conceptualising interactive stories before production, as well as for the development of the script.

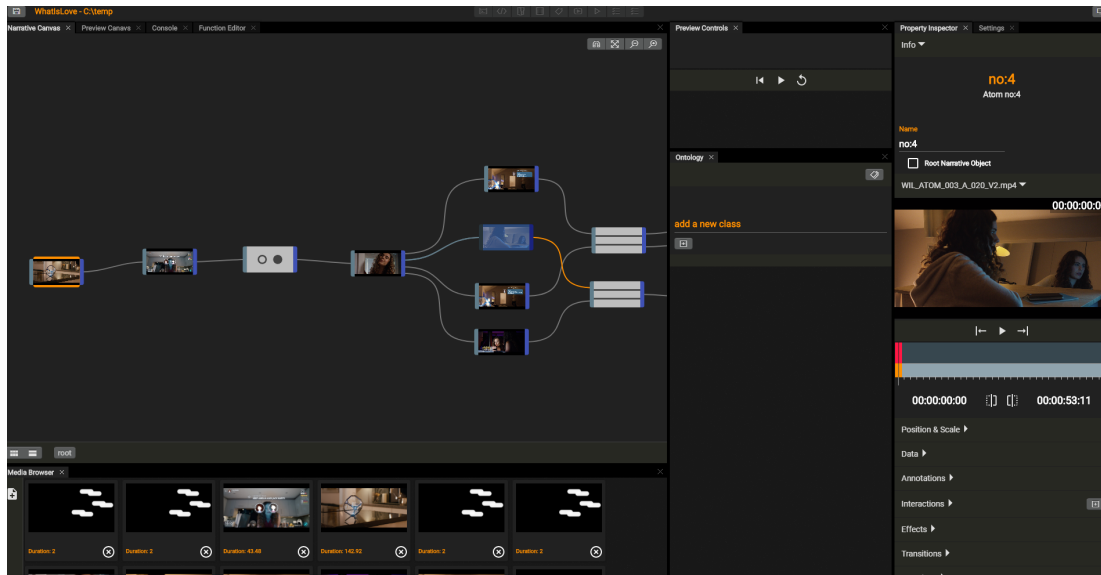


Figure 2: Cutting Room

### 3.4 Cutting Room

Cutting Room is the authoring toolkit we developed to implement the representation structures described above (see Figure 2). It provides the following tools: media asset ingestion tool, atomic narrative object browser, ontology definition (for structured meta-data annotations), narrative objects inspection tool, which allows also for specific annotations to be made, and, most importantly for this paper, the story logic authoring tool. The latter tool allows for atomic objects to be aggregated into more complex objects, in a recursive manner. Each structured object can be navigated in and out. The story logic authoring tool allows the viewing of only one narrative object at any one time – i.e. all the fork structures at the same level, the content of a selection group, or the layers of a conditional layered object. Figure 2 shows the top layer of the production *What is Love?*, which consists of two sequenced atomic narrative objects, followed by a selection group, then another atomic object forking into four objects possible in the sequence, continuing with two layered structures. In addition, Cutting Room also provides a preview tool and a playlist visualisation tool.

Cutting Room is implemented in JavaScript, is fully web compatible and supports the creation of OBM narratives which are HTML5 compliant, therefore possible to be viewed in any HTML5 browser. Online delivery of OBM narratives is achieved by *exporting* them as a static, client-side webpage, including two JavaScript libraries: the narrative engine and the composition engine (See Figure 1). The former is implemented by and proprietary to us. The latter is an open source client-side library called Video Context [10] and was developed by BBC R&D. It uses HTMLWebGL canvas to render video frames as textures.

Cutting Room was used in the authoring of a number of OBM interactive narratives, including *What is Love?*, which is described below.

## 4 WHAT IS LOVE?

### 4.1 Commission

We secured an investment of £20,000 to commission a media production company to develop an OBM interactive film employing the Cutting Room toolkit. We received eight applications in the form of a one page story treatment and a development plan. We shortlisted three and selected Symbolism Media, a production company set up in York, to develop a 20 min long interactive film, *What is Love?*, as the story promised to provide the richest space for exploring OBM fictional storytelling. The film’s director and the producer have previously worked in visual effects for Imaginarium Studios, on large-budget films, such as *Star Wars: The Last Jedi*. Both had significant experience in technology focused film and TV production through VFX, but neither, nor the script writer, had any previous experience of interactive film.

