



**HAL**  
open science

## Serious Games & Cultural Heritage: A Case Study of Prehistoric Caves

Damien Djaouti, Julian Alvarez, Olivier Rampnoux, Vincent Charvillat,  
Jean-Pierre Jessel

► **To cite this version:**

Damien Djaouti, Julian Alvarez, Olivier Rampnoux, Vincent Charvillat, Jean-Pierre Jessel. Serious Games & Cultural Heritage: A Case Study of Prehistoric Caves. 2009 15th International Conference on Virtual Systems and Multimedia (VSMM), Sep 2009, Vienna, Austria. pp.221-226, 10.1109/VSMM.2009.40 . hal-03578828

**HAL Id: hal-03578828**

**<https://hal.science/hal-03578828>**

Submitted on 27 Feb 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NoDerivatives 4.0 International License

# Serious Games & Cultural Heritage:

## A case study of prehistoric caves

Damien DJAOUTI\*\*\*\*, Julian ALVAREZ\*, Olivier RAMPNOUX\*\*,  
Vincent CHARVILLAT\*, Jean-Pierre JESSEL\*

\*IRIT, Toulouse University (France), \*\* CEREGE, Poitiers University (France), \*\*\* LARA, Toulouse University (France)  
[djaouti@irit.fr](mailto:djaouti@irit.fr), [alvarez@irit.fr](mailto:alvarez@irit.fr), [olivier.rampnoux@univ-poitiers.fr](mailto:olivier.rampnoux@univ-poitiers.fr), [charvillat@irit.fr](mailto:charvillat@irit.fr), [jessel@irit.fr](mailto:jessel@irit.fr)

**Abstract**— The creation and development of multimedia devices destined for the general public pose many questions for designers. In this article we present two multimedia applications – a Serious Play and a Serious Game – which were part of an experiment performed in 2006. This article will present both devices designed specifically for the promotion of a prehistoric heritage site – the Gargas caves – and describe how they were received by the general public. The aim of this task was to identify the added value of video play and video game items within the context of everyday use by the general public, and particularly by children.

**Keywords:** *Serious Games, Serious Play, Multimedia, Virtual environments, Heritage.*

### I. INTRODUCTION

According to a previous definition, Serious Games are “Games that do not have entertainment, enjoyment or fun as their primary purpose” [4]. Of these games, several titles were released to deal with “serious matters” that related to cultural heritage. The most popular examples come from the 90’s “Cultural Entertainment” wave, such as *The Amazon Trail* [MECC, 1993], *Museum Madness* [Novotrade, 1994], *Versailles 1685* [Cryo 1997], *Egypt 1156 BC Tomb of the pharaoh* [Cryo, 1997] *Byzantine: The Betrayal* [Discovery Channel Multimedia, 1997], *China the Forbidden City* [Cryo, 1998], *Pilgrim Faith As A Weapon* [Axel Tribe, 1998], *Vikings* [Index+, 1998] or *Rome: Caesar’s Will* [Montparnasse Multimedia, 2000]. Alongside these games, explicitly designed to broaden knowledge, some teachers are “hijacking” commercial “off-the-shelf” videogames to use them for educational purposes, as discussed in [9], [8] and [11].

Apart from these examples involving titles released by the entertainment industry, the rise of the “Serious Games” movement has led to a new genre of projects. Instead of games released solely by entertainment software editors anticipating eventual “sponsorship” from Institutions, the latter are now playing a key role in the production of games. Indeed, from becoming involved in the development process to taking an active role in the publishing, Institutions are now showing a growing interest in “Serious Games” [10].

This article presents a Serious Game project which was focused on cultural heritage. First of all we will introduce the subject of this project - the “Gargas caves”, a prehistoric site located in France. To celebrate the 100<sup>th</sup> anniversary of its discovery, two Serious Games were designed and demonstrated

by its managing Institution. The second part details the design process of these applications, from game design to technological choices. Finally, we will discuss the results of a field experiment conducted during the first day of the public release of these games. From this extensive case study, we will endeavour to extract clues towards the design and use of Serious Games in promoting cultural heritage.

### II. CONTEXT

Public access to prehistoric sites, especially ‘closed’ ones such as caves, is often restricted. In the first place, some of these sites are hardly accessible without special equipment, and creating the infrastructure to allow safer and easier access is not always possible. Secondly, lighting such a site without damaging its features is often challenging, since mural paintings deteriorate by exposure to light and heat. Finally, the increase in human activity may cause a variation of thermal conditions and humidity that can irreversibly damage the walls (such as the development of moisture).

