

# 20 Seconds into the Future: Narrative Space for Maths Motivations

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## Abstract

The innate and powerful ability of the human mind to create narratives from a given situation is an effective means of transmitting information in a full context. The project described here, “20 Seconds into the Future,” presents the office of H. Kadigan, itinerant mathematician, along with all the surrounding of his personality. Visitors investigate the contents of the room, the books and papers, letters and photos, building up a complete view of his world and his work within mathematics and its applications.

We describes a Physical Narrative of the world of a research mathematician, communicating his life and work, the breadth of mathematical interests and the applications of mathematics within the world of physics.

## What is a Physical Narrative?

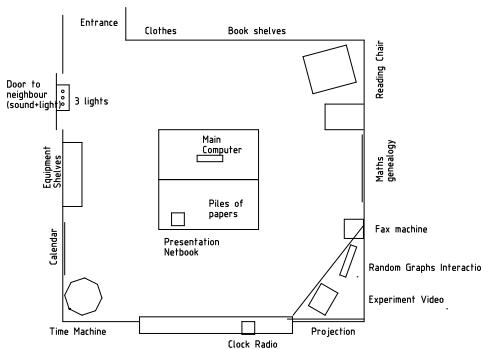
A Physical Narrative (PN) is a space which the public is invited to explore, within which they find the traces of a story that they piece together during their experience. Evidence suggests that this is a natural and effective mechanism for determining character of a room’s occupant [5]. One comparison is with a detective coming into a crime scene; confronted with the physical evidence, their job is to reassemble the story that led to this state. Another metaphor is that the space is a network of story elements, with visitors moving from one element to the next according to interest and offered cross references across space (within the room) and time (within media streams). Story elements reinforce one another using network effects. Two recent examples of such environments in an artistic context are inspiring. In *Shelter II*[2] entry was through a discarded roadside sausage stand to a tunnel that entered the building through a second store window. Moving through the space, one discovered traces of human habitation. One was left with the feeling of having stumbled across a recently abandoned human outpost on a distant planet, very familiar yet completely alien. *Opera for a Small Room*[3] is filled with opera memorabilia, an active piece of operatic fetish and obsession, portrayed through mechanised systems. A related example within a science context was the travelling ”Einstein Office” that toured in the Physics Year 2005.

There are several ways of placing Physical Narrative within the constellations of other art forms, including theatre, computer games, interactive installations and Alternate Reality Games [1]. As we move from poetry through writing, theatre, film making and games, we see the movement of content from the imagination of the reader to the media. In a PN, we must build all possible areas of investigation of the visitor into the world: there is no off-camera area. Similarly we cannot control how a visitor will explore the space. They may arrive at any time and may find many things in the space to investigate. This is a strength of the PN, as each visitor can be initially and independently intrigued by different aspects (*entry points*) of the space and the story, thus appealing to a wider spectrum of visitors.

The genre of PNs offers a wealth of possibilities for allowing exploration of a world. In this article we will summarise our experiences around one PN with a mathematical and research focus.

## Criteria and Context for the Narrative

*20 Seconds into the Future* was presented as a part of the Austrian *Lange Nacht der Forschung* (Long Night of Research) in 2010, a nation-wide showcase for active research, inviting the general public to a



**Figure 1**: Left: a schematic diagram of the room and its contents. Right: a photo taken from the entrance, showing the desk, the random graphs interaction and the projection. In the foreground visitors are burrowing into Kadigan's computer and the piles of books and papers on his desk.

better understanding of the research activities within Austria. The expected audience was a full spectrum of ages and interests, from university colleagues to children, teenagers exploring career prospects and adults investigating where their taxes are being spent. Our goal of developing multiple entry points to mathematical content for a spectrum of interests was justified.

