



Report cognitive experience with VR

Project: Reviving, Boosting, Optimising and Transforming European Film Competitiveness - REBOOT

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Description	This document in two parts details how to explore the impact of new audiovisual technologies on young audiences. The first part draws on an experimental study with students in two masters programs, all in all



	around 50 people. We organise both, viewing sessions of different immersive videos and other VR products. This provides a practical basis for conducting empirical research in two closely related directions: Researchers examine how two cohorts' students, proficient in MR technologies and those without, prior experience process spatial transitions and complex narratives, through experimental trials involving Head-Mounted Displays (HMDs) featuring filmed theatrical performances. The study employs a comparative analysis of both groups to evaluate mnemonic retention, narrative comprehension, and susceptibility to visually induced motion sickness (VIMS). The findings indicate that the attentional agility inherent in digital content creators represents a strategic asset for the future of the European audiovisual economy. In conclusion, this work proposes frameworks to optimize the ergonomics of immersive scripting while prioritizing user physical comfort. In a seconde phase, by exploring the relationship between cinema and Mixed Reality media technologies (XR - encompassing VR, AR, and MR), this study proposes the model of <i>cinema / XR</i> hybridisation and convergence as a critical avenue for enhancing the attractiveness and competitiveness of European cinema. A comparative analysis of incentive policies across various European and non-European countries highlights the fragmented and insufficient support for this sector in Europe. In response, the UCA team conducted an
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	experimental study employing eye-tracking methods to examine how audiences engage with Mixed Reality content, particularly in relation to perception and spatial information processing. These findings aim to support the hypothesis that <i>cinema</i> / XR hybridisation may present a distinct, and potentially superior, cognitive model compared to traditional cinema. From a media-induced social cognition perspective, the results suggest that strengthening Europe's film competitiveness requires investment not only in hybrid production practices and XR-focused education, but also in the development of individual and collective viewing spaces offering immersive, interactive, and reality-blending experiences targeted at younger audiences.
Keywords	Content Creators in Mixed Reality (MR) Attentional agility - Attractiveness - Competitiveness Mnemonic retention Viewing Ergonomics VR headsets - Head-Mounted Displays (HMDs)
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THE REBOOT PROJECT SUMMARY

This project aims to connect existing strengths, identify and overcome weaknesses, and plan for future competitiveness in the fields of policy, practice and experience. More concretely, the project's objectives are, firstly, to explore the long-standing strengths and pervasive gaps in European competitiveness and policies for competitiveness. This includes ways of measuring, analysing and evaluating the impact of policies and strategic pathways. Secondly, the project aspires to actively prepare for future audiences by exploring audience preferences and their generation, as well as modes of film content production. The latter are elements which today's youth will engage with in the coming decades as makers and consumers, as well as industry and policy leaders. Therefore, the consortium interrogates not only "what is" but also "what has been" and "what will be" from fresh perspectives.

REBOOT's ambition is to provide a full set of knowledge of the European film industry, which maximises its existing strengths, combined with strategic and tactical dimensions of action to optimise the potential held in European youth publics, understood both as emerging audiences and as citizens. Specifically, the ambition of the project combines several dimensions, which reinforce each other but are listed separately for analytical purposes (and in no particular order): a) increasing support for young people's engagement with European film; b) strengthening the place of the European Union (EU) in the global audiovisual economy, particularly in light of the rise of video on demand (VoD); c) supporting cultural diversity in the EU film industry; d) addressing the need for a different understanding of competitiveness and relevant indicators in this context; and e) recognising and supporting the importance for the EU of film and, more broadly, of the cultural and creative sector as a geopolitical asset.



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1 DELIVERABLE ABSTRACTS

Conducting research with people, despite their age, comes with specific ethical responsibilities for researchers. The following is a discussion of the conceptual and practical measures taken to address some of these ethical issues during the design and implementation of research with minors and reflect the complexity and diversity but also common standards across different institutional settings in the countries involved. Some elements are here as to be expected, whereby researchers seek institutional clearing for research and set up an appropriate context for research subjects to provide their consent. Providing informed consent requires that participants have received adequate information about the study, which has been conveyed in a corresponding language. Additionally, researchers carry the responsibility to respect participants' boundaries of voluntary participation, which includes their right to withdraw anytime they wish, without facing any negative consequences. The ethical complexities become even more challenging when research involves minors. Children younger than 15 years are considered as a "vulnerable group," while they are still developing both physically and cognitively. This report aims to reflect, collect and present a comprehensive summary of key factors and processes on conducting research with children and young people, which derives out of collective work with 108 focus groups with a total of 607 children and young people and 4.453 survey responses from young people ages 12 to 24, from nine countries: Austria, Belgium, Finland, France, Greece, Italy, Poland, Spain and Türkiye. We begin with an overview of current understandings and sensitivities across various disciplines while doing research with children. We then address some important issues involved in conducting research with children as they transpired in the project and finally include researchers' direct reflections on the data gathering process. We conclude with an overview and thoughts for further consideration in projects.

2 DOING RESEARCH WITH CHILDREN

As part of the task 5.3.1 "Study of the cognitive abilities of young content creators in Mixed Reality," the role of UCA research team is to explore the intricate relationships between the competitiveness of film production, especially that of the EU, and young creators accustomed to emerging communication technologies and especially Mixed Reality technologies.

These latter, have become very important in the contemporary world, are unfolding along diverse vectors of industrial and commercial progression, encompassing the realm of video games, remote learning, metaverse communication, urban scenography, intelligent signage and, ultimately, the aforementioned developments are culminating in the media of individual and collective mobility. To link the issue of cinema competitiveness to the development of new cognitive abilities in young



populations, we develop an argument that goes from the management of attentional points in the moving image, through the question of the attractiveness of cultural practices and by this way the question of the competitiveness of film production, especially that of the EU. In order to go beyond the ephemeral nature of contemporary societal opinions and trends, often susceptible to commercial influences and fleeting fashions, an experimental methodology of attention point management analyses was opted for, to assess the cognitive processes underlying the creative process and the spectatorship, thereby accounting for the success or failure of innovations in the realm of creative media.

The experimental groups consist of young people who are used to handling Mixed Reality technologies, in contrast to young students who have no experience in this field. In parallel, we are carrying out a series of cognitive tests that compare the viewing of immersive narrative productions in the Virtual Reality headset, with reference to the natural perception of the same scenes. This approach is based upon the seminal work of Shimamura, a prominent researcher and precursor in the field of kinematic cognition, who has developed methods to mitigate experimental artifacts generated by different media languages, including film language. Our cognitive research indicates that young designer of content in Mixed Reality possess a unique ability to process complex spatial transitions (notably “teleportation” between 360° scenes, demonstrating superior spatial orientation agility) more efficiently than the general population. This “attentional agility” is the key to a new era of European competitiveness.

The second part of the deliverable is going to describe the achievement of the Task 5.3.2, an experimental study of the refection practices of content in Mixed Reality by young audiences. This report presents the findings of research conducted by the Université Côte d’Azur (UCA) as part of the Horizon 2020 REBOOT (Reviving, Boosting, Optimising and Transforming European Film Competitiveness) project. It explores the relationship between cinema and Mixed Reality media technologies (XR - encompassing VR, AR, and MR), with a focus on how the hybridisation and convergence of these domains could represent a key strategy for enhancing the attractiveness and competitiveness of European cinema. The study combines comparative policy analysis of state support mechanisms across a selection of European and non-European countries, in order to assess current incentive frameworks and identify gaps and opportunities for promoting innovation in the audiovisual sector.

To further investigate this convergence, the UCA team undertook an experimental study using eye-tracking technology, analysing how users perceive and process spatial information when engaging with XR content. The results suggest a distinct mode of cognitive engagement within immersive environments, pointing to a potential cognitive advantage over traditional film formats. These findings demonstrate how emerging technologies are reshaping youth engagement, attentional



dynamics, social interaction, and immersive cognitive experiences. In this context, the ability to influence and structure interactive media consumption becomes a critical determinant of global competitiveness.

Building on these findings, the report recommends a series of policy measures to support the integration of immersive technologies in the cultural and audiovisual sectors. These include expanded funding for XR-based content creation and education, with particular emphasis on involving younger generations in creative production processes. The report also calls for the harmonisation and standardisation of public and private funding frameworks across Europe. Establishing a more coherent regulatory and financial ecosystem would facilitate the development of immersive storytelling, promote interactivity and narrative innovation, and strengthen Europe's position within the evolving global media landscape.

3 DELIVERABLE CONTEXT

3.1. Preliminary considerations

The REBOOT programme must undertake a comprehensive audit of the current situation and dynamics of European cinema. Deliberately oriented towards the future, its primary objective is, among other things, to provide compelling arguments and evidence-based insights to inform the decisions of future experts responsible for distributing European funding for cinematographic creation. It aims to offer convincing elements regarding the progression of the cinema-related activities sector, spanning the entire value chain, encompassing elements from conception, through production and distribution, culminating in audience engagement and the fostering of a new cinematographic culture in the broad sense. These imperatives stem from the foundational documents underpinning the origin of this project.

The European authorities assume a role as instigators, with the potential to exert influence over the creative sector of reference, through the implementation incentive measures appearing under the common denominator of proactive strategies.

Our consortium comprises 12 research teams, each bringing their unique expertise to the task of diagnosing present events and future trajectories of European cinema within the context of rival industries. Developing a fair vision of European cinematography implies to adopt a multifaceted approach that transcends mere comparative analysis with other industries. Instead, our research will delve into the complexities' intercultural exchanges, both on the Old Continent and on a global scale, to identify emerging trends and patterns that are reshaping the cinematographic landscape.



Our horizon then opens onto the ecosystem of European cinematography grappling with its competitors and against a backdrop of currents running through globalised culture. It is the latter which will provide plausible observation criteria for our study.

Since the late 90s, it has widely been acknowledged that the most significant and profound shaking in world culture comes from the digitalisation of creative practices and communication fields. Therefore, one of the most important things to investigate within REBOOT programme will be the interplay between cinema and the digital technology sector.

3.2. Cinema and technology of attentional agility

Since its inception, cinema has maintained privileged links with the emerging industries of the 19th century. Enabled by advancements in chemistry, optics and mechanics, cinema took advantage over the 60-year-old medium that was photography, positioning itself as a creative response to the industrialisation of individual and collective mobility of societies during the colonial era. Additionally, cinema has been united with parallel development in life and human sciences, including physiology, ethology and psychology.

Technological development therefore emerges as the primordial vector of the dynamics of cinema. Its stages mark out the successive phases of development, of the narrative techniques of the film medium and of the socio-technical devices associated with it: industry, cultural policy, art critique, the consecration instances, training, education and spectator association movements. Since the early 2000s, cinematographic production has undergone a major global redistribution. The United States has gradually lost its dominant position to the benefit of emerging economies, particularly in Asia and Africa. European countries have managed to maintain a strong position, but only when considered collectively.

This phenomenon has been further amplified with the advent of smartphones and the proliferation of web-based video content, particularly in the domain of mobile formats. Since 2007, a noticeable shift in cinematic practices has come to the fore. The focus has expanded from traditional film to video-film, with increasing attention to the cognitive experiences these productions generate in audiences.

A new phase of evolution, if not a revolution, is now being observed, characterised by the appearance and democratisation of 3D video and 360° spherical imaging. This transformation has compelled the cinema industry to rethink its technological options, notably, departing from conventional 3D and 360° models, encumbered by cumbersome 3D glasses, towards more lightweight and autonomous devices such as autostereoscopic screens, virtual reality (VR) and augmented reality (AR) headsets, and immersive domes. Asian media industries, particularly those in China and Korea, have embraced these innovations



with considerable conviction. In contrast, Europe remains more cautious, reflecting a hesitation between tradition and innovation. This divergence manifests itself in two different approaches: Asian cinema has been observed to blend classical cinematographic techniques with video game interactivity and alternative narratives, whereas European cinema explores new storytelling modes with a view to establishing a thriving genre of 3D and 360° video-film production. Nevertheless, considerable challenges persist. Although technological tools and broadcasting platforms are increasingly available, access to personal immersive equipment among the general population remains limited.

The hypothesis advanced in this study is twofold. Firstly, younger generations must be progressively acculturated to immersive imagery. Secondly, new narrative forms should be developed that move beyond the traditional frontal, mono-screen projection. Instead, the central creative principles should be the management of attention within the immersive environment and the facilitation of spectator-driven interactions, based on individual informational needs. This dual evolution points towards the establishment of a new creative and spectatorial paradigm. Thus, by fostering the adoption of interactive technologies and empowering the next generation of creators and audiences, Europe can play a decisive role in shaping the future of the audiovisual and film sector. Enhancing its capacity to innovate in production, narrative form, and audience engagement is essential to maintaining its cultural, technological, and economic influence. Strengthening these dimensions will help ensure that Europe remains a competitive and influential actor within the global innovation landscape.

Direct and binocular animation, the reversible camera with collective projection by backlight, different films and different speeds of their scrolling, the adaptation of the architecture of the viewing places, the sonification, the different capture and projection formats, the transition from 2D to 3D, aerial imagery, multisensory experiences, immersive capture and display combined with the digitisation of all classic techniques with the emergence of new auxiliary digital techniques such as motion capture and artificial imaging, all these inventions and improvements punctuate the history of cinema as a major cultural phenomenon of our civilisation.

4. PART 1: UNRAVELLING THE PARADOX OF CREATIVE AND SPECTATORIAL ATTRACTIVENESS OF CINEMA

With the perspective of time, it is appropriate to note the existence of a singular moment in the history of the 125-year-old film industry.



Cinema theorists (Bordwell, D., & Thompson, K., 2002) do note a strong and symmetrical relationship between technological innovations and narrative techniques of the genre, but only over the period from the origins until the 1970s. We note that the panoply of means of filmic language remains relatively stable since this last period, which not without reason can be considered as a sort of **apogee of the film**. And if today's creators have nothing to envy of the celebrities from the 70s, the fact remains that, in the opinion of experts, the revolution comparable to the transition between mute cinema and sound cinema has not happened. during the last half century. The improvement in the quality of the image, the scale of the decor or the perfection of special effects accompany the narrative patterns which remain relatively immutable.

Should we compare this stabilization with the stagnation of the narrative techniques of the literary novel from the same period? Some specialists insist on the fact that despite the increase in editorial possibilities linked to new distribution techniques in digital networks, the only new literary trends to appear in the 21st century, autofiction, magical realism, or positive minimalism are in fact only “network” adaptations of narrative techniques already known in the 1970s. The question of similarities between the filmic and literary sectors remains unresolved but it does not concern us here.

In accordance with the intentions of the REBOOT project, we pose questions about the future evolution of the dynamics of cinema.

Will world cinema, and particularly European cinema, find sufficient creative resources to go beyond stagnant narrative genres and will it thus rise to the contemporary challenges that stand before us in the 20s of the 21st century?

Why do we ask this question today when by looking at cinematographic culture publications, such as “Les Cahiers du Cinéma” in France, “Sight & Sound” in the United Kingdom or even “Filmkritik” in Germany, we note the abundance of current topics, which borders on exhaustivity, and which confirms the central position of this media in the European, even global, cultural offering?

This appears to be a paradox: contemporary cinema speaks to us well about the challenges of our world and at the same time this “duty of topics” is rendered, it's the case to say it, in a cinematographic language with a topology which falls below expectations for resolving the complexity and the scale specific to the phenomena of our time.

This aporia stands at the place of questioning that we hope is the most fertile for our research within the framework of the REBOOT program.



4.1. Technological innovation as a lever for cinema's competitiveness

Another difficulty comes from the very status of the technological innovations which interfere with current cinema. If, for example, research on optical sound between 1911 and 1927 (Eugene Lauste, Lee De Forest) directly served the film industry, culminating in the Fox Film Corporation patent, the same cannot be said of recent advances coming from fundamental research and industrial applications in Information Technology.

Here, cinematography, unlike the communications sector, does not play the role of main backer. In particular, the origins of Virtual Reality, involved today in a vast sector of so-called Mixed Reality technologies, first came from military concerns, in the 60s and 70s, to flow during the 90s into civilian applications such as spatialisation and data visualisation (Sobieszczanski, M., 2019), while the most recent patents are most often registered by the gaming, merchandising, guidance of mobility and roaming communication industries, etc.

If some observers (Bergeron, P., 1982) note the existence of related points between cinematography and the industries consuming innovation in the digital sector, especially in terms of thematic inspiration (Bersini, H., 2009), the confirmed facts of technological transfer force us to adopt a more cautious attitude. Indeed, instead of massive transfers, it is rather a timid porosity between the two parallel domains, that we record.

But once again paradoxically, we see that the slightest technological transfer in this field leads to major resonances in cinematographic culture, which is not surprising since these facts are remarkable and noticed. It is therefore not shocking that different cinematography are positioning themselves in the face of these innovations and making them their vector of progress, supported by adapted cultural incentive policies and industrial achievements attested by patents, standards and formats.

This is how South Korean cinematography developed the ScreenX format, distributed viewing equipment in multiplexes in Asia, the USA and Europe and offered facilities to young creators wishing to undertake experiments within the framework of multi-screen and immersive cinema (3 screens at 270°). China promotes another strategy: the state provides aid to creators who work on the hybridisation of cinema and video games, with the assortment of narrative techniques specific to the latter: the intervention of the spectator in the unfolding action, alternative screenwriting, multiplayer experiences, etc. The North American industry is banking on 3D in the IMAX and IMAX DOME standards. Productions adapted to this environment have fluctuated since the peak in 2008, focusing on very lucrative blockbusters, without however developing a broad 3D culture in terms of training creators and educating spectators.



Europe at the level of common central bodies remains quite passive and delegates the issue to national industries. Here we see the necessity for a statistical and systemic study to contextualize certain well-known facts, such as for example the strategy of significant aid that certain Baltic countries allocate to the hybridisation of cinema and Virtual Reality, or the dropper-drip style help provided to digital creation in France by Centre National du Cinéma et de l'Image Animée.

4.2. Research of relevant methodology of research on cinema

To address the double paradox of cinematographic culture we have several possibilities, in particular the one which is most obvious: the conduct of a simultaneous and symmetrical study of the complexity of the problems treated and the topologies of their expression, in the sense of the treatment of space by the geometry inherent in the means of capture/viewing. This study was made for some masterpieces of the 70s, and more especially for the two most emblematic scenes, the finale in "[Professione: reporter](#)" by Michelangelo Antonioni and the torture scene in "Salò o le 120 giornate di Sodoma" by Pier Paolo Pasolini (Sobieszczanski, M., 2010). If the results of the analyses show that the giants of cinema of the classical age clearly announce their desire to escape from the restraints imposed on them by the geometry of the space of the filmic system, in which they are precursors of the new era, as much the folding of space on itself in "Inception" by Christopher Nolan admits the lack of this new geometry, 40 years later...

But, despite this suggestive theoretical result, the method suffers from its speculative nature and its inaccuracy.

Can we undertake a more exact and more formal study, based on considering the follow doublet: the narrated reality and the topology of the means of capture/viewing? To answer this, we must define what the correlation is based on, on the one hand the themes covered and the difficulty thinking their complexity or the status of the facts themselves, of knowledge and interpretations of reality, and on the other hand the narrative structures of different forms of expression: codified gesture, oral storytelling, pictorial and musical techniques, writing, photography, or cinema. In other words: on what set of parameters/variables of the apprehended creatively reality is indexed, as mathematicians would say, the characteristics of narrative techniques and especially those of the art of movement that is cinema?

4.3. Spectatorial cognition – the third term of an experiment

The difficulty of the challenge is immense, requiring a vast and multi-year investigation, poorly adapted to the scientific standards practiced in furtive fields such as cinema.

The solution would, however, come from a third term. We notice that spectatorial cognition is the place of focus of both shared causalities: the spectator thinks of reality with the creator, and it is



towards him, in the gesture of the invention of new cognitive ergonomics, that the narrative means are oriented. Spectatorial cognition constitutes for us the best experimental environment in which the contents and their filmic format constitute efficient and configurable inputs. In this we intend to reconnect with vast studies in kinematic cognition developed since the seminal work of the school of Arthur P. Shimamura (Shimamura, A. P., 2013).

4.4. Experimental method applied to the cognition of young creators

1. Parameterisation by extraction and memorisation of information

Among the characteristics of spectatorial cognition we retain the most basic, those relating to the extraction and memorization of information during the spectatorship of narrated/mediated reality.

2. Parameterisation through the semantisation of environments

From the extraction and memorisation of information, the spectator engages in higher-level processing which makes it possible to construct the complex semantics of the scene of reality represented to carry out intellectual actions such as spatial and temporal orientation or causal deduction and anticipation.

3. Parameterisation by emotional states

As a result of semantic processing the spectator is subject to different emotional states which in turn engages him in spectatorship with renewed potential.

4. The experimental framework – the choice of technological environment

Among the digital technologies interfering with the cinema sector, we believe that so-called immersive technologies present the greatest potential for hybridisation. This trend is particularly observed in imaging in the broad sense and in the field of sound and music.

Our choice falls on the environment of Mixed Reality: Head-Mounted Displays (HMDs) or Virtual Reality headsets.

Thanks to the application of the experimental protocol to different control groups of the populations to be studied, we intend to obtain results that can guide future arbiters of European cultural policies in the matter of hybridization between cinema and digital technologies, and especially immersive technologies.