However, there is a sustained public interest in discovering these sites. In such a context virtual applications can prove very efficient by providing an experience close to, or even richer than, a real visit. And this gave the cultural Institution managing the “Gargas caves” an idea. These caves contain some very rare paintings of stencilled hands and many wall engravings representing animals. Estimated to date from the Gravettian Period (*about 22,000 to 27,000 years ago*), these engraved panels are very difficult to appreciate without the help of an expert. Indeed, multiple meaningful shapes overlap in the same area, which make recognition quite difficult.

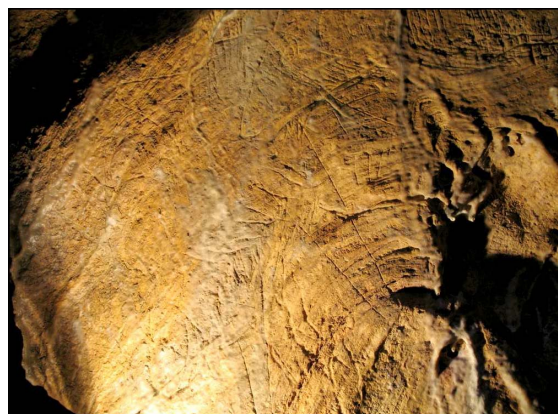




Figure 1. Photo of the rock wall featuring the overlapped engravings outlined in the right-hand diagram.

Hence, the cultural Institution contacted a Computer Science Research Laboratory to create virtual applications to coincide with the 100<sup>th</sup> anniversary celebration of this prehistoric site. Started in 2006, this joint project had two objectives. The first was to allow the exploration of the caves without damaging the actual site. The second was to use the virtual reproduction of the caves as a way of enhancing the experience of the visitors, by providing them with an insight on how to recognise the overlapping figures engraved in the rock walls.

The project started with the accumulation of data directly from the source. The Institution allowed our research team to capture a large range of natural photographs showing a group of engravings from different angles and illuminated conditions. In order to assist the deciphering of these engravings, drawings made by the prehistorian, Professor Claude Barrière [1], were at our disposal. These resources were used as a basis to start the design process of the Serious Game for these engravings.

### III. DESIGN PROCESS

Whether related to entertainment or serious purposes, several kinds of game are identified by classification and definition studies [6].

An initial distinction is usually made between two forms of “play”, as introduced by [3]: a first form, framed by a defined set of rules, called ludus, and a more free-form kind of play called paidia. In fact, these two forms are directly related to the definition of the words “game” (ludus) and “play” (paidia), regardless of associated material (board games, card games, toys, etc.).

From a digital game perspective, these two forms of play also exist, and are related to the kind of rules used to design the game. Sim City [Maxis, 1989] is a common example of a “play-based” (or “videotoy”) kind of videogame, while Pac-Man [Namco, 1980] demonstrates a “game-based” example. The main difference between these titles is that Sim City lacks any rule-defining “goals”: it cannot be “won” or “lost”. Furthermore, as Sim City sets no goals to achieve, the performance of the player is not assessed by this videogame, whereas Pac-Man sets goals (eat all pills and avoid ghosts) which are used to provide positive (increased scores) or negative (life loss) feedback to the player.

Thus, a videogame lacking “goals” is considered to be “Play-based”, while a videogame featuring “goals” is considered to be “Game-based”. Further discussion on the paidia / ludus videogames distinction can be found in [7].

During the design process on the Gargas caves project, these two forms of play appeared equally interesting to our team. Indeed, the open structure of “Play-based” videogames facilitates their integration into public presentations, as a demonstrator can easily adapt the game to public requests. However, “Game-based” structures have the advantage of embodying goals to guide the players, who become autonomous in their experience of the game.

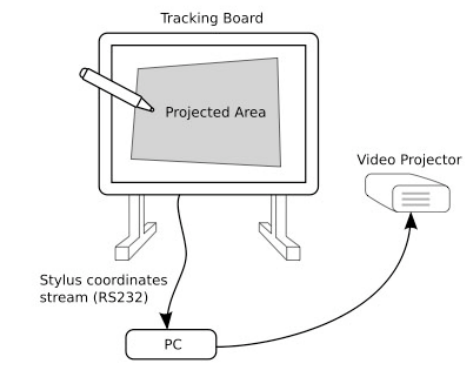
It was eventually decided to split our team into two “sub-teams” in order to design two titles: a “serious play” relying on a play-based structure, and a “serious game” built on a game-based one. Both games aim for the same “serious purpose”: to introduce the audience to how scientists discovered and identified the wall engravings a century ago.