### 4.2 Story Concept

*What Is Love* is the story of a triangular relationship between Amelia, a talented dancer, Jack, her partner and a rising star software developer, and Zee, Amelia’s devoted AI butler. Their relationship is witnessed and sometimes intruded upon by Amelia’s social network followers.

Amelia and Jack live in separate countries and, worse, in different time-zones. But most problematic is that they both live hectic lives and cannot find many occasions to talk directly to each other. So, their communication mainly happens through Zee. Zee is like a most-trusted friend and messenger. However, Zee belongs to Amelia and its mission is to make her life as happy as possible. Amelia sometimes asks Zee to keep things secret from Jack. Zee edits Jack’s bouts of anger to reduce their impact upon Amelia. It has a sharp logical intelligence. It is capable of mimicking people’s appearance, including Jack and Amelia’s, morphing its voice and



face into anyone's. Delicate voice nuances and subtle facial expressions are all within its control. But when it comes to reading and responding to emotion, Zee is still naïve and needs our help. Zee is also Amelia's "secretary" in interacting with her rich social network. Amelia sometimes asks Zee to share too intimate details with her followers. The boundaries between reality and fiction, happiness and ignorance, intimacy and exposure are challenged. Zee faces these challenges. How would AI be able to mediate such situations? The AI is the veil, as, ultimately, *What is Love?* challenges us, the viewers.

The ultimate shape of the story is determined by our interactions. We are asked by Zee to help with its decisions. When we do, we mark points of interest about which we have a view. The story then exploits this, by challenging us with pro and counter arguments. The denouement reveals our interventions and sheds a stronger critical light upon our views. The narrative intent is that, through interaction, we build a closer emotional connection to the issues to which we react, allowing for deeper messages to be conveyed.

Non-linearity was conjectured to be required for two reasons. One was to enhance the sense of urgency of the viewers' interventions, particularly when less activity is detected, by increasing the dramatic tension through faster cutting and the choice of higher tension scenes. The other one was to identify issues with which the viewer gets emotionally connected – signaled through interaction – and subsequently to explore them in more depth by following the respective story threads.

### 4.3 Interaction concept

The interaction mechanisms are versions of social media interaction. One is standard, allowing the active viewer to like or dislike posts by Amelia and her followers, but mainly suggestions by Zee. This is used when a fast reaction is required. The other mode allows more versatility with regards to the expression of an emotional response to a situation or a reaction by Zee and involves a series of emojis varying from loving to hating. In the first part of the story, as the viewers become familiar with the interaction mechanism, they don't carry much meaning. Later, they become more meaningful in influencing the development of the story. Also, initially, the cues for interaction are quite explicit and visible, but after a few interactions, they become more discrete.

### 4.4 OBM Implementation in Cutting Room

*What is Love* was fully implemented in Cutting Room. We do not have the space to provide a detailed description of the story logic expressed in our model, but will illustrate it with two examples.

*Like interactions.* They are used in points in the film in which Amelia shares posts on her social media feed. This structure is implemented as a layered object consisting, in turn, of three other layers: the video showing Amelia (including audio); a text box containing the post; and an interaction object giving the cue for input to the viewer, defining a variable that stores the input ("like" or "no reaction"), and an animated picture containing a series of hearts cascading up the screen on transparent background, shown as a response to viewer interaction. Each post is triggered by Amelia giving a waving hand gesture and saying the word "share!". In turn, after a second, this triggers the interactive object, cueing the viewer

for interaction. The like interactions are provided in a sequence, allowing the harvesting of viewers' points and topics of interest. These inform the choice of the subsequent chapters of the story. Despite the design and the logic readily expressed in Cutting Room, the choice of subsequent chapters was not implemented in *What is Love?* due to production costs.

*Emoji interactions.* It has a similar OBM structure to the "like" interactions with regards to eliciting viewer input, as it harvests point of interest associated with emotional responses. There is a sequence of such interactions which lead to a group structure which develops the themes, in accordance to the viewer's choices. The group's selection condition maximises the combination of theme and interest.