4.5. Our hypotheses: from the cognitive agility in attention management, to the competitiveness of European cinematography

Hypothesis 1. Hybridization as a catalyst for attentional agility

Strategic institutional investment in technologically hybrid creation (Cinema/Mixed Reality) is essential to developing new cognitive ergonomics for spectators. This hybridization facilitates the emergence of attentional agility - the unique ability to efficiently process complex spatial transitions and multi-point narratives - which serves as a foundational pillar for a new era of European film competitiveness.

Hypothesis 2. Evolution of social cognition and motor Initiative

The integration of immersive digital technologies into cinematic language responds to a required shift in social cognition, specifically regarding spatial representation and orientation. This transition necessitates motor initiative from the spectator, transforming them from a passive receiver into an active agent who chooses points of attention within a distributed narrative. This active engagement enhances the attractiveness of cultural practices and provides a comparative advantage against stagnant traditional genres.

Hypothesis 3. Cognitive optimization through specialized training

The successful implementation of technological hybridization depends on the specialized training of creators and the cognitive education of the public. Experimental evidence suggests that the population experienced in Mixed Reality media populations develop more efficient mental schemas, enabling them to move past basic factual extraction to high-level semantic environment processing and emotional engagement. Cultivating these specialized cognitive skills is vital for strengthening the EU's position in the global audiovisual economy.

Hypothesis 4. Transferable cognitive skills and economic opportunities

The manipulation of immersive imagery and spatialized sound fosters specialized cognitive skills that generate a systemic need for immersion in mediation. This cognitive shift allows for the transfer of narrative techniques and industrial prototyping from the cinema sector to broader environmental media, such as individual and collective media of mobility, thereby creating diverse economic opportunities across the entire media landscape.



Scientific context of our hypothesis

- **The Creative Advantage:** The study found that students trained in Mixed Reality displayed higher confidence in their memory and a superior ability to prioritize their gaze in complex 360° scenes compared to other groups.
- **Cognitive Progression:** While a population unaccustomed to using Mixed Reality technologies initially struggled with symptoms of cyberkinetosis, their cognitive progression and comfort levels improved with familiarity, underscoring the importance of public education in immersive technologies.
- **Strategic Goal:** The REBOOT project uses these findings to provide evidence-based insights for European funding experts, arguing that supporting these new cognitive ergonomics is the key to boosting and transforming European film competitiveness.

4.5.1. Choice of groups

The weighting of results in relation to the characteristics of control groups is the basis of any experimental study. In accordance with the working hypotheses, we will alternate classic groups according to the criteria of age and socio-professional involvement but the greatest expectations involving the third hypothesis, relating to creative training and education, we will put the emphasis on the contrastive study of groups initiated and uninitiated to creative practices in immersive media. The public of two years of the ICCD/CREATES/UCA M1 and M2 master's course will be concerned here.

Elements for the experimental protocol

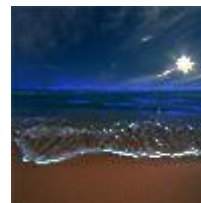
The following elements are the basis for the development of the experimental protocol aimed at measuring the cognitive impact of 360°/270°/3D film creations.

4.5.2. Variational method: the visual parameters

“SCENE-SPHERE/SPECTATOR” SYSTEM

1. Variation of scene-sphere side parameters

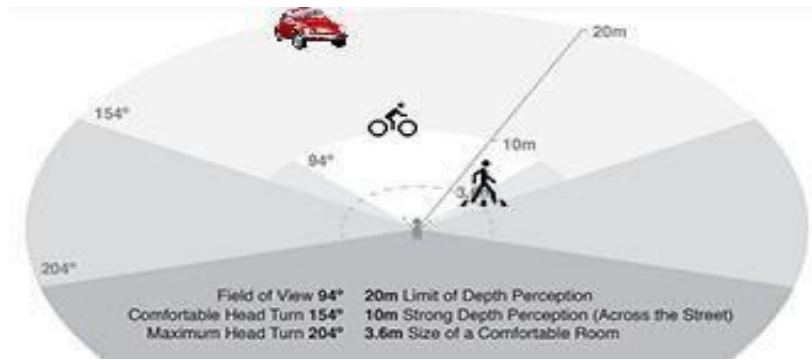
Scene-sphere brightness



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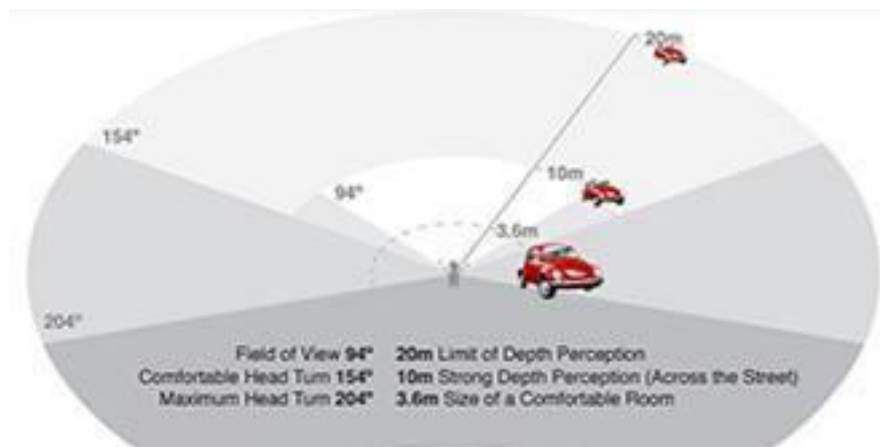


Dynamics of the elements filling the scene-sphere

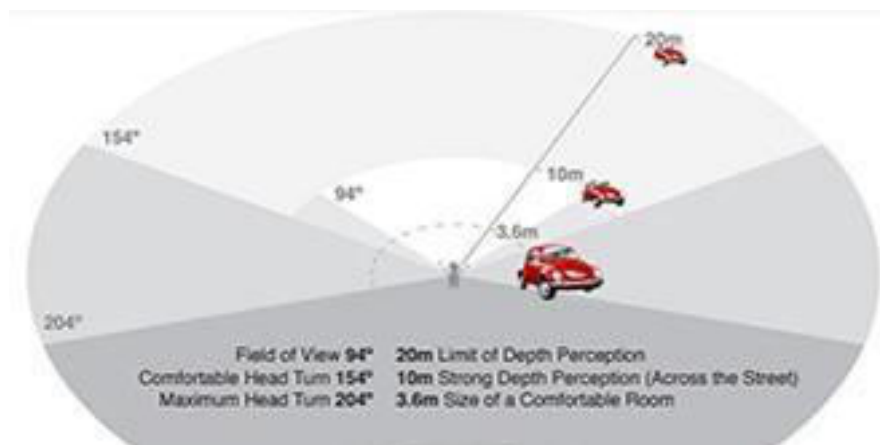


2. Topology/arrangement of visible elements of the scene-sphere

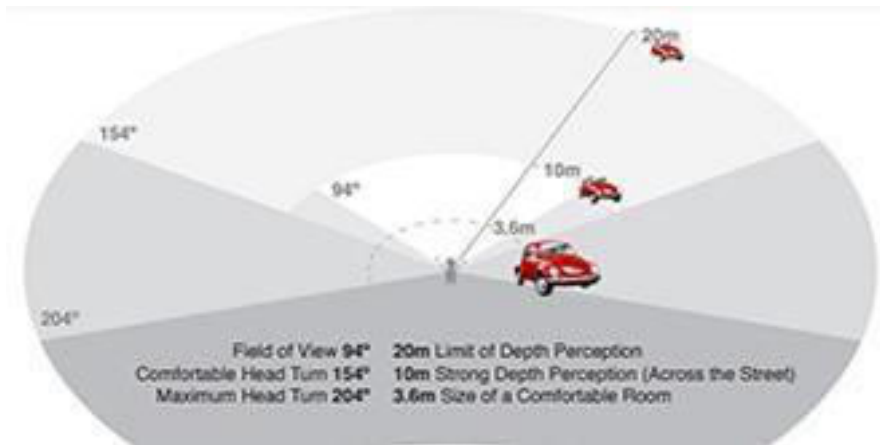
3. Concentric distance: 3.6m, 10m, 20m



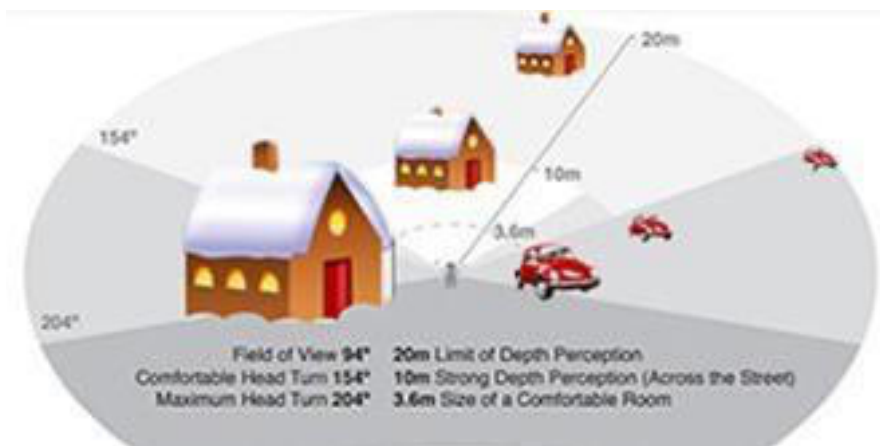
Angular layout



Visual overlay



Density/complexity of visual elements



4. Variation of spectator side parameters

Semantic variations of landscape types: interior, urban landscape, rural landscape, natural landscape, etc.



5. Variations in the emotional ambiances of the scene-sphere



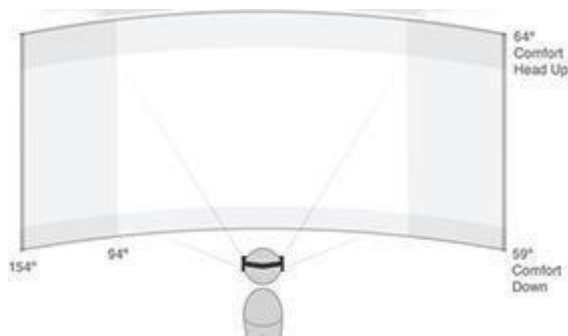
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6. Categorisation of the viewer's visual field

Orientation of the prime-frontality (the portion of the sphere delimited by the physiological visual field without moving eyes and head)

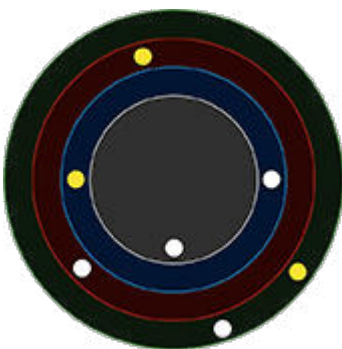


7. Vision motor categories

Frontal vision: prime frontality with eye movement

Peripheral vision: the need of head movement

8. Management/monitoring of attention points



(“In the Blink of a Mind Attention” – Jessica Brillhart, The Language of VR)



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9. Ocular exploration of prime frontality

Ocular exploration with eye motor skills

Exploration with head movement

Exploration with body movement

Quantitative categories of vision

Holistic vision

Detailed view

Interactional categories of vision

Vision of physical interactions

Vision of corporal interactions

Vision of psychic interactions

10. Permutation of narrative

Sequences Antecedence

Posteriority

11. Spectator tasks Search for hidden objects Remembering details

Construction of scene-sphere semantics

Orientation and spatial memory – outlines of the spatial situation of the scene-sphere Anticipation of the posterior sequence

Deduction of the future session of Emergence of emotional states

12. Experimental methodologies of information load and its management detail count measurements

Measures of memorization of narrative sequences

Spatial orientation measurements by freehand drawing

Measurements of skin conductance (electrodermal activity)

13. Population sample categories

A1 - group of students of media technologies - before the first creative experiments

A2 - group of students of media technologies - after their first creative experiences

B1 - group of media studies students without practice, 18-30 years old

B2 - group of people without practice, 30 years and over



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4.5.3. Implementation of the experimental protocol

Natural perception VS 'spherical scene' perception

Description of the experimental protocol: experiments on April 17th and May 16th, 2024.

Wednesday April 17th, 2024: Participants

Semantisation of the environment, situational logic, anticipation and causality.

A sample of 10 students enrolled in the first year of the ICCD and DISTIC courses of the master's degree in Information-Communication at Université Côte d'Azur was selected for this study. This sample included 7 women and 3 men, with 8 of whom were aged between 18 and 25 and 2 between 26 and 35. The students were divided into two groups of 5, one comprising 5 ICCD students (students proficient in MR technologies) and the other 5 DISTIC students (students non proficient in MR technologies), who had voluntarily taken part in the 'natural perception' experiment. Participation was voluntary, and no compensation, either in the form of ECTS credits or remuneration was provided.

1. Organisation of the protocol

The organisation of the experiment was carried out jointly by Marcin Sobieszczanski and Léa Gibilaro. Together, they coordinated the planning of the meeting by communicating the agenda to the participants. In addition, because of her involvement in post-production, Anissa Fahmi was unable to volunteer for the experiments, so she was included in the protocol group. Thus, the data collection benefited from the presence of two facilitators: Anissa Fahmi was in charge of the video recording of the participants' reactions, while Léa Gibilaro was responsible for organising the experiment, clarifying the objectives of the session to the participants, and ensuring that they were achieved. Carole Marconi, who worked on the project, was responsible for setting up the set and supervising the two actors and their costumes.

2. Stimuli

The two actors performed the theatrical scene in front of the audience in two adjacent rooms, creating, as I had envisaged in the script, a physical separation corresponding to the dynamics of the scene. The actors' movements from one room to the other were orchestrated to guide the audience's gaze and emphasise the narrative transitions. In addition, impactful sounds, such as screams and voice changes, were used to reinforce this immersion, allowing the spectator to follow the evolution of the scene even through the physical separation of the actors.

3. Procedure



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The test session took place in two distinct phases. First, each group was taken in turn to the corridor adjacent to the two rooms to observe the scene. Following each observation, the participants were asked to complete a questionnaire lasting around ten minutes. Throughout the experiment, the participants were positioned in the corridor, standing in front of the doors of the two rooms (Fig.1). They were allowed to move from one door to the other in the corridor but were not allowed to enter the rooms. Their only responsibility was to observe the scene carefully. In addition, they were forbidden to communicate with each other from the start of the observation of the scene until all the participants (in both groups) had finished answering the questionnaire. Each group was filmed during the scene so that their behaviour could be analysed.

The semi-directive questionnaire developed for this experiment was of crucial interest insofar as it made it possible to evaluate several key aspects linked to the perception and understanding of a scenarised scene between two distinct and adjacent spaces. Firstly, it provides an assessment of the participants' cognitive ability to grasp and interpret the elements of the environment presented to them. This includes their ability to semantise the environment, i.e. to attribute meaning to the various elements in the scene, as well as their ability to understand the situational logic and to anticipate the events taking place.

Secondly, the questionnaire was specifically designed to examine the quality of the participants' memories, particularly their short-term memory, by asking them to describe the narrative, the characters and the events that took place in front of them. This assessment was essential for understanding how information is processed and remembered in a natural context, important data to compare with how participants processed and remembered what they saw in VR Head-Mounted Displays (HMDs).

In addition, the questionnaire aimed to determine whether participants encountered difficulties in following the narrative between the two rooms and to identify which aspects they found most complex, which can provide valuable insights into the effectiveness of the staging and transition between narrative elements.

Finally, by asking participants to identify the moments they consider most important in the scene, the questionnaire provides insights into the narrative elements that capture their attention and interest the most. Again, this information can be used to optimise the design of immersive experiences to maximise engagement and impact on the audience.

The participants were explicitly informed that there were no correct or incorrect answers, and that the aim of the experiments was not to assess their mental capacities, but to test new approaches to storytelling adapted to immersive devices such as VR headsets.

4. Thursday May 16th, 2024: The participants



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For the second experiment, a sample of 10 students, different from the first experiment, 5 enrolled in the first and second years of the ICCD course of the Master's programme in Information-Communication at the Université Côte d'Azur, and 5 enrolled in the first year of the MSC Sound Design, was selected. The sample was made up of 2 women and 8 men, 7 of whom were aged between 18 and 25, 2 between 26 and 35 and 1 over 35. Following the same model, the students were divided into two groups of 5: 5 ICCD students (group of students proficient in MR technologies) and 5 MSC Sound Design students (group of students non proficient in MR technologies), who had voluntarily taken part in the 'spherical-scene perception' experiment. None of the students received any compensation (ECTS credits or remuneration) for their participation.

5. Protocol group

The roles were the same as in the 'natural perception' experiment.

6. Stimuli

Two videos of the same scene played by the same two actors in the same rooms, filmed in 360° on April 10th, 2024, and lasting 4 minutes and 14 seconds, were played in the VR Head-Mounted Displays (HMDs) (Meta Quest 2 and 3). The participant observes two separate videos in the headset: the video from the point of view of room 1 and the video from the point of view of room 2. In each video, the viewer is given a glimpse of what is happening in the adjacent room by the overlay of a video in equirectangular format at door level.

7. Procedure

The two phases of the test session were broadly similar to those of the first experiment. Each participant in each group viewed the scene in the VR Head-Mounted Displays (HMDs) (Fig.2), followed by the completion of a questionnaire lasting around ten minutes. Their task was also to observe the scene carefully. They were allowed to move their heads and turn around to look around. In line with the previous experiment on natural perception, any form of communication between the participants in the two groups was forbidden from the start of the visualisation until all the participants had completed the questionnaire. We recorded the mirroring of the content broadcast through the headsets to a few participants from both groups, to enable us to analyse their movements as they followed the narration.

The semi-directive questionnaires drawn up for this experiment were designed to replicate the questions posed in the natural perception questionnaire, with a focus on various critical aspects of perception and comprehension of a scripted scene between two distinct boundary spaces. Specifically, it probed the quality of memories and the identification of difficulties encountered.



However, it incorporated inquiries regarding the VR headset device, this time, seeking to establish the participants' prior familiarity with VR headsets, including their frequency and context of use. Secondly, it explored the comfort (or discomfort) associated with watching videos while wearing the headset, as well as the physical and sensory experiences of wearing the device itself. This included an analysis of the influence of the headset's weight and associated symptoms, such as cyberkinetosis or cybersickness, sensory incongruence, and other factors, on users' reception and understanding of the scene. Ultimately, the questionnaire sought to elucidate how these factors shape participants' relationship with the presented scene.

Understanding how participants relate to VR headsets enables us to assess their degree of acclimatisation to the interface and immersion offered by VR headsets. This knowledge has significant implications for assessing the impact of VR headsets on users' reception of presented content, as well as their behavioural responses and interactions, which are often manifested through bodily movements, and allow us to draw a link of causal influence. This also enables the establishment of a correlation between participants' familiarity with the device and the incidence of adverse symptoms, which affect a substantial proportion of users (ranging from 30% to 50%). Notably, these symptoms have been found to vary as a function of demographic factors, such as age and gender (with males comprising the majority of VR headset users), as well as the type of content presented (e.g., rollercoaster versus forest walk) and the degree of visual field stimulation (Attia, D., 2021).

The responses and data collected in this context will facilitate a more nuanced understanding of the ergonomic considerations involved in scripting content for Head-Mounted Displays (HMDs). Once again, it is noteworthy that participants were explicitly assured that their responses would not be subject to value judgments, and that the primary objective of the study was to investigate novel methods of scripting tailored to immersive technologies, such as virtual reality headsets, without attempting to evaluate their mental capacities.

4.5.4. Data collection and analysis

1. Results from April 17th, 2024

When we first analyse the answers to the quantitative questions, we observe a significant disparity in the way in which the participants in the group of students proficient in MR technologies (ICCD students) and the group of students non proficient in MR technologies (DISTIC students) approach the understanding of the scene. In response to the question 'To what extent do you think you have memorised the actions that took place in front of you?', the majority of the group of students proficient in MR technologies (three out of five participants) indicated that they had memorised 'the



majority of the actions'. However, two of them expressed a degree of uncertainty, believing that they had memorised 'most of the actions'. The group of students proficient in MR technologies were more confident, with four out of five believing they had memorised 'the majority of the actions' and only one believing they had memorised 'most of the actions'. Although this difference does not seem significant enough to suggest that the group of students proficient in MR technologies had a better grasp of their understanding of the scene than the group of students non proficient in MR technologies, their responses to the following questions nevertheless confirm this trend. In response to the question 'Did you find it difficult to follow the sequence of events between the two plays?', the trend is confirmed with all the group of students non proficient in MR technologies admitting that they found it difficult 'at times' to follow the narrative. On a scale of 1 to 5, where 1 represents the highest level of difficulty and 5 the lowest, two participants rated these difficulties at 4/5 and three at 3/5. Overall, although these participants felt that they had memorised the scene as a whole, they admitted that they had encountered difficulties. When we asked them to explain their difficulties, their answers were unanimous: following the narrative is difficult when it is distributed between two spaces, even concurrent ones, and with the possibility of moving around.