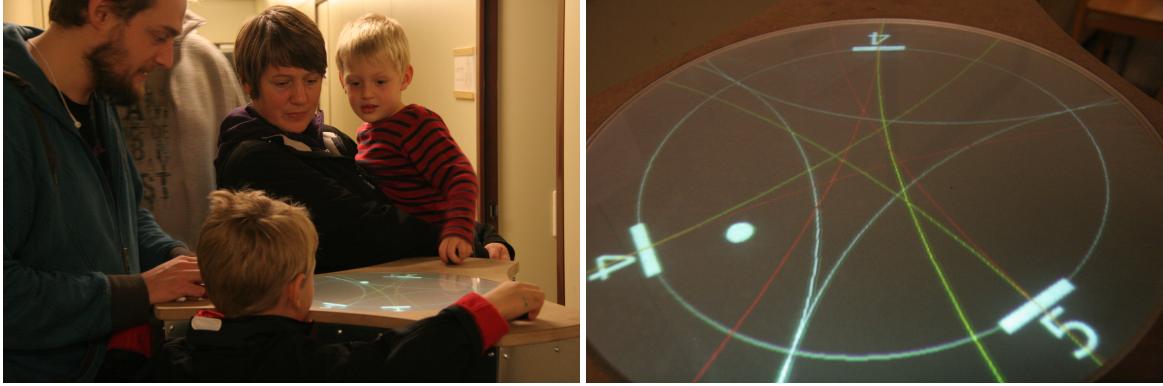
The space was a single roomed office, with an adjacent office for control electronics, light and sound effects to make it appear that our narrative space continued but was not accessible. People could arrive at any time during the seven hour exhibition, so we worked with looping media, with events cycling every 50-120 minutes. Design for arbitrary starting points was necessary and cross references across time were kept short. Cross references across space, however, were to be made as clear and plentiful as possible. In order to enhance the integrity of the experience, we wanted each entry point in the room to bind to many other parts of the room, so once a visitor had seen the first aspect that caught their interest, they would find easy access to other story elements.

The character, Henryk Kadigan, is an itinerant scientist, perhaps akin to Paul Erdős or the independent gentleman scientists of the 19th century. He was spending some time at the university as a Guest Professor and was moving from an interest in random graphs, emergent spatiality, topology, non-Euclidean geometry and the deeper structure of space to the phenomenon of time. Theories that he was investigating were related to *Process Physics* [6]. Furthermore we wanted to draw attention to the questions of non-academic research and to the possibilities and problems of life outside academia. The motivations for a person entering a certain research topic are, on an official level, usually quite pragmatic, whilst there are often important personal reasons that are not pragmatic at all. These motivations and background were important elements to convey within the installation, as well as the everyday work of research and development.

## **Description of *20 Seconds into the Future***

The invitation to the event stated that Kadigan would present his work on the mathematical basis of space and time. When people arrived they were told that the Professor was fictitious and they could explore his office freely.

Figure 1 shows a layout of the room which was situated off a corridor. The room was the office of a research mathematician, the large desk was covered in piles of papers, scribbled notes, journals folded open to certain articles and the other paraphernalia of a mathematician. The visitors were invited to dig around inside the papers, to read them, interpret them, to connect them to other parts of the room. A collection of



**Figure 2:** Left: group of visitors playing *Hyperbolic Pong*. Right: A close up of the screen, showing some of the geodesics, the bats and the ball and playing field borders.

books was selected as a reference to his work and interests, his life within and without the research world. A reading chair and table were set up, with a pile of specific books on the table, inviting visitors to sit down and read further within parts of the character’s life that attracted them. In the corridor outside the office was the game *Hyperbolic Pong* (Figure 2), a three player version of the classic computer game, played upon a hyperbolic surface using the Poincaré disc model. The playing field is a circle, the lines followed by the ball are the geodesics of the hyperbolic plane (for playability, we did not use the hyperbolic metric in the game). This piece was used to act as an entry point for gamers and to introduce some ideas about non-Euclidean geometry, continued in the scientific presentation.