The intention was also to use these variables in the final scene and make Zee break the fourth wall by referring specifically to the viewer's guidance. In this instance, too, the production costs required a simplification, namely the provision of a smaller set of endings, responding in more general terms, than individually, to the viewer's choices.

### 4.5 Delivery interfaces

The film was shown as an installation in a custom built display unit which contained 2 TFT screens with 1080p resolution. A large 32" screen was placed at the back of the display unit, and showed the film's main narrative. The second screen, 27" in size, was housed face-down in the ceiling of the display unit and created a holographic reflection on a 2mm piece of glass, positioned at 45° from the top back of the display to the bottom-front (a pseudo-holographic Pepper's Ghost display). It was used to display information pertaining to interaction points. Viewers initially interacted with the film using simple hand gestures via a LeapTM Motion controller, which was replaced, after some initial feedback, with a standard mouse.

### 4.6 Exhibition

*What is Love* was presented at the 2018 York Mediale, an international biannual Media Arts Festival. It is to note that this was one year before *Bandersnatch* and *Click 1000* (see the "Interactive fictional stories" section). The setting for the exhibition was a 12th century, Grade 1 listed, Anglican church. In total, 6 viewing booths were constructed, each allowing a group of up to three people to simultaneously view the film. When watched in a group setting, a single person was asked to control the interactions.

The exhibition ran for a period of seven days, from 30 October to 6<sup>th</sup> November. During this period, more than 900 visitors experienced the interactive production. About mid-way through the exhibition, viewer feedback uncovered problems with the interaction interface (see above) as well as insufficient visual and aural signposting in some points of interaction. Both problems were fixed by correspondingly amending the production.

## 5 EVALUATION

Three types of evaluations have been carried out: one by the Mediale team, reported in [55], and two by this research team, reported here, consisting of a questionnaire, to understand how aspects related to OBM narratives resonated with the general public, and interviews

with the production team and three industry experts to analyse the form and the creation and production processes. Although the evaluation done by the Mediale team did not involve us, it is still worth mentioning that *What is Love?* received full marks for 8 out of 12 surveyed categories, including concept, captivation, distinctiveness, originality and excellence, making it one of the most appreciated exhibit of the festival [55].

## 5.1 Questionnaire

**5.1.1 Aspects surveyed.** Our survey comprised of nine questions (Q1-9), with all responses being rated using a 5-point Likert scale from  $-2$  (not at all / very poor) to  $+2$  (fully / very good). The first two questions asked respondents to rate their perceived interest in (Q1) and engagement with (Q2) the overall experience. Q3 assessed whether the interactivity added to, or detracted from, the film experience, and Q4 assessed the extent to which *What is Love?* had made the visitor interested in interactive narrative drama. The final five questions (Q5-9) related to the quality of individual aspects of the production: exhibition (Q5), story (Q6), aesthetics of moving picture and sound (Q7), acting (Q8) and interaction (Q9). Following this, two binary tick-box questions were provided, asking whether the visitor had experienced interactive TV or film narratives before and if they would be interested in seeing further examples of this form in the future. Finally, there was a space for any comments visitors wanted to feedback. The surveys were kept completely anonymous, with respondents given only the option to provide their approximate age range ( $<30$ ,  $30-50$ ,  $>50$ ) and their occupation.

**5.1.2 Data collection.** Upon leaving the exhibition, random visitors were asked to complete a short survey. When the film had been viewed in a group, the viewer who had been in control of the interactions was asked to complete the feedback. We had 94 overall completed and valid questionnaires, and we use  $R$  to denote this number. Of the full set of respondents, 46 ( $r_1$ ) experienced the exhibit before the interaction amendment (see section 4.6) and 48 ( $r_2$ ) after. This sub-division, which is of almost equal sizing, allowed an informed analysis of the effect that the design iteration had upon the viewers experience.

In the following sections, we use  $\bar{x}$  and  $\tilde{x}$  to denote the mean and median, respectively. When significance is reported between the two sub groups, the comparison was calculated by using a Mann-Whitney U test. The limit for establishing a significance in the two datasets was defined as  $p \leq 0.01$ .