On the other hand, the group of students proficient in MR technologies were again more confident. Three of them said that they had 'sometimes' found it difficult to follow the events, while two said that they had not encountered any difficulties. On a scale of 1 to 5, two participants rated difficulties at 3/5, one at 1/5, one at 4/5 and one at 5/5. However, it is reasonable to assume that the participant who gave a score of 1/5 made a mistake by reversing the values on the scale. In fact, this same participant had initially answered 'No' to the question on the difficulty of following the course of events between the two rooms, which suggests an evaluation of the difficulty at 5/5. We therefore interpret his answer as an evaluation of the difficulty at 5/5: thus, the group of students proficient in MR technologies includes two participants who evaluated the difficulty at 3/5, one at 4/5, and two at 5/5. Once again, when we asked the three participants who admitted to having had difficulties 'at times' to describe them, their answers varied. One of the proficient in MR participants echoed the feelings of the group of students non proficient in MR technologies, explaining that following the narrative distributed between the two pieces made it difficult to understand (and remember). Another mentioned that the difficulties encountered were not linked to the narrative but to the space itself, particularly the narrowness of the doors, which prevented a view of the events taking place inside the rooms, given the number of participants present in the corridor. The last participant, meanwhile, mentioned the fact of 'maintaining vision between the two rooms and the two actions at the same time'. These last two responses are of particular interest,



as they will later provide opportunities to analyse the reactions, interactions and behaviours of the participants to the scene unfolding before them.

An initial analysis can already be made, with the results revealing several significant trends. Firstly, the group of students proficient in MR technologies showed greater confidence in their ability to memorise and understand the actions on stage than the group of students non proficient in MR technologies. This confidence was reflected in their responses to the question about memorising events, where most of the group of students proficient in MR technologies felt they had memorised the majority of actions, in contrast to the group of students non proficient in MR technologies who expressed more varied levels of confidence. In addition, the group of students non proficient in MR technologies reported more frequent and greater difficulties, whereas the group of students proficient in MR technologies presented more variable levels of difficulty, but overall, less pronounced. The reasons given for these difficulties also differed between the two groups, highlighting a different approach to their experience when observing the scene, and suggesting other elements to consider, particularly concerning the participants' spatial interactions with the scene, which we will analyse last.

Let's now look at the answers to the qualitative questions. First, we need to consider that the main elements necessary for an overall understanding of the narrative lie in the fact that Mrs Doubtfire's role is a double role (Mrs Doubtfire is both Daniel), that the scene is based on this deception and that it is eventually revealed. Other important elements punctuate this scene and guide the narrative between the two plays: Daniel/Mrs Doubtfire changes roles multiple times and alternates between the two characters, the narrative takes place in two separate and concurrent rooms, the two characters are injured during the play and Daniel/Doubtfire is eventually unmasked.

We asked both groups to briefly describe the story they had just observed, to understand what elements of the narrative they had understood and retained. When we look at the responses from the group of students non proficient in MR technologies, we can see that all five understood the dual role of Mrs Doubtfire/Daniel, the central point of the scenario. Four of them understood that Mrs Doubtfire was initially a man and mentioned the gender change. Their answers included 'a man pretends to be a woman', 'a person who welcomes a woman into his or her home', 'the person who invites plays two people, one of whom is an old lady' and 'the man plays two roles, his own and that of a woman [...] he dresses in accessories to feminise himself'. However, only two of them mentioned the plot twist (Mrs Sellner reveals Daniel's deception) and the distributed narration, which includes 'the room on the right' and 'the other room'. In addition, two participants mentioned the family relationship between Mrs. Doubtfire and Daniel (half-brother and sister) shown in the scene, one of whom expressed doubt about the nature of their supposed bond: 'The man is telling the story of his sister or [of] his mother-in-law, I'm not sure'.



In the group of the proficient in MR, the participants also unanimously understood the dual role and four of them understood that Mrs Doubtfire was initially a man and mentioned the gender change (tied with the group of students non proficient in MR technologies): 'The man is disguised as a woman', '[he] passes himself off as his mother', 'The story of a man who passes himself off as his sister', 'A man has disguised himself as a woman'. Three participants (compared to two non-proficient in MR students) mentioned the final scene and only one participant (compared to two non-proficient in MR students) specified that the scene took place between two rooms: 'The man switches rooms to change clothes'. Three participants (compared to two non-proficient in MR students) mentioned the family link between Mrs Doubtfire and Daniel, one of whom also expressed a doubt similar to the non-proficient in MR students: 'his mother or sister'. However, we can hypothesise that this confusion between mother and sister may be caused by two factors: the first being the actors' accents and the second being that the Doubtfire character is older (older than Daniel).

Thus, in terms of narrative comprehension, there was no significant difference between the two groups, although the non-proficient in MR students expressed greater difficulty in memorising and following the story than the proficient in MR students. Both groups used a similar lexical field associated with deception and impersonation, with expressions such as 'make believe' and 'pretend', indicating a common understanding of storytelling. Perhaps we can note that two non-proficient in MR students noticed the two distinct environments and their impact on storytelling, compared to only one proficient in MR participant, suggesting a potential difference in sensitivity to this dimension echoing the non-proficient in MR students responses about their difficulty in following the narrative between these two spaces. However, given the statistical insignificance of this observation, this interpretation remains unconvincing. There was, however, a difference in the incorporation of narrative details into the description of the narrative. Both groups memorised various details of the story, including the context, events and characters, but these elements differed between the groups. For example, two participants in the non-proficient in MR group identified the two rooms as being used as Daniel/Doubtfire's home by using the expression 'at home', while another participant specifically mentioned a 'flat'. In addition, one of the participants who used the expression 'at home' also remembered and identified Doubtfire as 'an old lady'. Another participant described the fact that the actor playing Doubtfire/Daniel changes characters in the second room by 'taking off a disguise and putting it back on later' and mentioned the fact that both characters are injured during the scene. In particular, he described the final scene: 'When actor B was injured, actor A ran into the room and realised that he was pretending to be several people. That was the end of the play'. So, the details that caught the attention of the non-proficient in MR participants were based more on the context of the scene (where are we?) and the events.



The proficient in MR participants retained fewer details. None of the non proficient in MR participants mentioned injuries or described the exact sequence of events. The details retained also relate to the context, but this time on the reasons for Daniel's deception: 'A man disguised himself as a woman to make an examiner believe that he lived with his sister', 'a man who invited a friend to his home, making her believe that his mother or sister was also there', 'a man who pretended to be his sister because she was absent in front of a lady who came to visit him'. Unlike the non-proficient in MR group, the proficient in MR participants provided more details about the characters (their roles, their emotions): while the non-proficient in MR students described the character of Mrs Sellner as a simple 'woman', two proficient in MR students described her, one as an 'inspector' and the other as an 'examiner', while a third described her as a 'friend'. The latter described Daniel as 'overwhelmed' by events, which led his 'friend' to discover the deception. What can be deduced from this difference in terms of remembering and interpreting the details of a story is that it highlights the different ways in which the proficient in MR and the non-proficient in MR groups prioritise what is an integral part of the narrative. The non-proficient in MR participants focus more on the concrete/primary aspects such as context and events, while the proficient in MR participants tend to provide fewer factual details but already begin a second reading/understanding of the narrative by focusing on the characters' motivations and emotional nuances.

To further assess the memorisation of details, particularly concerning the course of events and the characters, the two groups answered other questions: 'Can you briefly describe the events (actions) you observed?' and 'Can you briefly describe the characters (name, characteristics, character, etc.)?' To assess how the narration had affected their memory, they were asked what they considered to be the most important/memorable moments in the story, and to justify their comments. All the participants in the non-proficient in MR group described the events and actions that had been put in place to guide the narrative between the rooms and that had made important noises : all mentioned the tea (which led to a burning followed by a scream), three mentioned the mouse trap (which made a popping noise followed by a scream) and four mentioned the sticky (which led to a jostling, never mentioned by any of the participants in either group).

The proficient in MR participants, on the other hand, gave much less detailed and less complete descriptions of the actions guiding attention. None mentioned the mouse trap, although five did mention tea and changing gender (as did the non-proficient in MR participants), and four the sticky. However, in the majority of participants' responses we again find attention focused on details, such as the specific behaviours of the characters, which we do not find in the non-proficient in MR participants: we find "The woman observes the room", "the man greets his friend", "the woman takes notes", "the woman asking for sugar", "a man explaining his life and where he comes from", "the woman [...] gradually becomes [suspicious] [because of] the objects".



This tendency to memorise details linked to their own interpretation of the narrative was confirmed when the participants described the characters. On the one hand, the non-proficient in MR participants either described the appearance of the characters, or linked them to the objects they used or their behaviour during the scene: 'a girl guest, with a notebook', 'a person who changes sex', 'a person dressed in black and white trousers with a blue notebook + pen, wanting to find out what's in the room [...] The other person disguises herself as a lady with swollen breasts [...] a high-pitched voice', 'a curly blonde wig and fake breasts'. Only one non-proficient in MR participant described the characters as he perceived/interpreted them. Adjectives included 'smiling', 'talkative', 'bitter', 'clumsy' and 'very energetic'.

On the other hand, the proficient in MR participants, most of whom (four out of five) described either the characters or the roles and relationships of the characters. The role of 'inspector' and the 'brother, sister' relationship were mentioned twice, along with adjectives such as 'burlesque', 'stressed', 'serious', 'suspicious', 'confused', 'extravagant', 'funny' and 'simple'.

When participants from both groups were asked to identify the most significant moments in the story, a convergence in their responses was observed, with the majority highlighting Daniel's transformations, the revelation of the deception and the incidents involving the mouse trap and the tea. However, a dissimilarity again emerged when they were asked to justify their choices, highlighting a persistent distinction between the two groups in the way they interpreted and semantised narrative elements. The justification for the memorable moments chosen by the non-proficient in MR group focused, in many cases, on the impact of the actions on the unfolding of the plot. One participant even explained: 'the physical actions are more memorable than the dialogue. The key moments I remember are those where the action was strongest, where there was speed'. Only one non-proficient in MR participant mentioned that the plot had had an emotional impact on his perception and memory, speaking of 'controversial emotions' aroused by the suspense of the plot.

Among the proficient in MR participants, one said that it was the anticipation of the revelation of the imposture at the start of the scene that had made the moment of revelation memorable. This anticipation is a feeling of expectation stimulated by the plot (like suspense). Another participant described Daniel's transformations, the mouse trap incident and the plot twist as humorous ('funny') moments. Another described Daniel's transformations and the revelation as 'entertaining' and spoke of an 'interesting twist'. Only one proficient in MR participant pointed out that it was the actions that generated noise, such as the shouting and banging, that captured his attention.

What can we conclude from these responses? Firstly, there was convergence in the moments considered most significant, such as Daniel's transformations, the revelation of the deception and the incidents involving the mouse trap and the tea, regardless of the group to which the



participants belonged. However, when we examine the justifications for these choices, some important distinctions emerge. The non-proficient in MR participants tend to remember and give importance to the events that make up the action. It is through the perception of these events that they will understand the narrative and then memorise it. On the other hand, proficient in MR participants attach more importance to the emotional aspect and complexity of the plot, expressing expectations raised by the plot, as well as an appreciation for the humorous and entertaining elements of the story. They are already in a more advanced stage of 'information processing' than the non-proficient in MR participants. While the visual perception of non-proficient in MR participants focuses essentially on the development of mental schemas for understanding the environment, the proficient in MR participants seem to master the environment more quickly and easily, and thus begin a process of memorisation and semantisation that can be modulated by emotional states.

A final relevant aspect to examine concerns the behaviour shown by the observers in front of the scene and their way of observing the distributed narrative. Let's start with the behaviours common to both groups. First, let's look at the behaviours shared by the two groups. Firstly, the participants in both groups showed emotional reactions to the scene: they smiled, laughed, and expressed their astonishment by widening their eyes or exchanging furtive glances with each other throughout the event, with variations in these reactions depending on the events occurring in the scene and its comic aspect. Thus, the theatrical performance elicited emotional responses in both groups, although these appear to have had a more significant impact on memorization and semantic comprehension in the proficient in MR participants, as revealed by their responses to the questionnaire.

Then, while some participants remained motionless for most of the performance despite being able to move around the corridor, we observe that at the end of the scene some of them chose to move around to optimise their view of the rooms, particularly during the final revelation when Mrs Sellner discovers that Mrs Doubtfire and Daniel are the same person. The fact that these participants decided to move towards the end of the scene, particularly at the crucial moment of the final revelation, indicates a recognition of the importance of this element in the overall unfolding of the play, which they indicated in the questionnaire. Thus, the choice to move at this point reflects a conscious strategy on the part of the participants to better apprehend and appreciate the denouement of the story and testifies to the spectators' commitment and active involvement in the theatrical narrative.

The major divergence in behaviour between the two groups lay in their approach to optimising their observation of the scene shared between the two plays. The non-proficient in MR participants showed a tendency to move around the corridor to alternate their vision between room 1 and room



2. Their movements were characterised either by body movements or by head and eye movements. However, only two of the proficient in MR participants adopted a similar strategy based on body movements. The other three participants preferred another approach: they positioned themselves between the two rooms in order to have a view of both spaces simultaneously, by slightly adjusting their head or eyes.

To put in a nutshell, the analysis of the responses to the questionnaire on the 'natural perception' experience, coupled with the observation of the participants' behaviours, makes it possible to initiate a reflection on the way in which proficient in MR and non-proficient in MR individuals approach their own understanding of a new narrative, outside the standards of conventional theatre and cinema. In view of the overall results, we can already assume a relationship between creativity and the perception, memorisation and understanding of the events observed when a script differs from standard codes.

8. Results from May 16th, 2024

The questionnaires administered to the participants in the May 16th experiment included questions about their familiarity with the device, their comfort and the symptoms associated with its use, with the aim of assessing the influence of these factors on the reception of the content. We will therefore begin by analysing these aspects. Firstly, although we might initially assume that proficient in MR participants would have used a VR headset more frequently than non-proficient in MR ones, the results reveal similar trends between the two groups. Indeed, to the question 'Have you ever used a VR headset' (before the experiment), four out of five non-proficient in MR participants answered 'yes', compared to three proficient in MR participants. However, in answer to the question 'How often?', we can see that the proficient in MR participants who had already used a VR headset had used it several times and more frequently: two of the proficient in MR participants had therefore used a VR headset 'more than 10 times', one of whom said he had used it 'from time to time' and the other 'very often' over the last 6 months. The third proficient in MR, who had already used a VR headset between '5 and 10 times', said they had used it 'rarely' in the last 6 months.

Among the non-proficient in MR, the number of uses and frequency is less significant and more disparate. One participant had used a VR headset more than 10 times, another had used it '5 to 10 times', yet another '2 or 3 times' and the last had only used it 'once'. However, all four participants had almost never used a VR headset in the last 6 months: participants who had used a VR headset '5 to 10 times' and '2 or 3 times' felt that they had 'never' used a VR headset in the last 6 months, while participants who had used a VR headset 'more than 10 times' and 'only once' felt that they had 'rarely' used one in the last 6 months. They were asked two questions about the context of their use of the device. The first question concerned the overall context of use of the



helmet. Among all the participants in both groups, the three contexts mentioned most often were video games (Beat Saber, Space Pirate and VR Chat), cultural experiences in the context of museums and immersive cultural and creative experiences outside museums (cinema, music and virtual visits were mentioned). When asked about the contexts in which the VR headset has been used in the last 6 months, we can see that video games are still the big winner (three out of five participants in both groups mention this), followed by cultural events (two out of five participants in both groups mention 'museum' and 'immersive experience').

We can already conclude that although the two groups have already experienced VR headsets at least once, with no significant difference (four non-proficient in MR versus only three proficient in MR, mainly digital natives), the proficient in MR group have used the device more often and more frequently. We also noted that the content most consumed in virtual reality was video games (including VR Chat) and cultural content in the context of museums or various immersive experiences (virtual tours, artistic content, music). However, it is important to point out a potential bias. Among the non-proficient in MR participants, two had never used a VR headset. However, as the participants are students in the ICCD master's programme, they are used to creating and viewing 360° content without actually using headsets. It is therefore essential to highlight the proficient in MR participants' ease with immersive digital technologies (including the creation of content for digital devices) even if they have not experienced the VR headset.

Let's now look at the possibility of a link between the frequency of use of the device by participants in the two groups and the comfort (or discomfort) associated with wearing the headset.

Participants were asked to rate comfort on a scale of 1 to 5 (5 being considered 'very comfortable') after watching the first video, and again after watching the second video. They were also asked whether they found the headset heavy after the first viewing, and whether it felt heavier (or lighter) after the second viewing. Overall, the proficient in MR participants felt more comfortable wearing the headset. They found it quite comfortable, giving an average score of 4/5, and light, since they unanimously answered 'no' to the question 'Did you find the headset heavy' After the second viewing, the proficient in MR participants felt that their experience of wearing the headset remained the same, both in terms of comfort and weight.

The non-proficient in MR participants were less comfortable overall, giving an average rating of 3.6/5 for comfort. However, most of them did not find the headset heavy (only one non-proficient in MR participant said he found it heavy). After the second viewing, comfort dropped slightly from 3.6/5 to 3.4/5, with one participant finding it heavier and one finding it lighter.

After the comfort questions, the participants answered various questions relating to cyber kinetosis. They were asked if they had experienced headaches, dizziness or nausea and eye strain. If participants answered 'yes', they were asked to rate their experience on a scale of 1 to 5



(5 being 'very painful'). After the first viewing, the non-proficient in MR participants were the only ones to experience symptoms related to wearing the headphones: three out of five participants experienced mild headaches (with an average intensity of 2/5), four out of five participants experienced mild dizziness or nausea (with an average intensity of 2.75/5) and four out of five participants experienced mild eye strain (with an average intensity of 2.25/5). The most intense symptoms were nausea/vertigo. It is important to note, however, that the only non-proficient in MR participant who did not experience any symptoms was the participant who had used a VR headset more than 10 times, even though he had used one only rarely in the last 6 months. The proficient in MR participants did not experience any symptoms.

They were asked the same questions again after the second viewing, to assess whether their condition had improved or worsened. Thus, even after the second viewing and with a break of around ten minutes between the two viewings, the non-proficient in MR participants were still the ones experiencing the most symptoms. However, their condition improved markedly: only one participant experienced headaches, but with greater intensity (1/5 after the first viewing, and 4/5 after the second). This same participant was the only one to experience nausea/vertigo, which again worsened (2/5 after the first viewing, then 3/5 after the second). Two participants experienced eye fatigue, which also worsened (an average of 2/5 after the first viewing compared with an average of 3/5 after the second). Once again, the non-proficient in MR participant who used a VR headset more than 10 times did not experience any symptoms after the second viewing. However, on the other hand, a proficient in MR participant reported experiencing a single symptom, which was eye fatigue of intensity 3/5 after the second viewing.

To conclude the 'familiarity and comfort of wearing the helmet' section, participants were asked two final questions: 'Overall, would you say that wearing the headset interfered with your experience' and 'How would you describe your experience with the headset', which were repeated after the second viewing. While two non-proficient in MR participants 'agreed' that the headset detracted from their experience, the majority felt the opposite (two 'disagreed' and the participant who had used a VR headset more than 10 times 'disagreed at all'). The proficient in MR participants unanimously felt that wearing the headset did not detract from their experience. After the second viewing, all the participants in both groups remained in the same position.

Despite symptoms and a headset that bothered them overall, the majority of non-proficient in MR participants described the experience as 'quite immersive' (three answered 'quite immersive' and two 'immersive', again including the one with a high level of familiarity with VR headsets).

However, it was the proficient in MR participants who were more receptive to the experiment, with the majority describing the experience as 'immersive' (four out of five participants), including one who described it as 'very immersive'.



After the second viewing, two non-proficient in MR participants felt 'less immersed' and only one 'more immersed' than after the first viewing. The two non-proficient in MR participants who felt less immersed were the two whose symptoms persisted after the second viewing. As for the proficient in MR participants, one of them felt more immersed and another less so. However, this reduced sense of immersion was not correlated with symptoms experienced after the second viewing.

In conclusion, the answers to these questions in the two questionnaires make it possible to establish a link between familiarity with the VR headset, the comfort associated with wearing it and the way in which the experience is 'felt' (more or less immersion). We were able to highlight that although both groups had previous experience with VR headsets, the proficient in MR group felt more comfortable overall during the viewing sessions and had a more positive perception than the non-proficient in MR group. The only exception was the non-proficient in MR group who were familiar with the device, as they were the only ones to experience no symptoms and to feel comfortable with the headset, while describing the experience as 'immersive'. Previous experience with the device therefore seems to play a protective role both in terms of symptoms and the perception of immersion.

Let's now look at how participants in the two groups perceived their ability to memorise the scene. When asked 'How well do you think you remembered the actions that took place in front of you', the majority of the non-proficient in MR participants were less confident than the proficient in MR participants. Three said they had memorised 'most of the actions' and two said they had memorised 'some of the actions'. As for the proficient in MR participants, two indicated that they had memorised 'the majority of the actions', two 'most of the actions' and only one expressed some doubts, indicating that they had memorised only 'some of the actions'. In the questionnaire submitted after the second viewing, they were asked the same question. This second exposure enabled the non-proficient in MR participants to regain their confidence: two said they had memorised 'most of the actions', two others 'the majority of the actions' and only one said he had remembered nothing at all.

For the proficient in MR participants, the trend was also upwards, but less significantly than for the non-proficient in MR participants, since only one changed his answer to indicate that he had 'memorised everything'.