The presentation was a repeating series of electronic slides discussing the structure of space, non Euclidean geometry, emergence of spatial properties, quantum physics and the possibilities of creating warp drives and (forward) time travel by manipulating random graph processes. The presentation moved from well-known and accepted mathematical and physical ideas into the realm of science fiction. Visitors used the laptop to browse within the presentation and read and explore at their own pace. The presentation acted to a large degree as the glue between other elements of the room.

An interactive display of random graphs used a hand controller to change  $p$ , the edge probability, allowing the public to see the way that a dynamic random graph changed its topological properties as  $p$  was varied. This falls within the framework of contemporary scientific communication.

A small monitor with headphones showed videos of experiments exploring the possibilities for time travel. In these sequences the main elements of the time travel process were introduced, so that their presence in the room and their activity could be more readily interpreted by the visitor. The time machine used in the video was present in the room along with various destroyed (not all experiments were successful) and delayed watches. Time difference between two watches was used to show that the watch inside the machine has undergone a time shift [4]. Recognisable elements of the time machine such as the three lights and the time flow disjunction display, combined with savagely glowing light (seen in the videos) and sound effects from beyond the door, implied that a larger version of the time machine was running in the adjacent room.

A clock radio on the window frame broadcast a staged talkback science show with a nationally familiar format. The interviewee was an independent scientist discussing life as an independent researcher. Various characters were integrated as callers, introducing other points of view into this discussion.

A continuous flow of new emails was shown on his computer screen, as was a half written private letter; a fax machine in the room constantly received faxes from business and science colleagues. Every few minutes an answering machine responded to a call, the visitors heard the message as it was left. Some dealt with issues of scientific seriousness and non institutional researchers, others were asking about certain matters

relating to his family farm in Namibia. Namibia was further referenced in some of the handwritten letters lying upon the table, where aspects of his personal life were portrayed, including the fact that he was childless and, as his clothing suggested an age around 50, he was likely to remain so. This topic was underlined in various discussions, including the radio show, and in a large mathematical genealogy. One implication was that Kadigan regarded his ideas as his authentic children, offering him a motivation to travel into the future: he wanted to see what had come of his mind-children. Was it all a great mistake? Only time could tell, so he wanted to travel in time to see whether the rejection he received from academia was justified.

## Public Responses and Analysis

We were pleasantly surprised by visitors' eagerness to dive into the world of Kadigan: to open drawers; browse through papers; and read his letters. People expecting something quite dry wished they had brought their children or returned bringing friends. Mathematicians were unanimous that the room was authentic and communicated an undistorted representation of mathematicians' everyday life. We can say that it was a success on the level of audience engagement. This section will investigate some of the problems we saw and explore the ways that such a mathematical PN might be extended or applied in other contexts.

We were surprised by the extent to which people were willing to browse through papers on the table, explore files on the computer and use the offered reading chair to read books. General computer literacy implies that the computer should be well-filled with data that the character uses and refers to. Similarly all referenced telephone number must go somewhere "safe." This is the extension of the problem mentioned above; we must allow for (almost) all possible actions and investigations by the public.

The reading chair was surprisingly popular as it offered interested people a place to read through related literature in more depth. This suggests that PNs can be used as effective science and mathematical communication tools which prompt audiences to investigate and respond to more traditional science media. Following the Long Night of Research complaints were made, that in other exhibits there was a lack of "story telling" and little communication about the research process. Most displays talked about equipment and results, but not about the *practice* of research. We feel *20 Seconds into the Future* managed to address precisely these two problems and could be extended. This requires not only researchers but also a group of arts practitioners to make the entire environment coherent and cohesive; a truly interdisciplinary project.

## Conclusion

This paper has described the motivations for, the constraints and the composition of our PN investigating mathematical research and its communication. While we generally feel that the project was a success, we see several possibilities for extending it, as well as ways in which such PNs can be used in a mathematics and research communication role.

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