**5.1.3 Results.** Figure 3 shows the distribution of respondents' feedback for each question. For all the questions, save two, the number of people giving positive evaluations – i.e. either “good” or “very good” – represent 69% or more of the total number of respondents. Two questions were rated positively (“good” or “very good”) by 80% or more of the respondents – i.e. exhibition quality (Q5=83%) and aesthetic quality (Q7=80%). Three were rated positively by more than 70% of the respondents – i.e. interesting (Q2=79%), made you interested (Q4=77%) and acting quality (Q8=71%). Engagement and story quality followed very closely with 69% (Q1=69%, Q6=69%). One question that was evaluated positively by fewer people, but still over half of the respondents, was related to the value added by interactivity (Q3=54%). However, this was severely impacted

**Table 1: (Q1-4) Engagement ratings, summary statistics**

	$\bar{r}_1$	$\bar{r}_2$	$\bar{R}$	p
(Q1) Overall engaging	0.64	1.06	0.86	0.010
(Q2) Overall Interesting	1.00	1.14	1.07	0.243
(Q3) Interactivity + or -	0.23	0.68	0.47	0.008
(Q4) Made you interested?	0.84	1.04	0.95	0.266

upon by the reported inappropriateness of the interaction device and signposting, as the analysis below will illustrate. If we consider only the data after the iteration, when these problems were fixed (i.e. restricted to  $r_2$ ), this question too, was evaluated positively by almost 69% of the respondents. The only question for which the number of people evaluating positively was slightly less than less the numbers giving lesser evaluations – i.e. “neutral”, “poor”, or “very poor” – was for quality of interaction (Q9). However, in this instance, too, if we only consider the  $r_2$  set of the respondents, we get 65% positive evaluation.

If we consider the number evaluations per point in the Likert scale, then for all the questions, save Q3 and Q9, the percentage of responses for “good” and “very good”, individually, are greater than the percentage of responses for any of the other three categories. For both Q3 and Q9 “neutral” surpasses “very good”, but “good” surpasses everything.

Looking at data in more detail, Table 1 summarises respondents' feedback on Q1-4, regarding the overall experience and the value added by interaction. Responses to Q1 and Q2 highlight that, overall, viewers found the experience to be both positively engaging (Q1,  $\bar{R} = 0.862$ ,  $\tilde{R} = 1$ ) and interesting (Q2,  $\bar{R} = 1.074$ ,  $\tilde{R} = 1$ ). There was a significant improvement in the overall rating of engagement (Q1) as a result of the change made midway through the exhibition ( $\bar{r}_1 = 0.64$ ,  $\bar{r}_2 = 1.06$ ,  $p = 0.01$ ), but not with regards to the overall interestingness. Q3, asking whether interactivity added to or detracted from the production, despite a positive evaluation (Q3,  $\bar{R} = 0.46$ ), received the lowest overall value. However, there is a significant improvement after the design iteration in the viewers' consideration that interactivity added value to the production ( $\bar{r}_1 = 0.23$ ,  $\bar{r}_2 = 0.68$ ,  $p < 0.01$ ). Q4, asking whether the production had made viewers interested in interactive dramatic narrative as a form of storytelling, received positive responses overall, but, also, saw no significant improvement after the iteration.

Table 2 summarises respondents' feedback on Q5-9, relating to the audience's perception of the quality of specific elements of the production. All areas were received positively by respondents (Q5-9,  $\bar{R} > 0$ ), the highest received being the quality of the exhibition ( $\bar{R} = 1.29$ ) and the lowest being the quality of the interaction (Q9,  $\bar{R} = 0.30$ ). However, Q9 had a very significant improvement after the iteration ( $\bar{r}_1 = -0.16$ ,  $\bar{r}_2 = 0.70$ ,  $p = 0.001$ ), taking it from negative values to a value closer to 1. None of the other four questions (Q5-8) were significantly affected by the design iteration.

These are very encouraging results. However, the fact that Q3 and Q9 received the lowest evaluations indicates that interactivity still was the trickiest and weakest aspect of the production.