Both questionnaires asked them about their difficulty in following the course of events during the scene. In the first questionnaire, they were asked to rate, on a scale of 1 to 5 (5 being 'very easy'), how difficult it was to follow the course of events. The non-proficient in MR participants gave an average score of 3.4/5, meaning that the events were generally easy to follow. While the proficient in MR participants seemed to be the most at ease until now, the trend is now reversed, as they gave an average score of 3.2/5. We can therefore deduce that the proficient in MR group, although



confident, found it more difficult to follow the events than the non-proficient in MR group. There is one important point to note, however: although the average is 0.2 points lower, the proficient in MR group gave more marks close to 5: three of them gave a 4/5, one a 3 and the last a 1. It is this 1 that causes the average to fall drastically. If we calculate a median rather than an average, thereby eliminating the extreme values and expressing a value that is more representative of the groups, we obtain a median of 3/5 for the responses of the non-proficient in MR, and a median of 4 for the responses of the proficient in MR. This gives a fairer balance between the two groups and is more consistent with the answers to the previous question. Participants in both groups were given the opportunity to specify the type of difficulty they had encountered. The answers were similar and highlighted a major problem: the difficulty of following events/actions that are taking place rapidly (as in a real situation, with no editing to punctuate the actions) and simultaneously. In short, the difficulty lies above all in deciding how to prioritise our gaze, which means accepting that we may 'miss' elements of the set or the actions/movements of other characters outside our field of vision. In the second questionnaire, the non-proficient in MR participants found the task simpler, with a median of 4/5 on the scale used to assess the difficulty of following up actions. The answers of the proficient in MR participants obtained a median of 4/5. The medians therefore highlight the one-point improvement in the assessment of the non-proficient in MR participants, who found the exercise simpler after the second viewing. However, the median for the proficient in MR participants did not change. Nevertheless, can we really think that the 'progression' of the non-proficient in MR participants is caused by an adaptation to the device and the type of content? When they explained the reasons why the exercise had become simpler, two non-proficient in MR participants explained that there was less action and fewer set elements in the second video (showing the point of view of the second room where Daniel/Doubtfire carries out his transformations) than in the first (showing the point of view of the first room where Daniel and Mrs Sellner interact). The room was therefore 'emptier' than the first, and another element came into play: the presence of the flat inlay (in equirectangular view) to which two non-proficient in MR participants referred. None of the proficient in MR participants mentioned this overlay. The other factor that played a simplifying role was the fact of having observed the same scene twice. This was mentioned by two proficient in MR participants who found the exercise simpler, and by only one non-proficient in MR participant.

Once again, we can draw some conclusions from our observations. It would seem that the participants' familiarity with the device has a particular impact on the way they apprehend their own memory capacity. The proficient in MR participants were more confident than their non-proficient in MR peers, who found the exercise more difficult and therefore doubted their ability to memorise a scene they found complex. However, after a second viewing, the responses of the



non-proficient in MR participants showed an increase in confidence and a decrease in their estimation of the difficulty. This 'progression' was not present (or only to a limited extent) among the proficient in MR participants, who felt no significant change between the first and second viewings. We can deduce from this that, when individuals are introduced to the system or to new types of 360° content, their 'cognitive progression' is less obvious than that of a novice participant. The main difficulty, however, is shared by members of both groups: it is difficult to prioritise the view and to accept 'missing' elements. It is therefore easier, since we have absorbed the standard cinematographic codes, to follow an action (or a narrative) when it is isolated from any external distraction or when the image is in 2D.

By looking at the answers to the qualitative questions, we can now see whether the participants' feelings are reflected in their transcription of the scene. As in the experiment on 17 April, all the participants were asked to briefly describe the story, the actions and the characters they had just observed. All the participants in both groups mentioned the dual role and the change of gender. On the proficient in MR side we find: 'the man disguised as a woman', 'he changed his tone of voice (man and woman)' and 'he pretended to be his sister' (twice). On the non-proficient in MR side, we find: 'he pretends to be a woman', 'a man cross-dresses', 'the man plays a woman' and 'the man is disguised as a woman'. Four proficient in MR participants mentioned the narrative punchline: 'is unmasked by the woman', 'the inspector [...] sees that in the end there is only one person', 'the woman discovers her double game'. In the non-proficient in MR group, four participants also mentioned it: 'she [the inspector] enters the second room and finds the half- man half-woman', 'the secretary surprises him', 'his deception is revealed'. Two proficient in MR mentioned the distributed narration, describing 'he goes into a separate room to change' and 'the man moves from one room to another', while three non-proficient in MR described 'the change of character takes place in a different room', 'the man returns to room 2 to change into a woman' and 'two roles from one room to another'. We note that while only one proficient in MR mentioned the distribution of actions and justified why, this was the case for all the non-proficient in MR who mentioned the distributed narration. To continue with the important events in the scenario, the majority of participants in both groups (three proficient in MR participants out of five, and four non-proficient in MR participants out of five) mentioned the injuries suffered by the characters during the scene. Two proficient in MR mentioned Daniel's burn and fall, and another referred to the action where Mrs Sellner 'hits herself' (actually getting a mouse trap in her foot). The non-proficient in MR mentioned 'falling', the verb 'to fall' twice, 'burns himself with a cup of tea' and 'hurts himself'.

Overall, we can see that participants in both groups understood the important events in the scene. However, there was a difference in the memorisation of various details of the scenario, including



the context, the events and the characters. In fact, the proficient in MR group remembered more details overall than the non-proficient in MR group. We can cite a few responses to illustrate this point. Firstly, two proficient in MR participants identified the location as a 'flat', which was not the case for any of the non-proficient in MR participants. The difference in terms of memorisation is then accentuated on the details related to the characters. Two proficient in MR participants mentioned the family relationship between Daniel and Doubtfire 'he pretends to be his sister' (twice), and then correctly identified Mrs Sellner's role, describing her as an 'inspector'. Only one non-proficient in MR identified the family link ('brother') and two identified Mrs Sellner's role. However, one of them understood her to be an inspector, while the other participant described her first as a 'domestic' and then as a 'secretary'.

However, the major discrepancy between the two groups was in the way they described the characters. Among the non-proficient in MR, two mentioned the fact that the characters were English, one described Daniel as a 'clumsy man', and one described all the characters in detail: he remembered the first name 'Danny', described the inspector as 'cold' and curious, Doubtfire as 'bombastic and demonstrative' as well as 'wearing a lot of make-up' and Daniel as 'kind and clumsy'. Only two non-proficient in MR participants used adjectives to describe the characters and only one provided a detailed description. Furthermore, it is important to note that the participant who provided the detailed description was not the non-proficient in MR participant who was used to the device, but the one who had only used a VR headset once in his life. The descriptions of the characters written by the proficient in MR participants were denser: one remembered the first name 'Danny' and another described the inspector as 'attentive' and 'observant' and Daniel/Doubtfire as 'stressed, anxious, agitated'. Yet another mentioned a pre-scene relationship between Mrs Sellner and Daniel ('the characters seem to know each other'), described Daniel as 'disorganised' and the inspector as 'serious' and dissatisfied with the meeting. A final participant incorporated physical details into the characters, describing 'a dark-haired man' with 'a blond wig' and a 'stern-looking' woman.

Not only did the proficient in MR participants retain more details than the non-proficient in MR participants, but they also incorporated these details when asked to transcribe the actions taking place in the scene, with two participants stating that Mrs Sellner was 'uncomfortable' and 'worried'. When asked 'What were the most important or memorable moments in the story for you?', the majority of participants in both groups indicated firstly the revelation of the deception (final scene), then the actions that produced noise (the burning and the fall) and finally the double-cross. The main reason given for choosing the moment of revelation was that the secret was finally exposed, something that all the participants in all the groups seemed to be waiting for. With regard to the noisy actions and the double play, the responses once again diverged: the proficient in MR



participants stressed the importance of the sound that attracted their attention, while the non-proficient in MR participants mentioned the movements of the characters. It should also be noted that only one of the ten participants, a proficient in MR, said that the noisy actions were 'funny'. When we look at the recordings of the content broadcast through the headphones during the experiment, we see that all the participants, regardless of their familiarity with the device, follow the events with their eyes and move their gaze (by moving their head) from one character to another to follow the discussion. However, the proficient in MR participants tended to move around more, turning around and looking up and down, than the non-proficient in MR participants, who were more static. Discussion of the results from April 17th and May 16th, 2024, and conclusion. Let's now compare our results. Did the participants in the two groups have the same understanding of their memory capacity during the 'natural perception' experiment and the 'spherical-scene' experiment? To answer this question, let's analyse the responses concerning the participants' confidence in their memory and the difficulties they encountered during the two sessions. First of all, let's compare the answers to the question: 'How well do you think you remembered the actions that took place in front of you? It appears that, overall, the participants felt more confident after the 'natural perception' experiment than after the 'spherical scene'¹ experiment. One likely hypothesis is that this difference in confidence can be attributed to the influence of the device used. It is possible that the VR headset had an intimidating or disruptive effect on the participants, thus affecting their perception of their memory abilities. However, it should be noted that, when we take into account the responses to the second questionnaire of the 'spherical scene' experiment, the results obtained are considerably closer to (but not equal to) the results obtained from the 'natural perception' experiment, which may reflect a gain in confidence and an adaptation to the headset device and the content broadcast within it. Let's continue by looking in more detail at the responses relating to the difficulties encountered by the participants in each type of experiment. Evaluating these responses could give us further clues as to why 'natural perception' generated greater confidence in the 'spherical-scene' and whether our hypothesis is likely. And indeed, although the participants felt less confident during the experiment with the VR headsets, they nevertheless felt less difficulty in following the course of events² in the scene than during the 'natural perception' experiment. Let's compare the medians obtained: the scores given by the non-proficient in MR group obtained a median of 3/5 (5 corresponds to 'very easy') for the 'natural perception' experiment. For the 'scene-sphere' experiment, the scores obtained a median value of 4/5. The non-proficient in MR therefore seem to have found it less difficult to follow the narrative distributed in the headsets than in natural perception. However, the difficulty expressed by the proficient in MR was unchanged (obtaining a median of 4/5 in both sessions). While the experience was the same for the proficient in MR group,



the non-proficient in MR group rated the 360° experience as less difficult than the natural perception experience, the median having changed between the two questionnaires submitted during the second session. What can we deduce from this? The proficient in MR seem to be more at ease when faced with new scenarios and experiences (both in natural perception and in head-mounted perception). However, the difficulties faced by the non-proficient in MR diminish as they become more familiar with the device and the content, despite symptoms of cyberkinetosis.

Another observation: the participants gave reasons for their difficulties and, in both experiments, the difficulty that stands out most is that of prioritising the view. In fact, some participants from all groups said that it was difficult to follow events taking place simultaneously.

Let's compare the results of the two sessions in terms of extracting and remembering information, including details (context, location, characters, etc.). During the 'natural perception' experiment, the majority of the non-proficient in MR group were able to describe the actions/events more accurately than the proficient in MR group. Their attention was focused on the various events in the room and the actions that made significant noises: the burning with the tea and the mouse trap. They also mentioned the Daniel/Doubtfire metamorphoses and the injuries sustained by the characters. The proficient in MR group, on the other hand, had not mentioned any injuries and had described the actions in less detail. They did, however, attach the same importance to Daniel/Doubtfire's transformations as the non-proficient in MR group. Nevertheless, they focused their attention on other elements relating more to the behaviour of the characters, their profile and their interactions. During the 'spherical scene' experiment, the responses were balanced, with participants in both groups mentioning most of the injuries suffered by the characters and the same actions.

The most significant difference between the two groups, in both experiments, lay in the memorisation of details. In natural perception, two non-proficient in MR participants were able to identify the rooms as a flat. As for the characters, most of the details remembered related to the physical appearance of the characters or to the objects used in the action. The proficient in MR had memorised the context of the scene (the reason for Mrs Sellner's visit) and the relational links between the characters. They had interpreted the characters. In VR perception, the trend was reversed, with the proficient in MR giving more detail to the actions, identifying rooms like a flat, identifying the roles of each character and the links between them. Their description of the characters was in line with the way they described them in natural perception, and therefore described the characters' characters and their feelings. It should also be noted that none of the participants remembered the characters' first names during the first experiment, but that two participants (one from each group) managed to remember the nickname "Danny" during the



second experiment. In addition, more non-proficient in MR interpreted the characters in the 'spherical scene' experiment than in the 'natural perception' experiment.

These comparisons once again underline the fact that the proficient in MR participants interpreted the narrative and the characters more deeply than the non-proficient in MR participants, who only transcribed the 'tangible' elements for the most part, whatever the device. However, the 'non-creative' participants were more interpretative during the 'spherical-scene' experiment than during the 'natural perception' experiment. In addition, the participants were able to retain visual and auditory elements, as well as details, whether in the headset or in natural perception. Although there were discrepancies between the details memorised in the two sessions, and between the participants in the two groups, all the participants in both groups were able to understand the scene, and to retain the major events necessary for understanding the scene.

Let's continue our discussion by comparing the results to the question concerning the impact of the scene on the participants. When participants were asked to choose 'what were the most important or memorable moments in the story', the two groups combined chose the same scenes in both experiments: the revelation of the deception, the actions that produced noise (burning, falling, mouse trap) and Daniel's transformations. However, the recurrence of each of these events differed between the two experimental sessions. For example, more importance was given to the moment of revelation during the 360° experiment than during the natural perception experiment. This suggests that the scene broadcast through the headsets created a more intense sense of expectation (suspense) than the 'dramatised' scene. What's more, in the 'natural perception' experiment, Daniel's transformations were cited the most. In terms of potential emotional impact, the proficient in MR group were the ones who had the most emotional reactions (laughter, smiles, expressions of surprise) and who described this in the questionnaire, although some of the non-proficient in MR group also reacted but less significantly. However, it appears that the 360° experiment provoked fewer emotional responses, even among the proficient in MR participants. How can this phenomenon be explained? Do the VR headset and the scene filmed in 360° inhibit emotional responses compared with natural perception? To answer this question, we need to take into account the biases involved in analysing viewers' behaviour in front of the scene. Firstly, the spectators in the 'natural perception' experiment, unlike those in the 'stage-sphere' experiment, do not wear headsets to hide their faces. It is therefore easier to observe their reactions, to capture their smiles and laughter, and in particular their eyes and expressions. Although the headset does not cover the mouth, it is still more difficult to read facial expressions without the presence of the eyes. Also, during the 'natural perception' experiment, the participants, divided into groups, interacted with each other, even if they could not communicate verbally. The looks they exchanged, and the observation of their peers' behaviour may have influenced the way they



experienced and perceived the scene. However, the fact that the proficient in MR were able to perceive and understand the emotions of the characters (which they later transcribed) proves that even the spherical scene has the capacity to convey the emotions of the characters to the spectators. Secondly, we were able to see that the spectator's familiarity with the device influenced his or her perception, with the proficient in MR spectators being better able to perceive and interpret the characters' emotions. Given this observation and the results of the 'spherical scene' experiment, we can assume that the more familiar the viewer is with 360° content and the device, the better they will be able to perceive, interpret and in turn feel the emotions transmitted by the narrative.

Other points to consider concern viewers' behaviour during viewing and their links with the events that have marked them. It is possible that these responses will enable us to detect a different way of perceiving the narrative according to natural perception and perception in VR headsets.

For the proficient in MR participants, sound had less of an impact during the 'natural perception' experiment than during the 'spherical scene' experiment. The non-proficient in MR, on the other hand, seemed to be attracted overall by the visual action in both experiments. The first sense to guide attention and narration in both cases (natural perception and perception in the headsets) seems to be sight. Then comes hearing, which helps/accompanies the visual action and reinforces the impact on the viewer. This hypothesis is supported by observations of spectators' behaviour during the experiments. In the 'natural perception' experiment, the spectators initially followed the narration according to the actors' movements and were then guided by the noisy sounds that told them that something was happening. In VR, the spectators followed the actors' movements to understand whether they should look at the room in which they were immersed or at the overlay in the other room. It was the noisy actions that then drew their attention to a particular event. In short, the visual topology of a scene guides the spectator through the space and the sounds guide him towards the precise events that should capture his attention. However, all the spectators in the 'spherical scene' experiment tended to focus more on the actions taking place in one room, by watching the overlay, whereas those in the 'natural perception' experiment tended to want to perceive both rooms at the same time (either by moving more between the two rooms or by standing back).

What can we conclude from all these analyses? Although significant differences were not observed in all the dimensions examined, the overall results indicate trends suggesting a relationship between creativity/familiarity with new types of content and the perception, memorisation and understanding of events observed when a script differs from standardised codes. This would imply learning and adaptation, both to new demonstration/projection devices and to new types of content (in this case 360°) and scripting. In our studies, proficient in MR

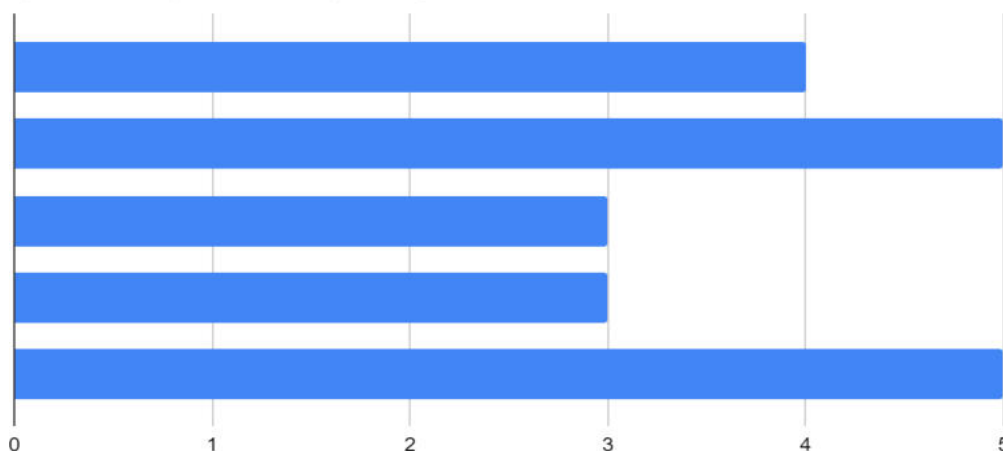


people have a more trained perception than non-proficient in MR people. As a result, they are more confident in their memory capacity (perhaps feeling less apprehensive) and have better recall, including of details. As a result, they can create mental schemas more easily and in a more 'efficient' way. They can then semanticise their environment and are able to adjust to it, even if it changes. In our case, the proficient in MR had no particular difficulty in following the narrative in two different spaces. The non-proficient in MR, although less confident and having encountered more difficulties, were also able to do so. In the headsets, participants in both groups were able to follow the narrative and orientate themselves spatially and temporally in the 360° scene. As a result, all the individuals were able to interact with the scene by turning around to follow the events, and to locate and watch the overlay when the action was taking place in the adjacent room. All the participants were therefore able to acquire a global understanding of the scene, both in natural perception and in 'scene-sphere' perception. The major difference was that the proficient in MR participants were able to go beyond these elementary cognitive schemas and continue their reading on an emotional level.

4.5.5. Selection of comparative graphs of questionnaire results

Proficient in MR group - Comparison of the difficulty experienced during the 'natural perception' and 'spherical-scene perception' experiments (5 = 'Very easy').

(Creatives) "Natural perception"



6. Sur une échelle de 1 à 5, notez la difficulté à suivre le déroulement des événements entre les deux pi...

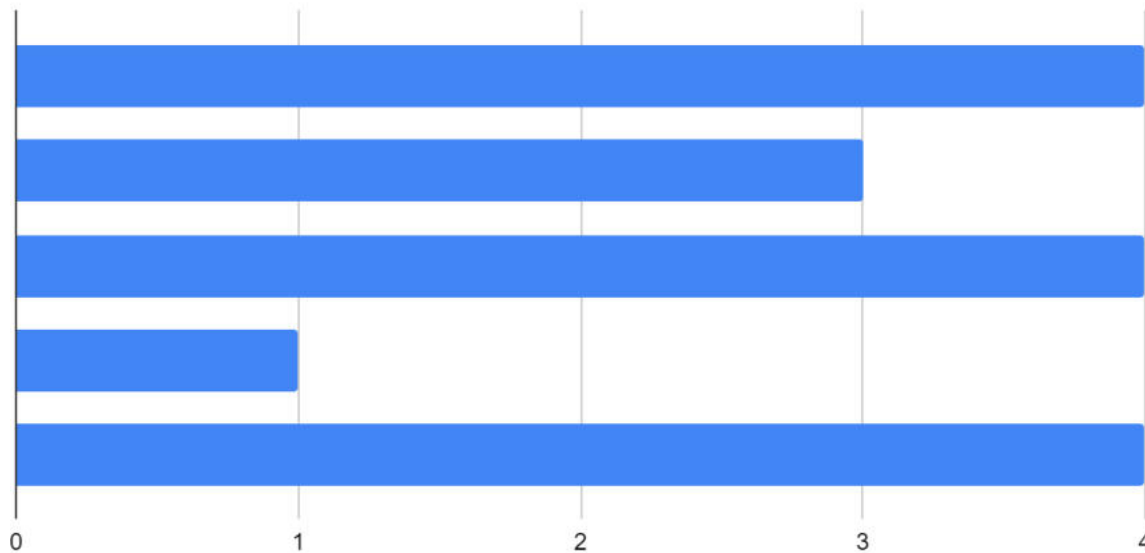
Non-proficient in MR group - Comparison of the difficulty experienced during the 'natural perception' and 'spherical-scene perception' experiments (5 = 'Very easy').