#### A. The “Serious Play”

Based on a “play-based” structure, the first application was designed for public display with a human demonstrator to guide the player. To highlight the “spectacular” dimension of this game, an unusual input/output device was chosen: an interactive board.

Tangible interfaces are often suitable in a context such as this. The use of a common device for interacting with the system (in this case a simple stylus and a board) often shortens the learning stage and makes users more at ease with the system. This system is composed of a tracking board, a video projector, and a standard Linux-based PC. These elements are very easy to set up and adapt to different practical setup conditions, as opposed to other augmented and virtual reality systems that use more complex display and interaction devices. Further details of the technical specifications of this game are presented in [5].

The game itself presents the players with the original photo of a rock-wall featuring overlapped engravings. Using the electronic stylus, the player can draw directly onto the tracking board, and attempt to outline each figure, just as the scientists did a century ago. As no instruction is incorporated in the game, the role of the demonstrator is to guide the player by giving him or her “live” feedback..



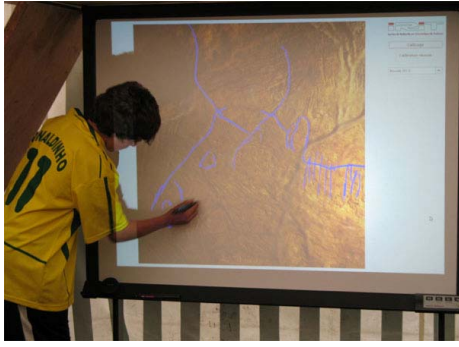


Figure 2. Diagram of the device and a child playing with it during the public presentation.

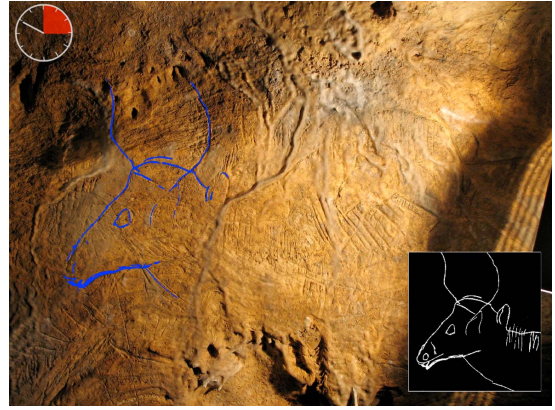


Figure 3. Picture of a child playing on the application and screenshot of the game itself.

For the first application, the design team clearly favoured the “spectacular” dimension through the use of a technological device that is little known to the general public: the interactive board and electronic stylus. Its main advantage is to be able to display a large image, allowing many people to observe the game at the same time. Designers also wanted the player to feel as if they are actually a real scientist working in the caves to identify the engravings. This “Serious Play” targets a wide audience, i.e. anyone able to draw on an interactive board.

### B. The “Serious Game”

The second application relies on more traditional input/output devices, as it is displayed on a standard computer with a mouse and a 19” LCD screen. At first sight, this game looks just like the first game. The player is presented with the same rock wall featuring overlapped engravings. The way to interact with the game is also similar: using the mouse, the player can outline figures hidden on the wall. However, as this application is built on a “game-based” structure, it also features a stated goal used to evaluate the performance of the player. As this game is intended to be used without the assistance of a human demonstrator, a picture of an outlined figure is shown to the player throughout the whole play session. He/she must then analyse the rock wall and retrieve the complete figure in a limited amount of time in order to win.

For the second application, the design team chose to give priority to the “playful dimension” by using videogame-like features, such as setting an explicit objective (to outline the animal shape shown), setting constraints to test performance (time limited challenge) and providing a quantifiable outcome (“win” or “lose”). Their second intention was to include an educational dimension. They wanted the player to experience the difficulties faced by the real scientists in identifying the various animal engravings on the walls of the Gargas caves. This “Serious Game” is aimed at a young audience of 5 to 10 years.

Given its “game-based” elements (goals, time-limit...) this second application is designed to complement the first one. Indeed, both applications were presented during the 100th anniversary celebration event. Whilst the “serious play” was the more “spectacular” having a public demonstrator, the “serious game” was available to be used freely by any visitor who wanted to sit down and play. In order to highlight the differences in the public reception of these two games, a qualitative field study was conducted during the whole event.