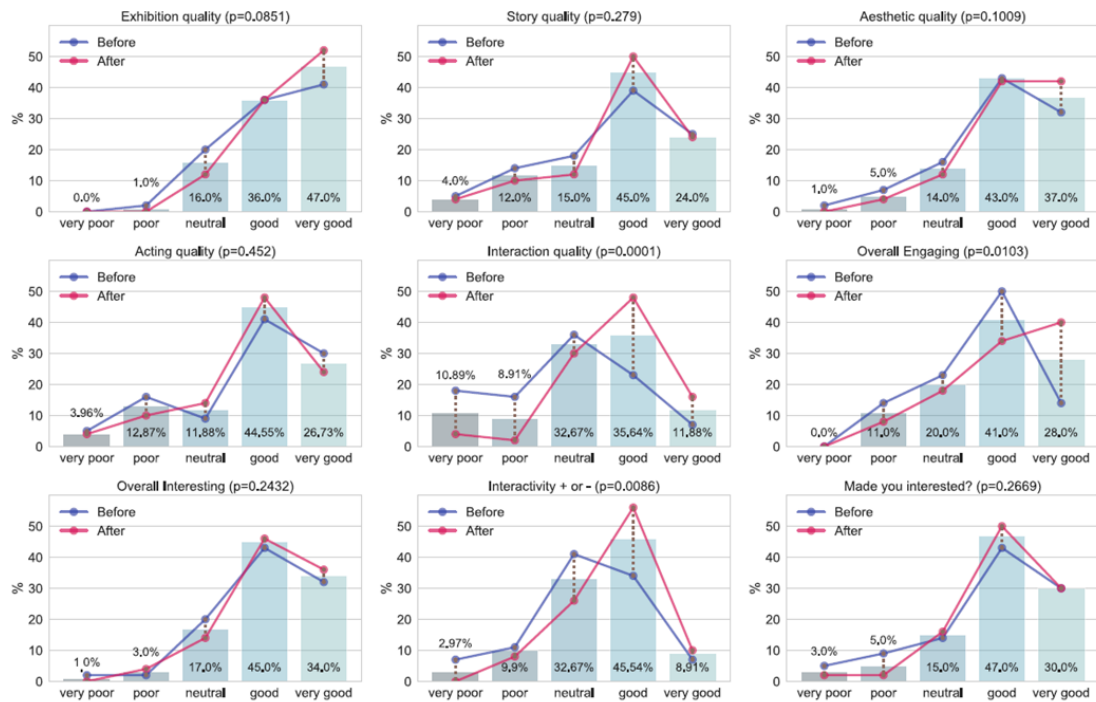


Figure 3: Distributions of questionnaire data (from left top to bottom right: Q5, 6, 7, 8, 9, 1, 2, 3, 4)

Table 2: (Q5-9) Quality ratings, summary statistics

	$\bar{r}_1$	$\bar{r}_2$	$\bar{R}$	p
(Q5) Exhibition	1.16	1.40	1.29	0.085
(Q6) Story	0.66	0.80	0.73	0.278
(Q7) Aesthetic	0.95	1.22	1.10	0.100
(Q8) Acting	0.75	0.78	0.77	0.452
(Q9) Interaction	-0.16	0.70	0.30	0.0001

### 5.2 Expert analysis

The production company, Symbolism, although experienced in very large budget film productions employing significant technological innovations, have found the production workflow of interactive film extremely challenging. Writing was the most difficult part of the process, posing a difficult challenge in solving two opposing requirements: providing a reason for the viewer to interact and allowing the story to flow naturally. For a traditional scriptwriter, narrative continuity seemed to invalidate the need for interaction, whilst the insertion of events that would motivate viewer interaction seemed to break the continuity of the narrative. The conceptual model helped the director design interactive film structures, but they had little impact upon the development of the script. The sequence in the workflow remained very much from script writing to production, being more or less impossible in this instance to support the opposite direction of travel – from production designs to the script. For script development, the written text remained the sole object of design and analysis. The script underwent numerous

drafts in the conversation between the writer and the research team, with the latter providing extensive suggestions for development along interactivity and the writer simplifying and aiming to ensure clarity, focus, flow and continuity. A key conclusion was that Cutting Room could and should have been directly involved in this process. However, this was not possible due to budgetary constraints, as training the scriptwriter to think within the conceptual model suggested here would have taken much longer and would have drawn too much from the production costs. Instead, the script, still linear, provided the skeleton of the story, but allowed the subsequent development of an interactive experience in the production phase.