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(Creatives) "Spherical-scene perception" (questionnaire 1)



16. Sur une échelle de 1 à 5, notez la difficulté à suivre le déroulement des événements entre les deux...

Proficient in MR group - Comparison of responses to the question 'To what extent do you think you remembered the actions that took place in front of you?' in the "natural perception" and "spherical-scene perception" experiments.

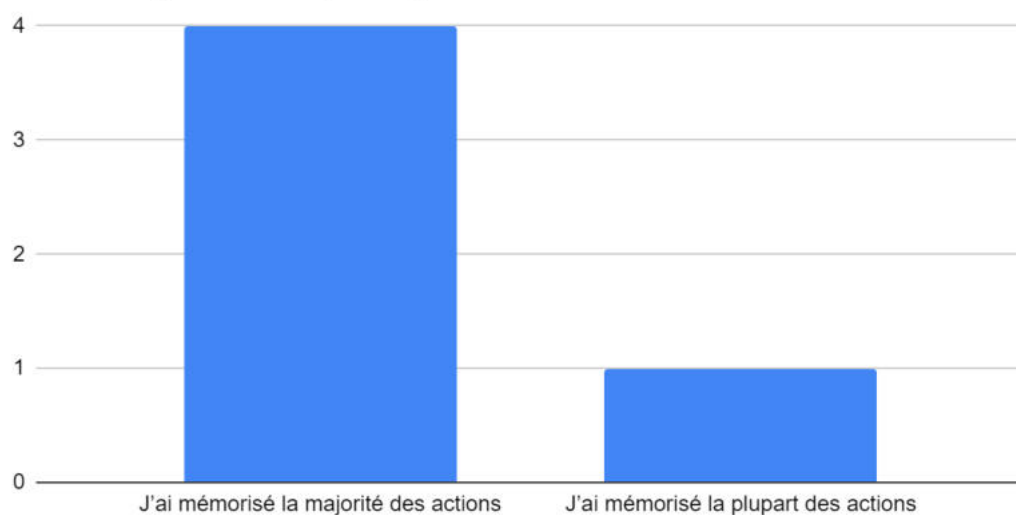
4 'I have memorised the majority of the actions and 1 'I have memorised most of the actions'



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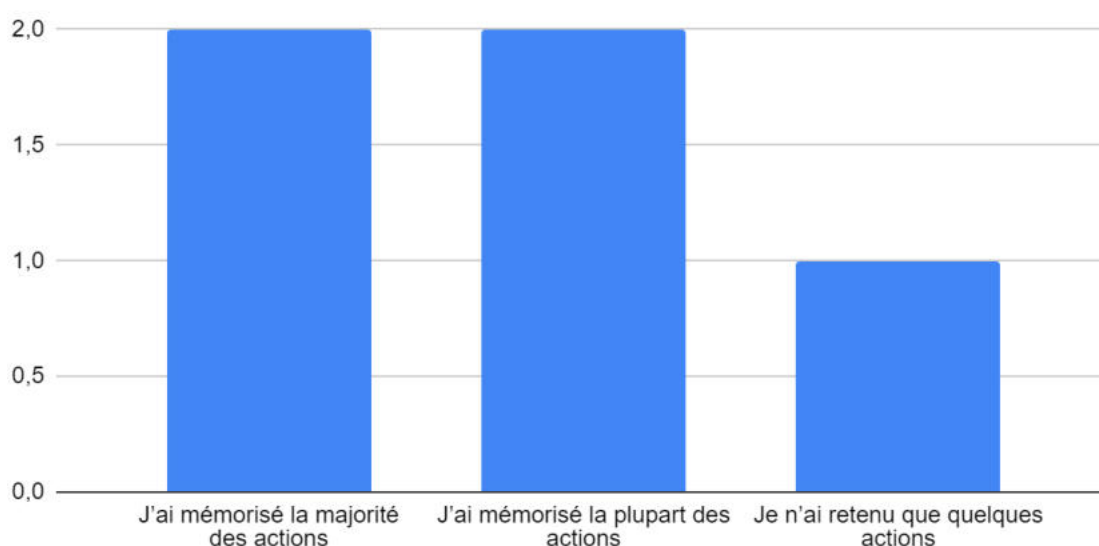


(Creatives) "Natural perception"



Nombre de 4. À quel point pensez-vous avoir mémorisé les actions qui se sont déroulées devant v...

2 'I have memorised the majority of the actions, 2 'I have memorised most of (Creatives) "Spherical-scene perception" (questionnaire 1)



Nombre de 14. À quel point pensez-vous avoir mémorisé les actions qui se sont déroulées devant...

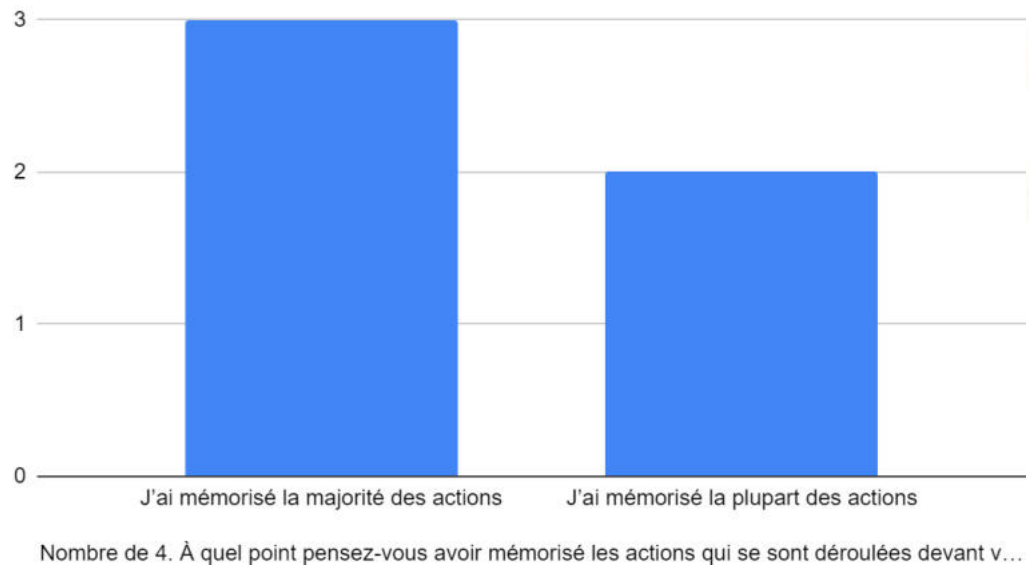
the actions', 1 'I have memorised only some actions'



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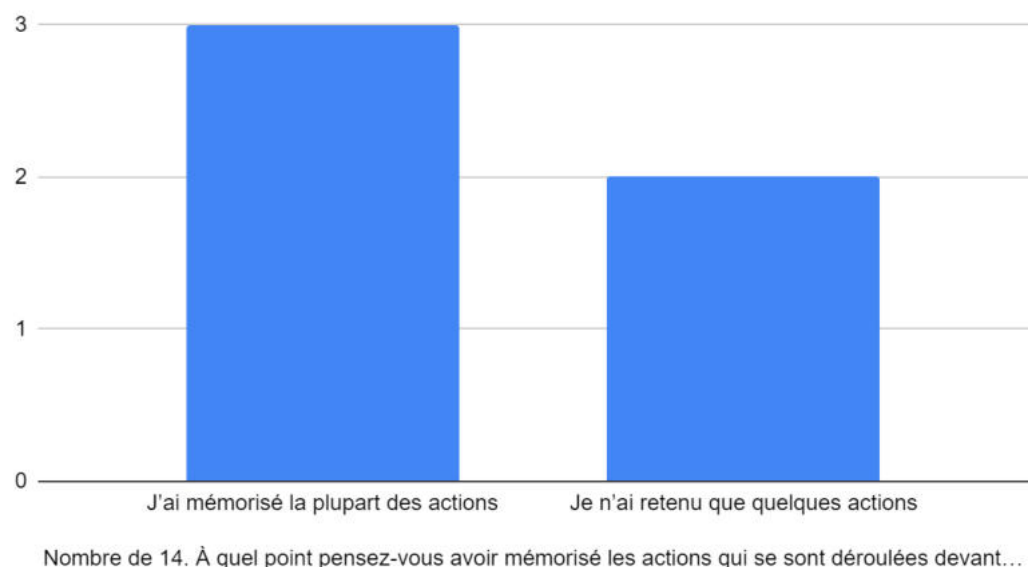


Non-proficient in MR group - Comparison of responses to the question 'How well do you think you remembered the actions that took place in front of you?' in the "natural perception" and "spherical-scene perception" experiments.
(Non-creatives) "Natural perception"



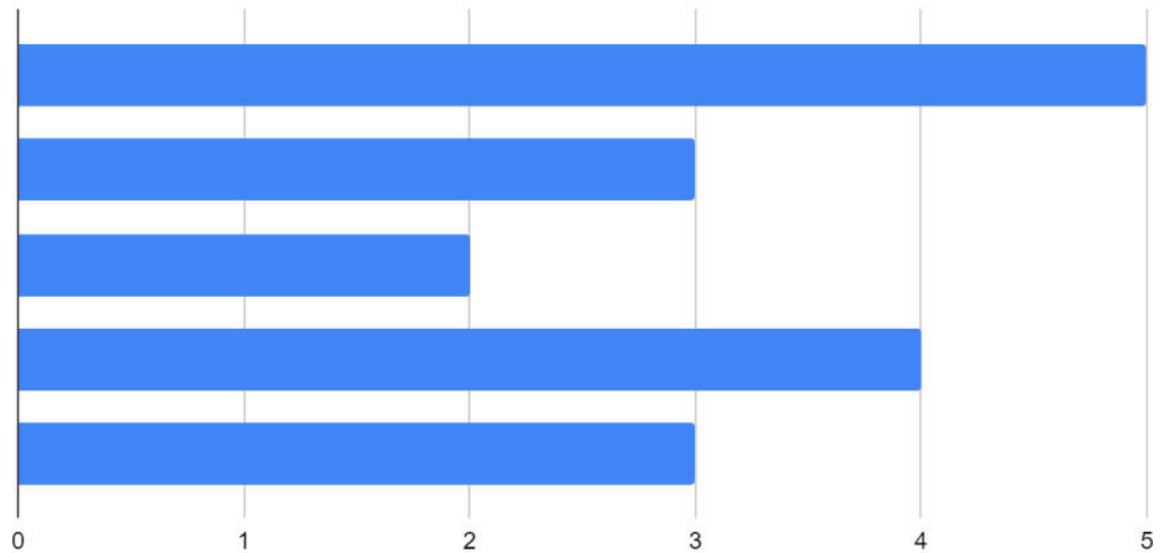
3 'I have memorised the majority of the actions and 2 'I have memorised most of the actions'

(Non-creatives) "Spherical-scene perception" (questionnaire 1)



3 'I have memorised most of the actions' and 2 'I have memorised only some actions'

Non-proficient in MR group - Evolution of the difficulty felt between (Non-creatives) "Spherical-scene perception" (questionnaire 1)



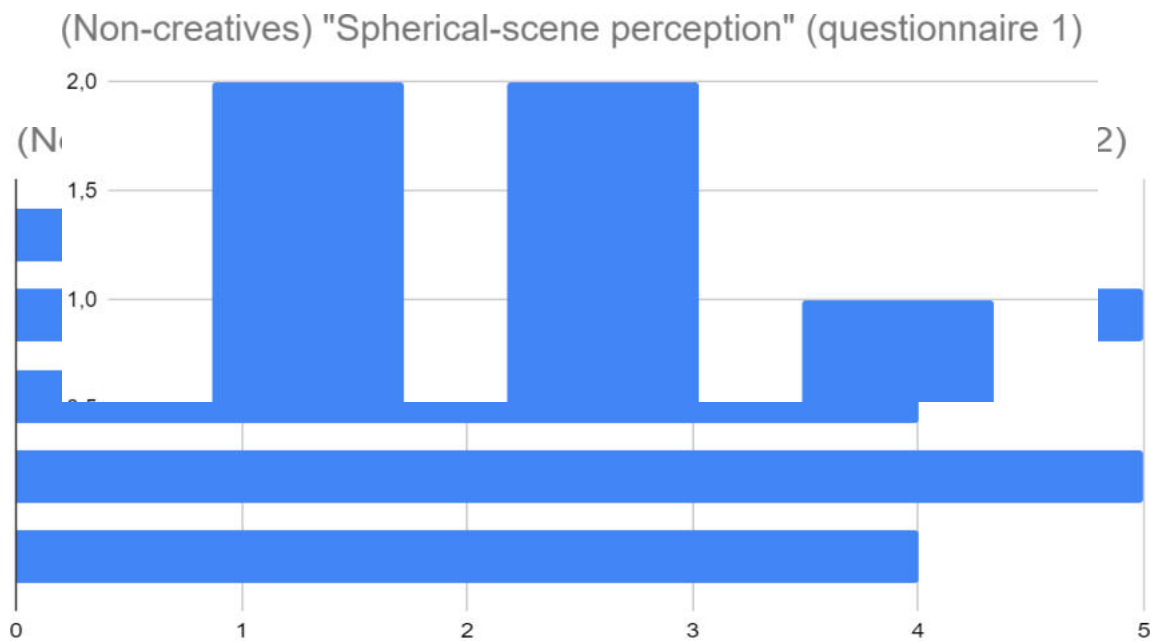
16. Sur une échelle de 1 à 5, notez la difficulté à suivre le déroulement des événements entre les deux... questionnaire 1 (after a first viewing) and 2 (after a second viewing) during the 'spherical-scene perception' experiment (5 = 'Very easy').



Non-proficient in MR group - Comparison of responses to the question 'To what extent do you think

you remembered the actions that took place in front of you?' between questionnaire 1 and

2 during the 'spherical-scene perception' experiment.



13. Sur une échelle de 1 à 5, notez la difficulté à suivre le déroulement des événements entre les deux...



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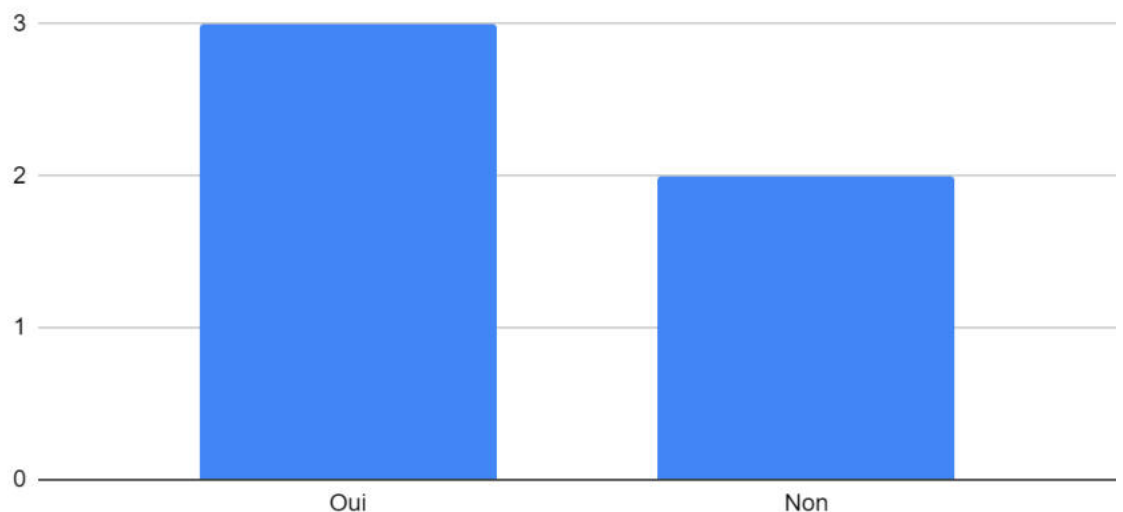


3 'I have memorised most of the actions' and 2 'I have memorised only some actions'

2 'I have memorised most of the actions', 2 'I have memorised the majority of the actions' and 1 'I didn't remember anything'

Non-proficient in MR group - Comparison of responses relating to symptoms of cyberkinetosis experienced between questionnaire 1 (after a first viewing) and 2 (after a second viewing).

(Non-creatives) "Spherical scene perception" (questionnaire 1)
(Non-creatives) Did you experience any headaches during/after viewing? (questionnaire 1)



Nombre de 8. Avez-vous ressenti des maux de têtes ou des migraines pendant/après le visionnage ?

3 'yes' and 2 'No'

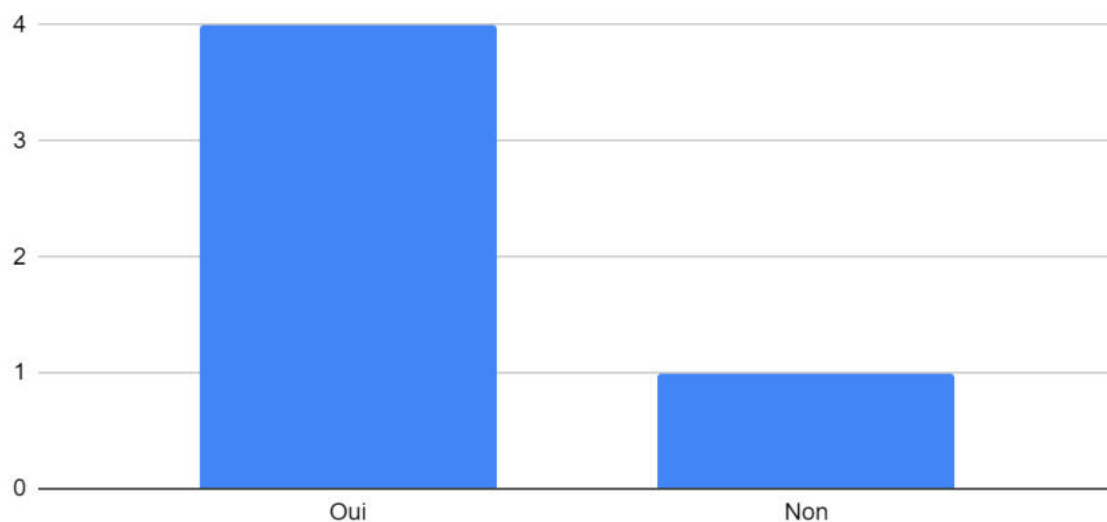
1 'yes' and 4 'No'

4 'yes' and 1 'No'

(Non-creatives) Did you experience any headaches during/after viewing? (questionnaire 2)

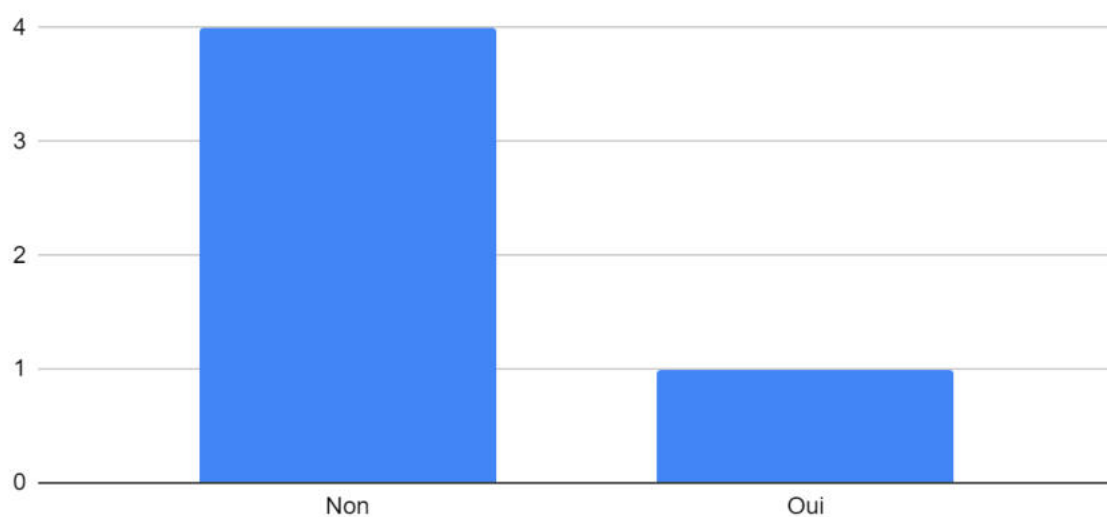


(Non-creatives) Did you feel dizzy, unbalanced or nauseous during/after watching the video ? (questionnaire 1)



Nombre de 9. Avez-vous ressenti des sensations de vertiges, de déséquilibre ou de nausées pend...

(Non-creatives) Did you feel dizzy, unbalanced or nauseous during/after watching the video ? (questionnaire 2)



Nombre de 6. Avez-vous ressenti des sensations de vertiges, de déséquilibre ou de nausées pend...