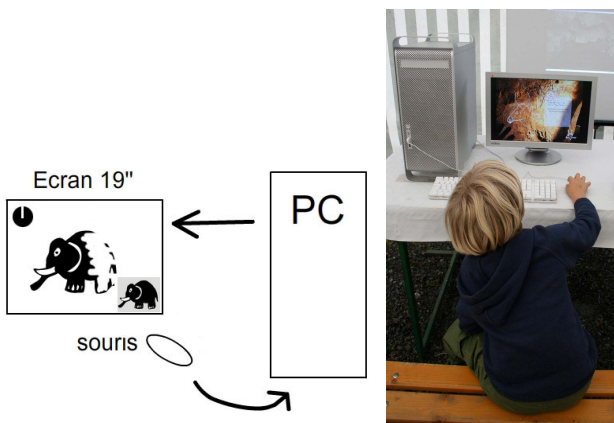
## IV. FIELD STUDY

Our research team designed and developed these two applications. However, due to time constraints we were not able to organize regular test sessions prior to their public presentation. In order to gather some qualitative feedback on the project, we set up a test session during the actual presentation to the public. The visitors who came to the 100th “Gargas caves” anniversary were used as guinea-pigs to assess the effectiveness of the two Serious Games. We first recorded on camera people playing the games, and we then proceeded to semi-guided interviews with them.

Below is a summary of the main observations relating to the use of each game.

### A. The general public’s reaction to the “Serious Play”

The following observations were made during the field study on the first application, which is built on an interactive board and requires the presence of a public demonstrator.



At the beginning of the public presentation, approximately twenty elderly people (many of the visitors were elderly) took chairs and sat in a circle around the board. At first they sat quite far away from it, but started to move closer and finally right in front of the demonstrator. Other middle-aged visitors then volunteered to try the “Serious Play” application. According to the spectators, watching the spectacular images created by the people playing was like watching an interactive artistic performance. This dimension was reinforced by the high number of players who wanted to draw on the interactive board, up in front of an audience.

For the many players (both children and adults) there was no technical barrier that prevented them from fully enjoying the application. They felt it was as easy as drawing on a regular chalkboard, but with much more impressive results.

The only problem encountered by players was caused by people blocking the projector light, which cast their giant shadows onto the board and disrupted the experience. The demonstrator was obliged to prevent people from getting too close to the board, and to make them wait for their turn to play. He also played a central role in ensuring that everything went smoothly. Apart from the technical management of the application, he explained to players what they were trying to outline. He was also able to guide them using his own stylus, which drew lines in a different colour. More than just a demonstrator, he actually enriched the play experience with his scientific knowledge of the caves, such as the methodology used by Professor Claude Barrière to analyze the engravings.

We then interviewed the volunteers who actually played the game. Among them, several teenagers explained the purpose of the game to us - drawing the animal figures - and emphasized how much they enjoyed it. They were also able to give us the names of the animals they had outlined on the interactive board.



Figure 4. For the first application, the elderly sat down to watch the presentation

Taking into account the aims of the design team, the reception of this game by the public was very satisfactory. The reaction of both the spectators and the players appeared to match the objectives of the original designers. The public was attracted by the “performance” dimension of the application, as shown by the spontaneous circle of spectators formed by the older people. However, the application seemed to fail in its aim to make the younger players aware of the hard and meticulous work actually carried out by the scientist who discovered the caves. This observation seems quite logical when one considers that these younger players still lacked the ability to react to the situation. Consequently, they focused on the names of the animals represented by the outlined figures.

As a final observation, children were the most enthusiastic players of this “Serious Play” application, as they particularly enjoyed the whole “play” experience of outlining animals on a giant board.

#### *B. The general public's reaction to the “Serious Game”*

For the second application, the ‘Serious Game’, the organizers placed a bench in front of the computer and invited users to sit and play. One or two parents supported or guided them. They sat next to the player or remained standing behind him. There were fewer users than for the “Serious Play” application and they consisted mainly of children between 4 and 12 years old. There were few spectators and they did not stay for very long to watch the children play. Even though the scenario of the “Serious Game” was similar the “Serious Play”, the application was not as “spectacular” as the multimedia board. Although no demonstrator was present to explain how to use the “Serious Game”, the majority of users were able to explore and understand the game mechanics by themselves. According to its graphic design, this application relies on cultural conventions already familiar to young people. Indeed, the latter have a natural instinct for screen applications and have no concerns or hesitation in handling multimedia applications. Moreover, all children tried to complete the game before leaving the bench. When some of them had difficulty in achieving the goal, their parents took control of the mouse to help them win. When the children won by themselves, they often played again choosing another animal to work on. We observed an average play time of 4.5 minutes.