The conceptual framework and Cutting Room were regarded as excellent tools in production design. They supported the development of various ambitious and supposedly novel approaches to interactive storytelling. However, there was a significant divide between the designed interactive narrative structures conceived in production workshops and the actual ones committed for production. The abstract description of the footage resulted naturally from thinking within the conceptual framework. However, when translated into production plans, they were too often hard to realise, given the allocated production budget. One of the key problems stemmed from the production workflow. Interactive narrative development requires an iterative development process. Production has been more or less linear. An iterative production process raises many challenges, such as ensuring continuity. Locations, sets, actors, weather, etc., are factors that add major complexities to iterative production. However, save all these problems, the production

team became well accustomed to the aggregation structures provided by Cutting Room and ended up describing *What is Love?* in the terms defined by our conceptual framework. Although the production team did not achieve autonomy in using Cutting Room, they became comfortable users under the supervision and advice of the research team.

The key finding inferred at the end of production and public evaluation by the production team in consultation with our industry experts concerned the interaction mechanisms. Liking or disliking social media posts or providing emotional responses expressed as symbolic icons, indeed simple and meaningful, was concluded to be too restrictive and unrewarding an interaction mechanism. Indeed, overlay of social media with interactive storytelling was assessed as having great potential for the development of a new *format* for interactive storytelling. However, the recipe for success was hypothesized to be a seamless blend between film storytelling and social media interaction: - i.e. to employ social media in the story and to expose it *as such* as a means for audience interaction. In the case of *What is Love?*, the viewer should be made to believe they are one of Amelia's followers, and be given exactly the same interface for interaction as the characters in the story (e.g. via a secondary screen). This concept could be used in individual as well as social viewing. In the former case, interactions from other followers are staged. In the latter, they can be real communications between actual viewers, either in an asynchronous model, accumulating posts from prior individual viewings, or in a synchronous model, when viewers are watching at the same time. This idea is to be explored in subsequent productions.

## 6 DISCUSSION

*What is Love?* has been positively received by its viewers. This is a very encouraging result which we interpret as a validation of our conceptual framework and generic authoring tool Cutting Room. A production company with no prior experience of interactive film, managed to produce a successful short interactive film. However, this is only a step in its evaluation, albeit big. A proof of its value can only be founded in a larger number of successful exemplars.

Despite a positive evaluation, the interactive aspects received the lowest appreciation from viewers amongst all the other aspects of the experience. Our conclusion is similar to those drawn in other similar contexts: interactivity is an avenue worth exploring, but the road to finding successful recipes is long and complex. Nevertheless, *What is Love?* contributed to the landscape of examples with an original take upon viewer interaction – namely that through social media, which, at the same time, is an inherent part of the story – as all the key exemplar productions representing the state of the art, save *Accidental Lovers*, provide the viewer only with explicit binary choices which determine the subsequent development of the story events. More refined evaluations are needed to really understand the public's position in this regard and Cutting Room provides the means for carrying out such experiments.

The conceptual framework facilitated the development of rather complex and allegedly potent film narrative structures, illustrating its potential to inform thinking and that of Cutting Room to facilitate experimentation. However, all the designs were more ambitious than what was ultimately realized in the final production,

leading us to the conclusion that workflow processes themselves have to be challenged and appropriately amended. Cutting Room, as a tool for rapid prototyping, could be essential in such enquiries.

## 7 CONCLUSION

We have presented an end-to-end study in authoring OBM fictional narrative experiences. We trust it constitutes a milestone in the development of OBM for fictional storytelling. This study, we hope, answered a number of fundamental questions. First, how do we conceive and think of non-linear story spaces that could result in meaningful and attractive linear story threads and, more specifically, what concepts, representations or structures could we employ to transform large story spaces into comprehensible objects to the human mind? This we answered through our proposed conceptual model dedicated to thinking of and designing OBM interactive fictional stories. Its recursive nature allows creative producers to transform large story spaces into comprehensible objects. Second, how do we express our thinking into something that the medium can operationalise itself? For this, we proposed Cutting Room, an authoring tool able to operationalise the structures of the conceptual model. And thirdly, how do we make interaction an intrinsic part of the story, rather than being a simple add-on? This we answered with a conjecture regarding the potential of integrating social media *into* the story as well as exposing it as a mechanism for interacting *with* the story.

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