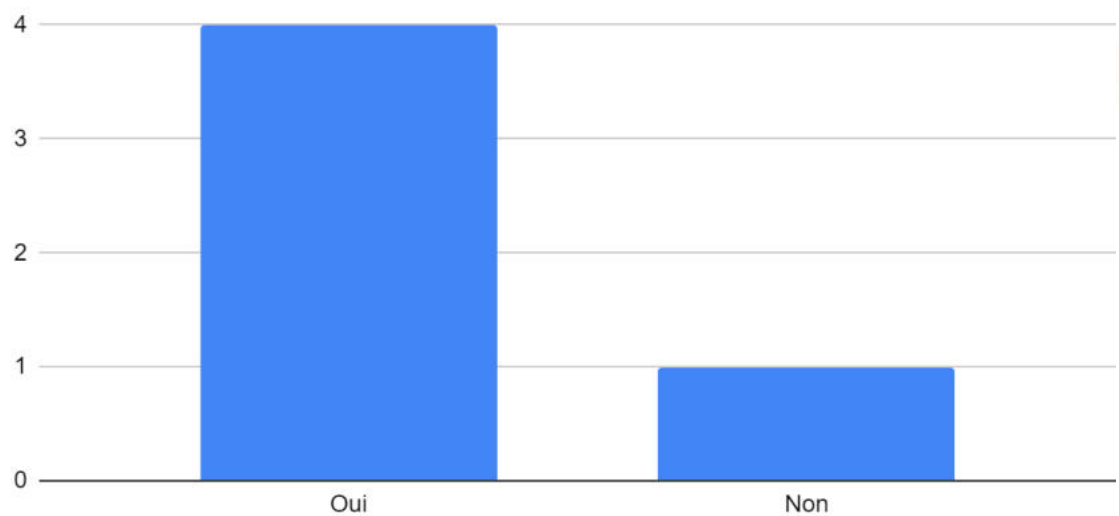


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1 'yes' and 4 'No'

(Non-creatives) Did you experience eye strain after viewing?
(questionnaire 1)



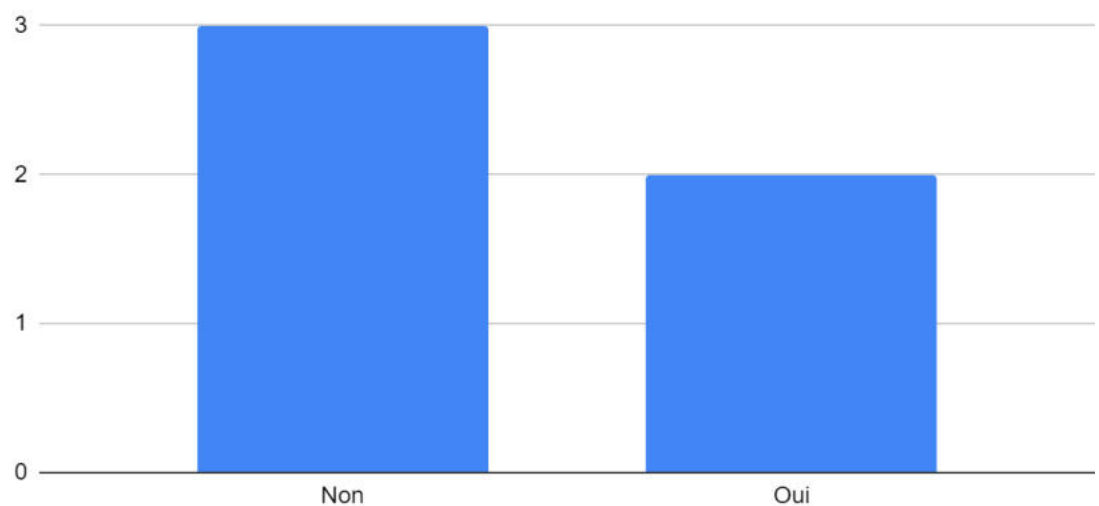
Nombre de 10. Avez-vous ressenti une fatigue oculaire après le visionnage ?

4 'yes' and 1 'No'

2 'yes' and 3 'No'

2 'yes' and 3 'No'

(Non-creatives) Did you experience eye strain after viewing?
(questionnaire 2)



Nombre de 7. Avez-vous ressenti une fatigue oculaire pendant/après le visionnage ?



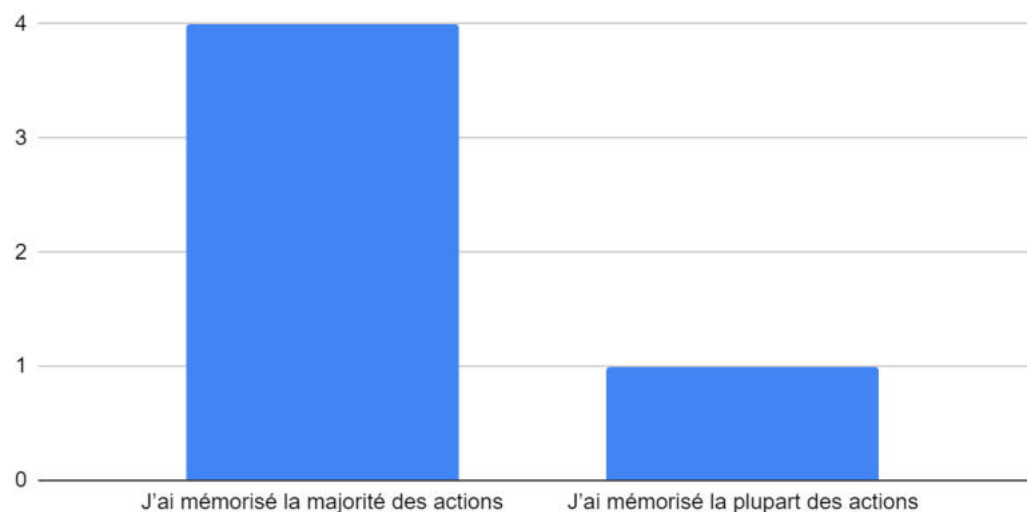
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Proficient in MR group - Comparison of responses to the question 'To what extent do you think you remembered the actions that took place in front of you?' in the "natural perception" and "spherical-scene perception" experiments.

4 'I have memorised the majority of the actions and 1 'I have memorised most of the actions'

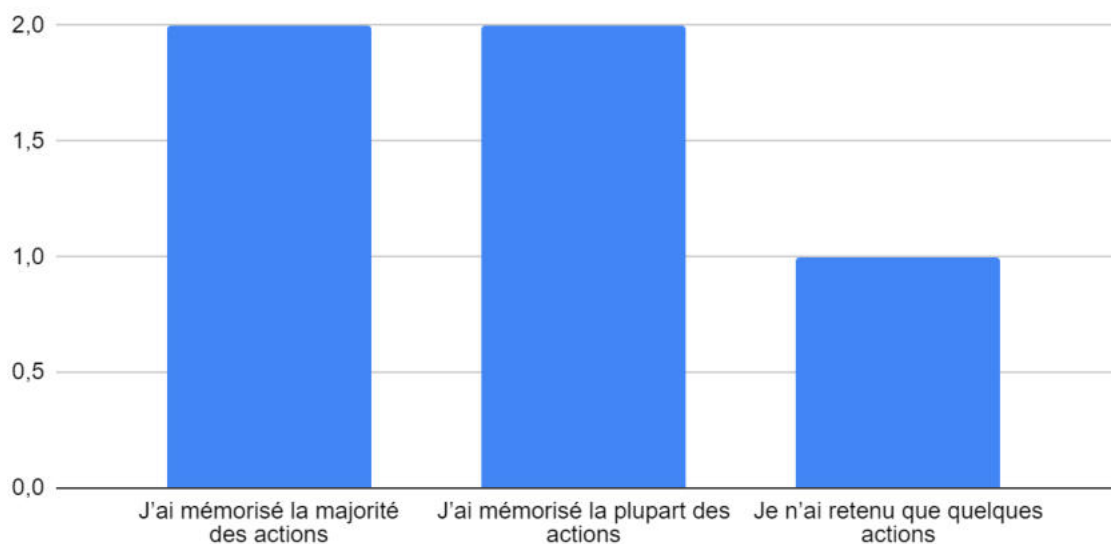
(Creatives) "Natural perception"



Nombre de 4. À quel point pensez-vous avoir mémorisé les actions qui se sont déroulées devant v...

2 'I have memorised the majority of the actions, 2 'I have memorised most of the actions', 1

(Creatives) "Spherical-scene perception" (questionnaire 1)



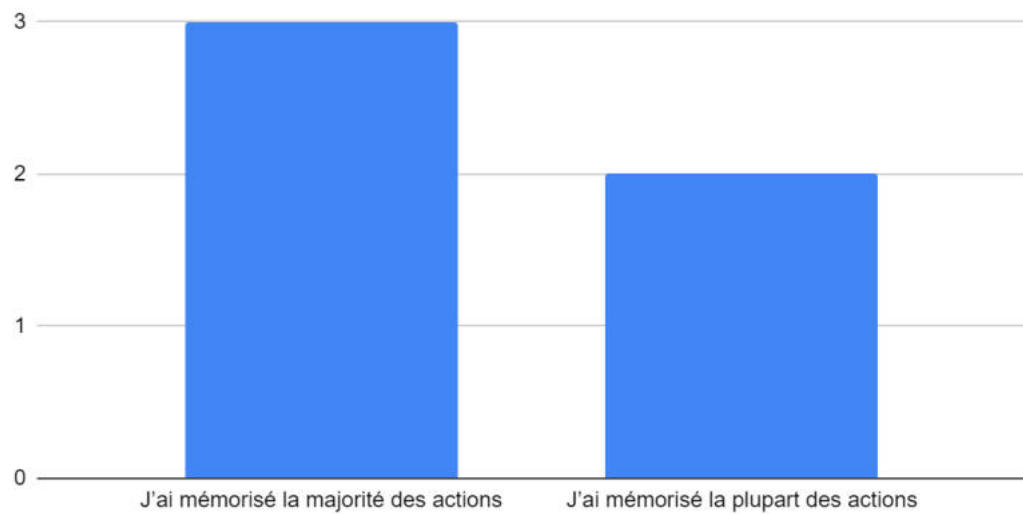
Nombre de 14. À quel point pensez-vous avoir mémorisé les actions qui se sont déroulées devant...

'I have memorised only some actions'



Non-proficient in MR group - Comparison of responses to the question 'How well do you think you remembered the actions that took place in front of you?' in the "natural perception" and "spherical-scene perception" experiments.

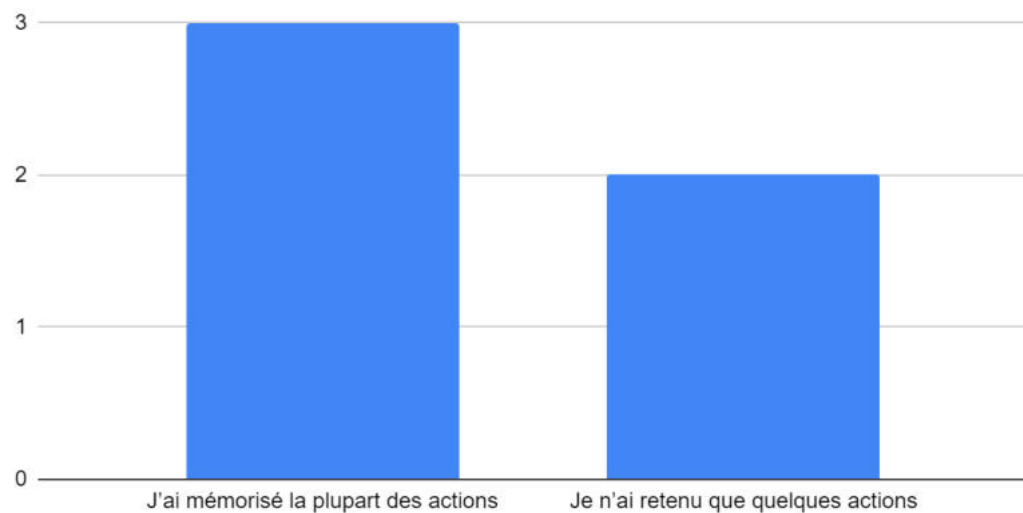
(Non-creatives) "Natural perception"



Nombre de 4. À quel point pensez-vous avoir mémorisé les actions qui se sont déroulées devant v...

3 'I have memorised the majority of the actions and 2 'I have memorised most of the actions'

(Non-creatives) "Spherical-scene perception" (questionnaire 1)

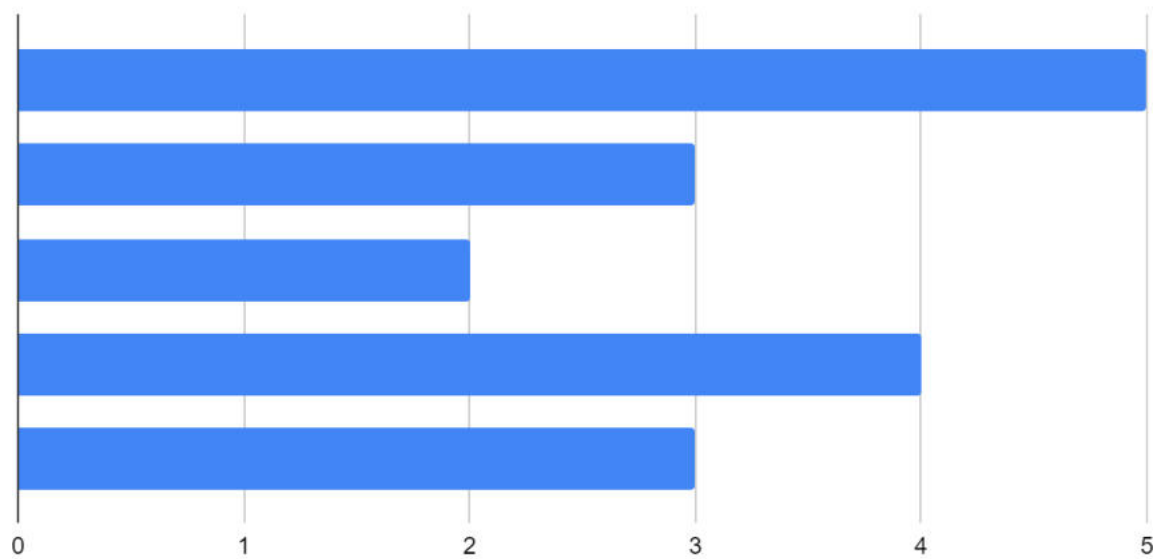


Nombre de 14. À quel point pensez-vous avoir mémorisé les actions qui se sont déroulées devant...



3 'I have memorised most of the actions' and 2 'I have memorised only some actions'

Non-proficient in MR group - Evolution of the difficulty felt between questionnaire 1 (after a (Non-creatives) "Spherical-scene perception" (questionnaire 1)

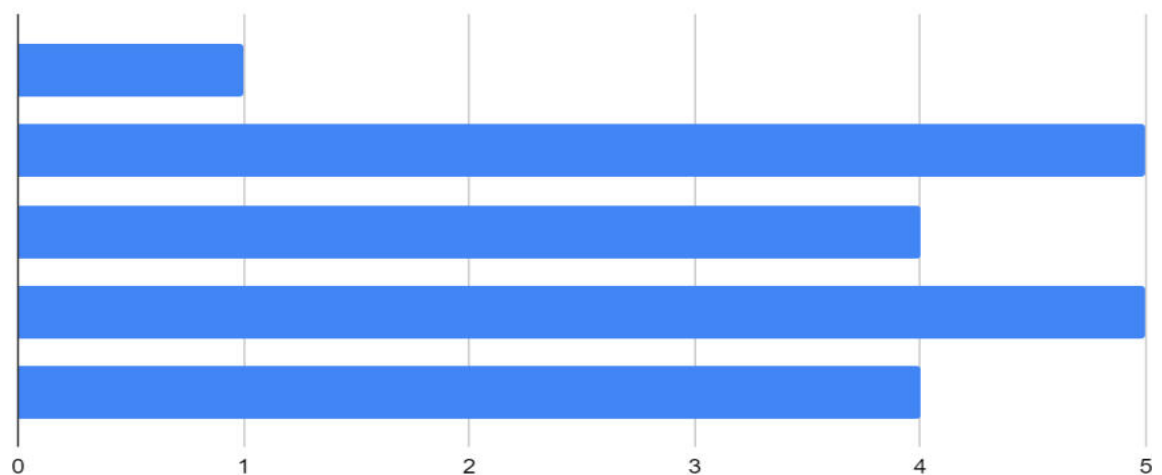


16. Sur une échelle de 1 à 5, notez la difficulté à suivre le déroulement des événements entre les deux... first viewing) and 2 (after a second viewing) during the 'spherical-scene perception' experiment (5 = 'Very easy').

Non-proficient in MR group - Comparison of responses to the question 'To what extent do you think

you remembered the actions that took place in front of you?' between questionnaire 1 and

(Non-creatives) "Spherical-scene perception" (questionnaire 2)



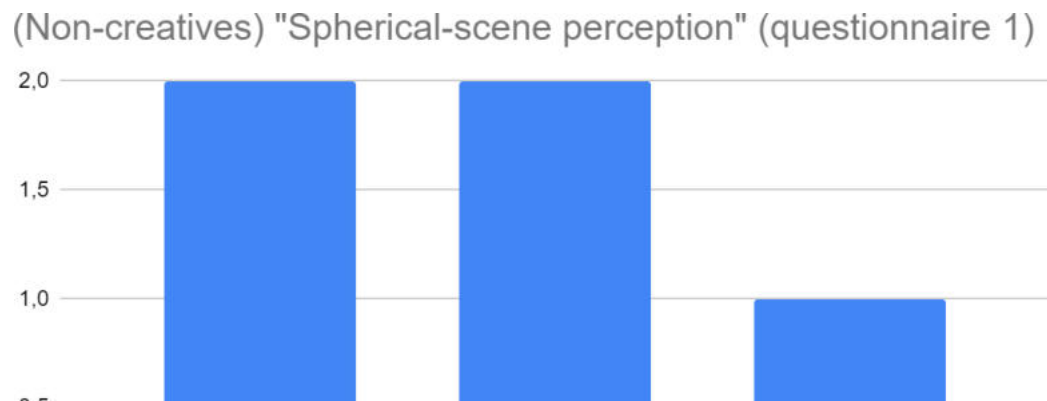
13. Sur une échelle de 1 à 5, notez la difficulté à suivre le déroulement des événements entre les deux...



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2 during the 'spherical-scene perception' experiment.



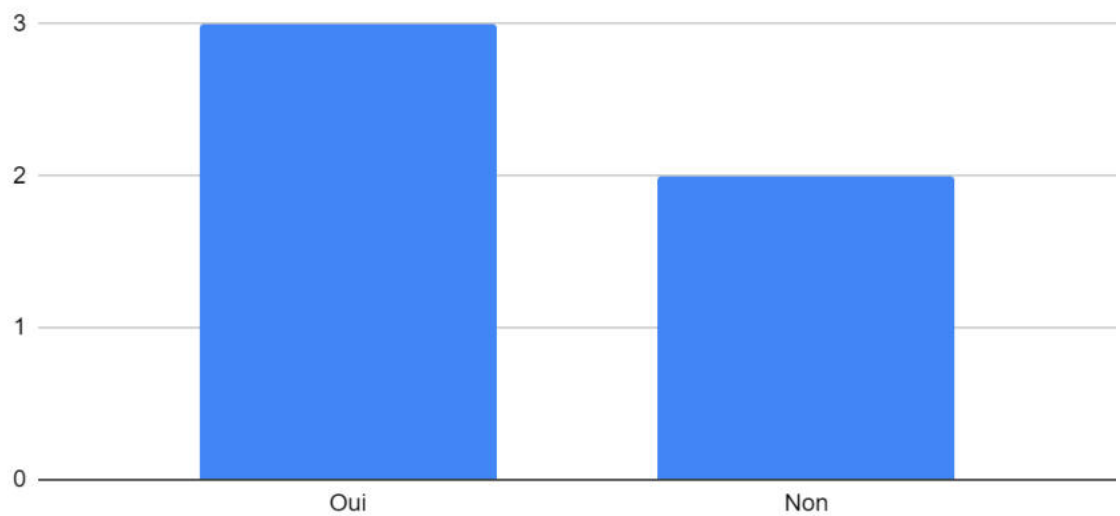
3 'I have memorised most of the actions' and 2 'I have memorised only some actions'

2 'I have memorised most of the actions', 2 'I have memorised the majority of the actions'
and 1 'I didn't remember anything'

Non-proficient in MR group - Comparison of responses relating to symptoms of cyberkinetosis experienced between questionnaire 1 (after a first viewing) and 2 (after a second viewing).