When the children were asked to talk about the “Serious Game”, they described only the fun challenge: *“In this game, you have to trace the shape of the animal before the time is up!”*. The children never gave the name of any animal they had to draw. Nor did they ask any questions or make any comments about the difficulty the original researchers must have faced in deciphering the animal engravings. These aspects are more often broached by parents when observing their children as they are less immersed in the game and have a greater capacity to distance themselves intellectually.



Figure 5. Parents watching or helping their children when they use the Gargas Caves ‘Serious Game’.

With regard to what was expected of the “Serious Game” application the design team noted that it achieved its public target. The fun aspect was also perceived by the public, though we observed that younger children found the multimedia board more attractive.

The educational dimension was more easily promoted when a demonstrator guided the children. The “spectacular” dimension was not envisaged in this game as a video projector was not installed. The reaction of the public conformed to what was expected at this stage.

## V. CONCLUSION

We have set out an approach using two digital applications for the presentation of an authentic prehistoric site to the general public whilst preserving the conservational conditions of the heritage site. This development was made possible by collaboration between researchers and by the creation of an

innovative game which took into account the context and the original scientific materials. The opportunity to promote the heritage site through a “Serious game” presented an imaginative prospect that should be followed through. However, it also required a rigorous procedure both from the scientific point of view as well as from that of the “Serious Game” design. The study refers to the first stage of development of a heritage site and it has certain limitations of which we became aware when the results were analyzed.

On the one hand, the presence of a demonstrator who accompanies the player in the use of the device allows the player to consider its use whilst playing. Therefore when designing a “Serious Game”, it is important to think about the mediation which allows the player to be accompanied in the activity, according to Vygotsky [2]. The joint activity thus proposed enables the child to be accompanied in his learning. This accompaniment by a “demonstrator” would enhance the serious message carried by a Serious Game.

On the other hand, the initial wish to combine several objectives within the same game resulted systematically in one message imposing itself over all others. In neither application, were we able to make the players and the public aware of the difficulty of the paleontologist’s work in locating and identifying the animals in the rock paintings and engravings. This message was even more scrambled in the second application in which we had incorporated a timer which took the children’s attention. Incorporating secondary objectives into a Serious Game which do not support the main message is a major limiting factor in the quality of the message delivered. In this case, it would undoubtedly have been wiser to relate the timer to the message that, when trying to decipher the outlines of the various engravings, the scientists were obliged to limit their use of strong lighting because of the risk of deterioration in this prehistoric heritage site.

Finally, when considering the peculiarity of the Gargas caves, and more generally any historical heritage site, it is necessary to incorporate a “spectacular” dimension into the Serious Game so that a lasting impression is left in order to reinforce the message. The discovery of the caves is “spectacular” for the scientist in his research and also for the visitor, thus the Serious Game must also be ‘spectacular’. The interactive board device achieved this objective.

A final observation we would make is to propose that Serious Games should use similar game supports and interfaces so as to be able to compare the results of the actual design concept of the play element.

## ACKNOWLEDGMENT

The authors would like to thank Christophe Dehais and Jean Conter. They also extend their thanks to the anonymous examiners and their constructive observations which enabled the authors to explore their research in greater depth.

## REFERENCES

- [1] G. Barrière, C. (1976). *L’art pariétal de la grotte de Gargas* (vol. 1), France, Oxford Press.

- [2] Brunner J. (1996), *The Culture of Education*, USA, Harvard University Press.
- [3] Caillois, R. (1961). *Man, Play and Games*. USA, Free Press of Glencoe.
- [4] Chen, S., & Michael, D. (2005). *Serious Games: Games that Educate, Train and Inform*. USA, Thomson Course Technology.
- [5] Dehais, C., & Charvillat, V., & Conter, J. (2007, April). *Interactive augmentation of photographs depicting prehistoric engravings*. Paper presented at the Euromedia 2007 conference, Delft, The Netherlands.
- [6] Djaouti, D. & Alvarez J., (2009). *Serious Games: From definition to classifications*, to be published.
- [7] Frasca, G., (2003). *Simulation versus Narrative: Introduction to Ludology*. In Wolf J.P. & Perron B. (Eds.), *The Video Game Theory Reader*, USA, Routledge.
- [8] Gee, J.P. (2003). *What Video Games have to teach us about Learning and Literacy*. USA, Palgrave Macmilan.
- [9] Prensky, M. (2001). *Digital Game-Based Learning*. USA, Paragon House.
- [10] Sawyer, B. (2007, March). *The "Serious Games" Landscape*. Paper presented at the Instructional & Research Technology Symposium for Arts, Humanities and Social Sciences, Camden, USA.
- [11] Shaffer, D.W. (2006). *How Computer Games Help Children Learn*. USA, Palgrave Macmilan.