(Non-creatives) "Spherical scene perception" (questionnaire 1)



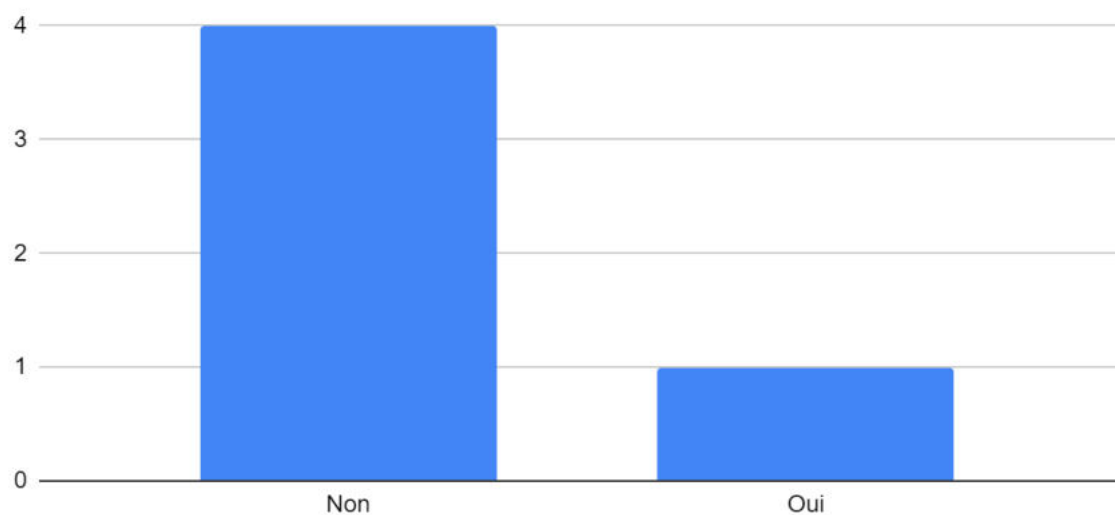
Nombre de 8. Avez-vous ressenti des maux de têtes ou des migraines pendant/après le visionnage ?

3 'yes' and 2 'No'

1 'yes' and 4 'No'

4 'yes' and 1 'No'

(Non-creatives) Did you experience any headaches during/after viewing? (questionnaire 2)



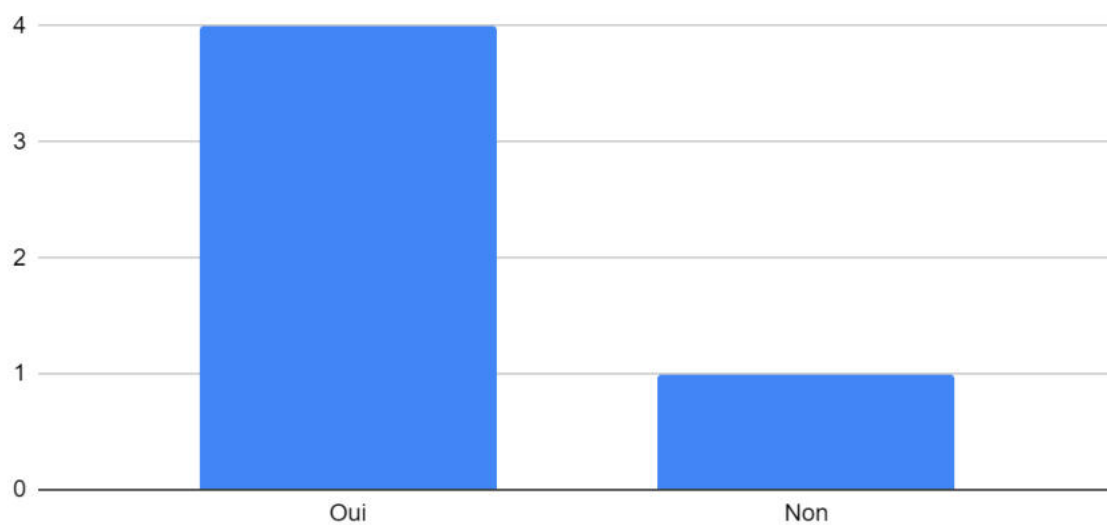
Nombre de 5. Avez-vous ressenti des maux de têtes ou des migraines pendant/après le visionnage ?



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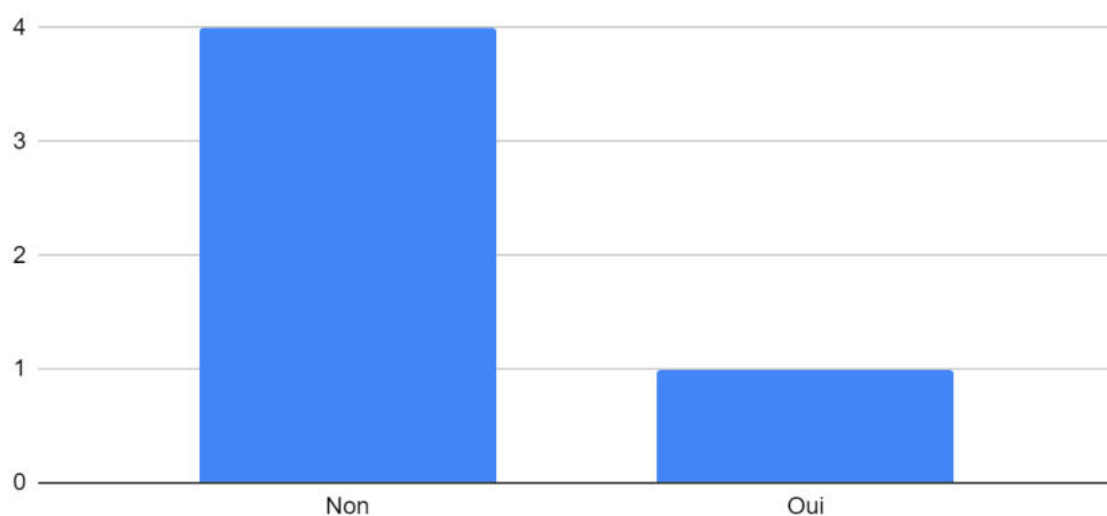


(Non-creatives) Did you feel dizzy, unbalanced or nauseous during/after watching the video ? (questionnaire 1)



Nombre de 9. Avez-vous ressenti des sensations de vertiges, de déséquilibre ou de nausées pend...

(Non-creatives) Did you feel dizzy, unbalanced or nauseous during/after watching the video ? (questionnaire 2)



Nombre de 6. Avez-vous ressenti des sensations de vertiges, de déséquilibre ou de nausées pend...

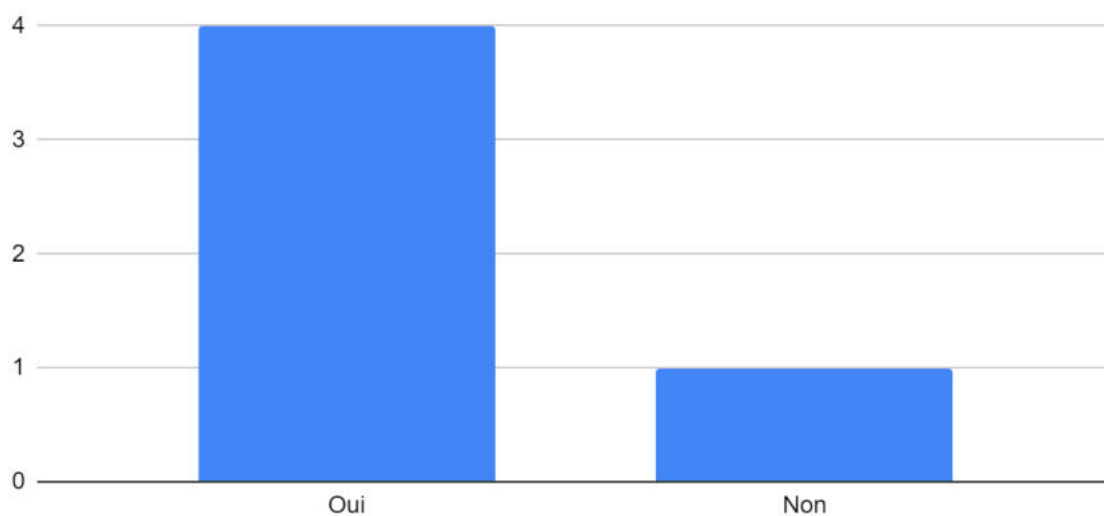


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1 'yes' and 4 'No'

(Non-creatives) Did you experience eye strain after viewing?
(questionnaire 1)



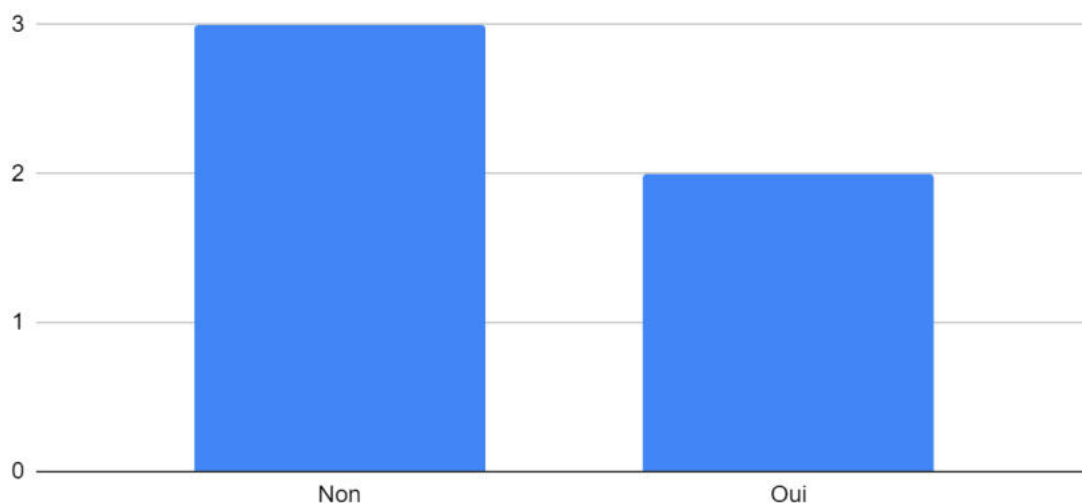
Nombre de 10. Avez-vous ressenti une fatigue oculaire après le visionnage ?

4 'yes' and 1 'No'

2 'yes' and 3 'No'

2 'yes' and 3 'No'

(Non-creatives) Did you experience eye strain after viewing?
(questionnaire 2)



Nombre de 7. Avez-vous ressenti une fatigue oculaire pendant/après le visionnage ?



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4.5.6. 'Natural perception' experiment questionnaire

Your age

- 18-25 years old
- 26-35 years old
- over 35
- Your gender
- Female
- Male
- Non-binary
- Other
- I do not wish to answer
- Your course of study
- DISTIC
- ICCD

How well do you think you remembered the actions that took place in front of you?

- I remembered nothing at all
- I only remembered some of the actions
- I remembered most of the actions
- I remembered the majority of the actions
- I remembered everything

On a scale of 1 to 5, rate how difficult it is to follow the sequence of events between the two pieces.

- 1 = very difficult / 5 = very easy

Did you find it difficult to follow the sequence of events between the two parts?

- Yes
- At times
- No

(If yes or at times) What did you find difficult?

Can you briefly describe the scenario (story) you observed? Can you briefly describe the events (actions) you observed?

Can you briefly describe the characters (names, characteristics, etc.)?

In your opinion, what are the most important or memorable moments in the story? Why?

Is there anything else you would like to share about your experience?

Questionnaire 1, 'spherical-scene perception' experiment.

Your age

- 18-25 years old



- 26-35 years old
- over 35 Your gender
- Female
- Male
- Non-binary
- Other
- I do not wish to answer

Your course of study

- Msc Sound Design
- ICCD

Your number

-

1

-

2

-

3

-

4

-

5

Have you ever used a VR headset?

- Yes
- No

If yes) How many times?

- 1 time only
- 2 or 3 times
- 5-10 times
- More than 10 times



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In what context (video games, VR chat, museum, etc.)?

How often have you used a VR headset in the last 6 months?

- Never
- Rarely
- Once in a while
- Often
- Very often

(If other than never) In what context (video games, VR chat, museum, etc.)? On a scale of 1 to 5, rate the comfort of wearing the headset.

- 1=Very uncomfortable / Very comfortable Did you find the headset heavy?
- Yes
- No

Did you experience any headaches or migraines during/after viewing?

- Yes
- No

(If yes) On a scale of 1 to 5, rate the intensity of these aches.

- 1 = Not very painful / 5 = Very painful

Did you feel dizzy, unbalanced or nauseous during the viewing?

- Yes
- No

(If yes) On a scale of 1 to 5, rate the intensity of these sensations.

- 1 = Very slight / Very intense



Did you experience eye strain after viewing?

- Yes
- No

(If yes) On a scale of 1 to 5, rate the intensity of this eye strain.

- 1= Very mild / 5= Very intense

If you have experienced other symptoms related to the use of the headset, please mention them below.

Overall, would you say that wearing a headset interfered with your experience?

- Totally agree
- Agree
- Disagree
- No agreement at all

How would you describe your experience with the headset?

- Very immersive
- Immersive
- Quite immersive
- Not at all immersive

How well do you think you memorised the actions that took place in front of you?

- I remembered everything
- I remembered the majority of the actions
- I remembered most of the actions
- I only remembered some of the actions
- I remembered nothing at all

Did you find it difficult to follow the sequence of events between the two rooms?



- Yes
- At times
- No

(If yes or at times) What did you find difficult in following the sequence of events?

On a scale of 1 to 5, rate the difficulty of following the sequence of events between the two rooms.

- 1= Very difficult / 5= Very easy

Questionnaire 2, 'spherical-scene perception' experiment.

Your course

- MSc Sound Design
- ICCD

Your number

-
- 1
-
- 2
-
- 3
-
- 4
-
- 5

After watching video 2, how would you describe the comfort of wearing a headset?

- It's more comfortable



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- The comfort is the same
- I felt more discomfort

(If 'it's more comfortable' or 'I feel more discomfort') On a scale of 1 to 5, rate the comfort of wearing a helmet after watching video 2.

- 1= Very uncomfortable / 5= Very comfortable Did the headset feel heavier?
- Yes
- No
- It seemed lighter

Did you experience any headaches during/after viewing?

- Yes
- No

(If yes) On a scale of 1 to 5, rate the intensity of these aches.

- 1 = Not very painful / 5 = Very painful

Did you feel dizzy, unbalanced or nauseous during the viewing?

- Yes
- No

(If yes) On a scale of 1 to 5, rate the intensity of these sensations.

- 1= Very mild / 5= Very intense

Did you experience eye strain after viewing?

- Yes
- No

(If yes) On a scale of 1 to 5, rate the intensity of this eye strain.



- 1=very mild / 5=very intense

If you have experienced other symptoms related to the use of the headset, please mention them below.

After watching video 2, would you say that wearing the headset interfered with your experience?

- Strongly agree
- Agree
- Disagree
- No agreement at all

After watching video 2, how would you describe your experience with the headset?

- I felt more immersed
- My experience was unchanged
- I felt less immersed

This time, how well do you think you memorised the actions that took place in front of you?

- I remembered everything
- I remembered the majority of the actions
- I remembered most of the actions
- I only remembered some of the actions
- I remembered nothing at all

Did you find it more or less difficult to follow the sequence of events between the two parts than when you watched video 1?

- Following the events was easier
- My experience was unchanged
- Following the events was more difficult

(If easier) Why do you think it was easier/more difficult?

On a scale of 1 to 5, rate the difficulty of following the sequence of events between the two rooms.



- 1= Very difficult/5= Very easy

Can you briefly describe the scenario (story) you observed? Can you briefly describe the events (actions) you observed?

Can you briefly describe the characters (names, characteristics, etc.)? For you, what were the most important or memorable moments in the story?

Why?

Is there anything else you would like to share about your experience?

4.5.7. Outlook

The continuation of this study necessitates dual trajectories: the extension of the experimental environments and the refinement of analytical methodologies.

In addressing the former outlined in deliverable 5.3.2, we intend to conduct extended cognitive tests with all the environments currently available in the industry: new generation VR headsets, 270° devices and the 360°/180° dome. We will also work with content created specifically for these environments.

Augmenting our experimental framework, we will avail ourselves of a shared research unit at the UCA COCOLAB laboratory with **state-of-the-art eye-tracking instrumentation (WP5.3.2)** and expert personnel proficient in these investigative techniques.

5. PART 2: EXPERIMENTAL STUDY OF THE RECEPTION PRACTICES OF CONTENT IN MIXED REALITY BY YOUNG AUDIENCES

5.1 Presentation of work

In addressing the reception of Mixed Reality practices, and of related technologies more commonly referred to under the umbrella term Extended Reality (XR) — encompassing Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) — this study first examines the emergence of these technologies within the contemporary media landscape. Over the past two decades, XR has asserted an increasingly prominent presence, progressively permeating not only the media industries themselves but also a wide array of sectors where the media structures play a critical role.



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This sustained expansion has had a profound effect on media consumption practices at large and is now exerting a growing transformative impact on both the film industry and the broader entertainment sector.

Building upon the work of numerous scholars, this study recognises that emerging media technologies are exerting a notable influence on the social cognition of audiences, particularly among younger generations. The evolving relationship between cinema and Mixed Reality technologies is most evidently manifested in the phenomenon of their hybridisation. This report offers a historical account of this process, tracing its origins to the early 1970s, when initial attempts at hybridisation were observable both through the development of innovative technologies in their prototype forms and through experimental practices within cinematic production.

The initial hybridisations of classical cinematic techniques and Mixed Reality technologies began to materialise in the early 2000s through the development of industrial formats. These innovations introduced a third dimension to the cinematic spectacle, expanded and multiplied the visual fields, incorporated spatialised sound systems, and integrated multisensory installations — including vibrational effects, pressure sensations, olfactory stimuli, optical illusions, and other sensory enhancements — within the architectural design of movie theatres. Furthermore, the widespread adoption of Video on Demand (VOD) services since 2007, propelled by the ascendancy of major streaming platforms, has significantly contributed to the desertion of traditional cinemas by audiences. This shift has been compounded by the fact that cinemas frequently find it challenging to offer a viewing experience that can adequately compete with the privacy and convenience afforded by home-based media consumption. Consequently, the cinematic landscape — and, more specifically, the processes of hybridisation between cinema and XR technologies — has become increasingly fragmented and differentiated across diverse national models.

Hybridisation subsequently emerged as a vehicle for the dissemination of widely distributed major productions; however, it did not supplant traditional cinematic formats. In the multiplexes constructed over the past decade, theatres employing hybrid formats coexist alongside those maintaining conventional projection methods.

In response to this increasingly complex situation, we sought to analyse the incentive and financing policies supporting the hybridisation of cinema and XR technologies across different national contexts. To this end, we conducted a comparative analysis of policies implemented in five European countries and two non-European countries.

The findings reveal that the hybridisation between cinema and XR technologies remains inadequately supported across European countries, characterised by significant disparities, a lack of harmonisation, and minimal integration of creative education initiatives, where traditional training



models continue to predominate. In contrast, the policies adopted in Canada and South Korea appear to be more coherent, structured, and sustained in their support for hybrid creative practices. This observation, grounded in a detailed quantitative and qualitative study, highlights the need to articulate arguments in favour of enhancing the attractiveness of European cinema by promoting both the production and the consumption of audiovisual works emerging from the hybridisation between cinema and XR technologies.

Acknowledging the evolving modes of social cognition induced by the massive use of media incorporating elements of XR technologies in their devices and recognising the risk that the creative and spectatorial ergonomics of cinema might remain constrained by creative and spectatorial models rooted in the 1970s, we initiated an experimental study focused on the cognitive factor underpinning all media experiences, namely spatial cognition. Informed by the recommendations of early twenty-first-century film theorists, we reconnected with the research traditions established, following David Bordwell's seminal contributions, by the Psychocinematics school, particularly the work of Arthur Shimamura and Tim J. Smith, employing the eye-tracking method in our cognitive experiments to investigate the relationship between both classical and hybrid audiovisual formats and spatial orientation.

In collaboration with the CoCoLab technological research support platform of the Maison des Sciences de l'Homme et de la Société Sud-Est (MSHS Sud-Est) at Université Côte d'Azur (now UniCA), we developed an original experimental workstation, based on the Varjo and Tobii matrix systems, designed to study the perceptual behaviours of users engaging with both classical and hybrid cinema formats.

This study aimed to investigate the potential benefits associated with the integration of XR technologies within both classical cinema and hybrid cinema / XR products. The experimental results revealed substantial advantages in terms of spatial orientation, indicating a promising direction for future research and development in this domain. Eye-tracking data demonstrated a measurable enhancement in spatial orientation among users engaging with hybrid formats compared to traditional cinematic experiences. These findings suggest that revitalising audiovisual consumption in Europe will require the mobilisation of financial and structural resources, including the reinforcement of creative education, to support the production of innovative formats capable of offering a competitive alternative to traditional VOD platforms. Two complementary strategies are envisaged: firstly, the revalorisation of multiplex spaces through increased immersion, interaction, and the blending of physical and virtual realities; and secondly, the advancement of XR technologies aimed at promoting greater economic accessibility and ergonomic refinement in next-generation VR and XR devices.



Through this renewed competitiveness, cinema may reclaim its position as a major medium within the global media landscape, fulfilling its historical role both as a driver of technological innovation and as a catalyst for the renewal of social bonds within viewing communities. This revival encompasses not only the architectural revalorisation of multiplex spaces but also the development of immersive sensory environments that blend in-person and remote experiences, thereby fostering new forms of collective cultural consumption.

Accordingly, our recommendations centre on the redesign and harmonisation of European funding mechanisms to support the creation and distribution of hybridised cinema integrating XR technologies, as well as on the investment in creative film education that explicitly incorporates XR. To illustrate this approach, we have developed a conceptual model for an innovative training programme within this emerging sector.

5.2 Audiovisual Contributions

Apart from our study, we have developed within the framework of REBOOT Programme several audiovisuals' contributions, classic and XR, as part of D7.8 and D5.3.

5.2.1. VR-Based Artistic Works (WP7.8)

The following three videos, along with the immersive scenario developed by Sara Tirelli, are provided for illustrative purposes (when viewing on a computer, it is recommended to select a higher resolution (preferably 1080p HD or 2160p 4K) and to prioritise activation of the '360° / 3D' mode).

- '43° 43' 23.7972' / 7° 21' 32.3022' - https://www.youtube.com/watch?v=NcBpqH_fhJ8
- 'LOOKING FOR AGNÈS' - <https://www.youtube.com/watch?v=vOMG0dmcXqc>
- 'FATHOMING' - <https://www.youtube.com/watch?v=jZi5iOfLNf0>

5.2.2. Videos for Cognitive Studies (D5.3)

The following audiovisual resources were developed as part of cognitive testing protocols related to induced cognition in spatial orientation:

Classical content is intended to support conventional cognitive evaluations related to spatial orientation skills.

- *La Napoule Art Foundation CC* - <https://vimeo.com/1034496770>

Virtual Reality (VR) content was specifically designed to enable cognitive assessment under immersive conditions, targeting both spatial orientation perceptual mechanisms and processing.

- *La Napoule Art Foundation VR* - <https://www.youtube.com/watch?v=jFchzlQQPNs>



5.3. Cinema and Emerging Technologies: Towards the Hybridisation of Two Worlds

5.3.1. Preliminary Statement

In order to enhance the appeal and global competitiveness of European cinema, the EU's incentive policy in the film production sector must define, ponder, and implement a coherent strategy focused on the hybridisation of classical cinema and XR creative technologies.

This necessity stems from a rapidly evolving media environment, in which immersive experiences, interactivity, and new storytelling formats are reshaping audience expectations and global market dynamics. In the absence of strategic adaptation, European cinema risks losing ground/faces the prospect of relinquishing its competitive advantage to other industries that demonstrate a greater agility in integrating technological innovations. Prominent among these are the video game industry and the emerging audiovisual sectors in Asia and North America, which have already achieved a more rapid and systematic adoption of immersive technologies.

Strengthening Europe's position in this new competitive landscape demands proactive support for hybrid cinematic forms, fostering both innovation and cultural distinctiveness. Therefore, a coherent strategy for integrating XR technologies is critical to ensure not only the pursuit but the renewed global competitiveness of European film industries.

The present study aims to shed light on the reasons behind this strategic necessity and proposes pathways for boosting European cinema's capacity for technological and artistic innovation.

5.3.2. The Rationale Behind the Hybridisation of Classical Cinema and XR Technologies

The Emergence of XR Technologies in the Current Media Landscape

A thorough analysis of the prevailing trends within the contemporary media landscape has revealed a substantial proliferation of Extended Reality (XR) technologies, encompassing Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), over the span of at least two decades (Rauschnabel et al., 2022).

The applications of XR technologies have been identified across a broad array of sectors, including various domains of environmental media such as urban and peri-urban scenography, individual and collective mobility media, 360° and 3D geo-localised navigation, museology, the exhibition and event sector, performing arts, immersive telepresence, immersive e-commerce, social and mercantile metaverses, teaching and knowledge dissemination, as well as recreational and entertainment environments.



As of 2025, the publication of a comprehensive volume has offered a broad survey of the diverse applications of XR technologies, highlighting their profound influence on media practices and on a wide range of professional and educational disciplines (Vohra, ed., 2025).

Finally, In the field of media research, XR technologies provide access to highly valuable opportunities for data visualisation. Notably, the use of multimodal data collection within XR, such as eye-tracking (see further), which enables researchers to gain a deeper insight into the cognitive processes underlying the interactions between the viewer/creator and their environment.

The Impact of XR technologies on Social Cognition

The production and use of media are giving rise to a new dimension of the so-called social cognition, evolving under the influence of the broader digital media ecosystem, in areas that are pivotal to the lifestyle of current generations around the world.

In the theory established by the renowned Canadian psychologist Albert Bandura from 1986 onwards (cf. Bandura, 1989), the concept of social cognition is delineated as the evolution of an individual's cognitive processes - such as perception, communication, language, thinking, memory, and problem-solving - all of which shaped by social and environmental factors.

A considerable proportion of this social cognition is determined by the use of various media, as well as by the appropriation and creation of the content they convey.

Since the development of this theory, the media landscape has undergone continuous transformation. The transition from the mass media of the late 1980s - such as print, cinema, radio, and television - to the digital media of the late 1990s marked a pivotal shift. Initially, digital media influenced and reconfigured traditional formats through the process of digitalisation. Following the advent of the smartphone in 2007, media consumption increasingly shifted towards mobile-based digital platforms, paving the way for the emergence of XR-based media.

In the light of the growing prevalence of immersive media, the need to update the theoretical framework initially proposed by Albert Bandura has become essential. This necessity has been underscored by numerous experts, who have identified significant shortcomings within the original model (Beyea et al., 2025).

All educational applications contribute to the enhancement of social interaction within processes of knowledge transfer and the dissemination of up-to-date information. In this context, XR facilitates the creation of realistic and interactive social scenarios, supports the improvement of user practices and social competencies, particularly by fostering empathy, understanding, and awareness of social diversity. As such, XR experiences have the potential to sculpt users' social attitudes and behaviours in real-world contexts.



Beyond existing applications, the repercussions of XR technologies may extend into new domains, notably through their creative convergence with media that, until recently, evolved according to their own internal dynamics. Cinematography - central to the REBOOT project - exemplifies this emerging layer of hybridisation.

The Potential Issue of Social Cognition Disparities Arising

Technological media, industrialised and widely disseminated, have formed an environment governed by major trends, including the proliferation of visual and audio information sources, interactivity, and immersion. While some media adopt an avant-garde position, assuming the role of pioneers, others conform to more traditional standards. This process is driven both, from industrial and commercial pressures, as well as a societal need to adapt to the evolving landscape of cognitive development (Pajares et al., 2009).

Cinematography that fails to consider these new patterns of social cognition - along with the creative and spectatorial ergonomics of media users, which encompass immersion, interactivity, and the blending of realities - risks further exacerbating the already patent gap between general media trends and the specific dynamics of cinema. This can be attributed to the medium's intrinsic characteristics: its continued reliance on photographic and audio recording, which inherently hinders the perceptual field, on linear, goal-oriented narrative structures, its conventional modes of spectatorship experience, largely confined to traditional settings - typically structured around frontal projection in darkened classic architectures or domestic settings, both of which offer limited opportunities for social interaction.

5.3.3. Towards a Historical and Prospective Hybridisation of Classic Cinema and XR

Nevertheless, a prominent trend has been observable over the past two decades - namely, the hybridisation of 'classical cinema' and XR technologies - although earlier, more experimental historical precedents can be identified. This tendency is not uniformly distributed across the global cultural landscape, as it benefits from varying degrees of institutional, governmental, and private-sector support.

The integration of Extended Reality (XR) technologies together with conventional filmmaking techniques represents a multifaceted set of opportunities, while also embedding inherent challenges. Ensuring the continued appeal of European cinema remains a primary objective, and it is imperative that EU incentive policies evolve accordingly to address the ongoing process of hybridisation in the audiovisual and film sector, innovation and global competitiveness can only be sustained through the establishment of a coherent policy framework that strategically incorporates XR technologies into the creative workflow.



Historically, cinema has always been at the forefront of technological innovation, persistently engaging with emerging technologies to shape new cultural narratives and visual storytelling methods. Over the past decade, a noteworthy acceleration has occurred in the convergence between conventional cinematic practices and XR technologies - comprising augmented reality (AR), virtual reality (VR), and mixed reality (MR) - captivating, engaging and creating new audience experiences. Rather than being an isolated phenomenon, this process aligns with recurrent patterns throughout the historical trajectory of the audiovisual and film industries, wherein successive technological advancements have consistently reshaped both formal conventions and institutional structures.

The sustained integration of spherical image capture, spatialised sound, multisensory effects, interactivity, and the amalgamation of mixed realities into cinematic practices reflects a complex interplay between photorealistic imagery rendered through real-world capture, synthetic environments offering varying degrees of sensory immersion, and visual conventions rooted in naturalistic perception. This phenomenon has been recurrent within cinematic experimentation over the past several decades.

Building upon the pioneering works of Ivan Sutherland (Sutherland, 1968), John Whitney (Whitney, 1991), and Morton Leonard Heilig (Morton, 1992), the origins of experimental cinema and video can be situated in the groundbreaking endeavours of the 1960s and 1970s. From the late 1970s onwards, the field witnessed significant advancements, largely propelled by the contributions of emblematic figures such as Nam June Paik (Zurbrugg & Paik, 1990), Bill Viola (Keith, 1998), and Bruce Nauman (Lewallen & Bowen, 2019). These artists consistently drew upon concepts that challenged and reconfigured the boundaries of traditional cinema, both in terms of artistic production - such as screenwriting and recording methods - and in terms of the viewing and auditory devices utilised, including performance hall architecture and individual and collective reception or participation mechanisms.

Over the course of the two decades from 2000 to 2020, alongside artistic experimentation aimed at expanding and transcending established cinematic aesthetic standards, a discernible rapprochement between cinema and the video game industry surfaced. By 2014, the video game industry had overtaken cinema to become the world's most lucrative cultural industry, generating revenues twice those of the film industry (Vosmeer & Schouten, 2014); significantly contributing to the evolution of the global media landscape. This shift has enhanced the cinematic sphere, incorporating the individual aspect of social competition through the interactivity of man/machine and man/machine/man-adversary dynamics (Vosmeer & Schouten, 2014). The hybridisation of cinematic narrative and video game scripting (Wibowo et al. 2024) has come to define a cultural



policy within the intertwined economic realms of the gaming and film industries, particularly in countries like Japan (Otmazgin, 2022) and China (Kim, 2022).

Faced with these disruptions to the genre and these transdisciplinary interpenetrations, cinema, driven by its own dynamics, has sought to propose solutions since 2007. These solutions draw on standards previously tested, such as IMAX, which has been in existence since 1971. Following the transition to 'all-digital' in 2009, when digital postproduction accounted for 70% of films, technological adaptations became widespread across the industry. From this point onward, immersiveness, interactivity, multisensory experiences, and mixed realities have become central to any innovation influencing both film production and distribution.

The ascent of streaming services has progressively undermined the traditional cinematic distribution model. Launched by Netflix in 2007 through subscription-based VOD offerings and accelerated by the improvements in internet infrastructures, the market expanded rapidly during the 2010s with the entry of platforms such as Hulu and Amazon Prime Video, and later Disney+, leading to a profound shift in consumer habits towards home-based, on-demand content consumption (Lobato, 2019; Tryon, 2013).

By the late 2010s and early 2020s, this shift had culminated in a substantial transformation of audience expectations, characterised by an increased demand for immediacy, content personalisation, and flexible viewing conditions (Courtois & Dwyer, 2020). The industry consequently witnessed a paradigm shift marked by direct-to-streaming releases, the erosion of exclusive theatrical windows, and the prioritisation of original content designed specifically for digital consumption. Streaming has thus established itself as a dominant force, fundamentally altering the relationship between audiences and cinematic experiences (Curtin & Sanson, 2016).

In this context, VOD platforms exert a dual influence: they compete directly with traditional production and distribution models, while simultaneously fostering new opportunities for hybridisation through the incorporation of immersive technologies. The development of dedicated platforms such as Arte 360° in Europe exemplifies this convergence between streaming services and extended reality formats. These dynamics signal not merely an adjunct to existing cinematic practices, but a redefinition of audiovisual culture itself, calling for strategic adaptation across the European film industry.

The architecture of cinema theatres has evolved in response to this trend, particularly with the proliferation of large immersive 3D theatres equipped with glasses. Noticeably, the Canadian IMAX standard saw significant expansion, reaching 1,000 screens by the end of 2015 and 1,300 theatres across 75 countries by 2017, predominantly in commercial multiplexes (Orzel, 2017). This growth has spurred the production of numerous high-profile blockbusters in stereoscopic 3D or featuring



2D/3D conversion (for example: Dunkirk - 2017, Avatar: The Way of Water - 2022, Oppenheimer - 2023, Dune - 2021 and 2024, Civil War - 2024).

Some of these productions also employ 'motion capture' technology to 'naturalise' 3D animation, taking another step toward refining the effect of blending realities. This is especially evident in the Chinese film industry, where 'motion capture' not only revives the traditional concept of 'suppositionality' (jiadingxing) (Quah Sy, 2010) but also reinvents itself within the framework of 'virtual realism' (McGrath, 2021).

Other Asian film industries are attempting to follow the same path, both in terms of production and architectural developments, shifting the focus from 3D to the broadening and multiplying the viewer's visual fields. In 2009, the Asian group CJ 4DPLEX pioneered the 4DX room architecture, (adjustable seats, a range of physical effects entailing vibrations, acoustics, olfactory sensations, and meteorological elements). In 2012, the ScreenX format further refined this pursuit, introducing a 270° projection spanning three screens, with a fourth a fourth added to the ceiling in 2020. Since its debut in Seoul, South Korea, in 2009, these innovations have been implemented in over 750 theatres across 65 countries. By 2019, approximately fifteen blockbusters per year were being showcased in this format, either designed especially for this format or adapted (e.g., Alita: Battle Angel - 2019, Wonder Woman 1984 - 2020, Spider-Man: No Way Home - 2021, Top Gun: Maverick - 2022, Napoleon - 2023, Furiosa: A Mad Max Saga - 2024).

As evidenced, even prior to the digitalisation of the profession, and to a greater extent in its aftermath, the propensity for immersion, interactivity, multi-sensoriality, and the blending of realities has evolved from experimental phases to its consolidation in the establishment of industrial standards, thereby assuming a pivotal role in steering not only the production and architecture of films but also the economic, sociological, and cultural dimensions of cinema.

This inclination finds one of its most compelling articulations in the recent expansion of two major international film festivals: the Venice Film Festival's Venice Immersive - Extended Reality (XR) section, which in 2024 presented 63 projects both in and out of competition; and the Cannes Film Festival's newly established Immersive Competition, which featured eight VR productions in competition - including En amour by Claire Bardainne, Adrien Mondot, and Laurent Bardainne, exhibited at the Georges Méliès Creative Industries Campus of Côte d'Azur University in Cannes - alongside six additional works screened out of competition.

In view of the historical and increasingly evident convergence between cinema and XR technologies, it is clear that the transformation of audiovisual practices is no longer a speculative prospect but an ongoing and accelerating reality. Case studies ranging from early experimental cinema to contemporary large-scale productions demonstrate that hybridisation is reshaping not only the modes of production and experience, but also the ways in which films are distributed, consumed,



and monetised. While such technological shifts are taking place globally, their integration within European cinema remains selective and uneven, lacking the support of a coherent policy framework. As the audiovisual and film sector enters a new phase of industrial consolidation and mainstream adoption, the absence of coordinated public support mechanisms risks sidelining both European institutions and creators in the global innovation race around interactive media. Against this backdrop, the following section provides a critical examination of national and international policy responses, and evaluates their capacity to address the challenges and harness the opportunities presented by cinema - XR convergence.

5.4. European Policy Support for the Hybridisation of Cinema and XR

5.4.1. Introduction

In this study we examine different film funding policies, first in Europe, and then on an extra-European scale. Our criteria in this study concern the financial volumes of the aid in question and their strategies and structures, in order to arrive at contrasting results. We highlight the disparity and inequality of the aid granted separately by *five European countries* and we compare this image to *two strategies practiced on a global scale*.

These observations underscore the lack of a coherent and sufficiently ambitious European policy with regard to the integration of XR technologies into the wider ecosystem of audiovisual creative tools. In the absence of strategic and concerted investment in this area, the European Union runs the risk of being outpaced by extra-European industries - often rapidly developing - that have already embedded these technologies at the core of their innovation agendas.

Notwithstanding these advancements, a significant gap persists in the EU's policy configuration. Current support for XR technologies within the European film industry remains fragmented and inconsistent across member states. The disparities in funding allocations, coupled with the uneven and selective prioritisation accorded to XR in audiovisual initiatives, bring to the fore the pressing necessity for a more cohesive and harmonised policy approach.

This section evaluates the ways in which European policies might be more effectively aligned with the ongoing hybridisation of cinema and XR technologies. By identifying and addressing the limitations of the current policy landscape, it proposes strategic avenues for the integration of XR into the European audiovisual sector, with the dual aim of fostering innovation and safeguarding the distinctive cultural identity of European cinema.

By examining official public funding reports from five European countries (Belgium, France, Germany, Italy, and Luxembourg) alongside two non-European counterparts (Canada and South Korea), this section seeks to identify patterns, convergences, and divergences in policy approaches.



It focuses on understanding how state support mechanisms contribute to fostering innovation within the audiovisual sector and to bridging the gap between traditional cinematic practices and immersive technologies. The findings aim to shed light on the underlying policy frameworks governing the hybridisation process, whilst offering a comparative perspective intended to inform both academic inquiry and policymaking.

5.4.2. Research Hypotheses

Hypothesis 1: Europe's film system is characterised by significant diversity and a lack of coordination, with policies exhibiting fragmentation. This disunity warrants investigation, particularly in light of emerging trends such as the hybridisation of traditional cinema with XR (extended reality) technologies.

Hypothesis 2: No global framework or comprehensive policy currently exists to address the hybridisation between traditional cinema and immersive technologies.

5.4.3. Research Design

To investigate the hybridisation of cinema and XR technologies, a multiscale comparative study is employed. Comparative research is instrumental in identifying patterns, similarities, and differences across various contexts (e.g. Yin, 2018), allowing researchers to systematically appraise and interpret diverse data, thereby providing valuable insights into how state aids have influenced the hybridisation of cinema and XR technologies across different regions.

The present study undertakes a detailed documentation and categorisation of data drawn from a selection of state aid reports. Secondly, it examines the underlying principles that inform the allocation and utilisation of such aid. Finally, it scrutinises the effectiveness of these schemes with regard to public sector efficiency and their impact on fostering hybridisation between classical cinema and XR technologies.

5.4.4. Sampling

The careful selection of source materials is essential in qualitative research (Creswell, 2003; Flick, 2009: 131). In this study, purposive sampling is employed to identify documents that offer the most pertinent and insightful information regarding state aid schemes for film and XR technologies.

The sample under consideration comprises state aid reports from five EU member states (Belgium, France, Germany, Italy, and Luxembourg), and two extra-European countries (Canada, South Korea). These countries were specifically identified within the REBOOT Grant Agreement (Grant No. 101094796) as key areas for comparative analysis.



Within Europe, Belgium and Luxembourg are notable for their exceptionally high rates of international co-productions, which make them central nodes in the networked structure of European film production. Their funding mechanisms and policy frameworks provide critical insight into the ways in which smaller countries can use cooperation and cross-border initiatives to stay competitive. Meanwhile, France, Germany and Italy are historically and structurally among one of the strongest film industries in Europe. As founding members of the EU, they have a mature and highly developed audiovisual sector, which is a traditional core of European film culture and political leadership. Studies reveal how large, influential players adapt to - or sometimes - resist, emerging technological shifts such as XR. Beyond Europe, Canada and South Korea's aid reports are selected. These countries are pioneers in terms of adopting multiplex theatres, innovative and interactive technologies and provide valuable comparative perspectives worldwide. The selected documents were obtained from the states' relevant public funding bodies and provide a solid basis for examining the commonalities, correlations, and links between state aid in these regions.

5.4.5. Limitations

This study is subject to several limitations. The primary limitation lies in the sample size, as the analysis is based on a limited selection of state aid reports, thus restraining the ability to extrapolate findings to the broader population of film funds. What's more, the observed discrepancies between national and regional data could result in disproportionate outcomes, complicating meaningful comparative analysis. Eventually, the absence of standardised data hampers the instruction of a clear and comprehensive picture of XR production across Europe. With some member states providing funding for XR / VR / AR projects while others do not, a disjointed landscape emerges, further obscuring the scope of XR production in Europe. In essence, the lack of transparency serves as a fundamental barrier to understanding the trends and challenges confronting the European XR sectors.

5.4.7. EU Policies and Funding Initiatives in the Audiovisual and Film Sectors

Previous REBOOT deliverables have already laid a significant foundation in the field of European policies and funding mechanisms in the audiovisual and film sector. *D2.1 (Competitiveness in European Law)* provides a detailed analysis of the ways in which European Law establishes the legal foundation for public support mechanisms and policies aimed at enhancing competitiveness. Similarly, *D3.2 (Governance and Public Value)* examines the ways in which governance structures and public institutions contribute to the development of public value within the European film industry. This study builds on these findings but extends the focus to recent policy developments -



on both European and national level - with regard to immersive technologies such as virtual, augmented, mixed and extended reality.

From a historical perspective the European film industry has frequently been depicted as lagging behind Hollywood productions¹. The preponderance of US films within the global cinema industry has prompted European nations to implement policies, in parallel with dedicated funding programmes and initiatives with the objective of upholding their national cinematic heritage and bolstering the production of European films.

European film policies have consistently acknowledged the contribution of films to culture, diversity, and identity. The Treaty of Rome (1957), which established the European Economic Community (EEC), primarily aimed at fostering economic cooperation, which would eventually evolve into political cooperation. While the treaty made limited reference to culture, it was the Treaty of Maastricht in 1992 that placed cultural issues at the heart of European Union priorities. Specifically, the Treaty of Maastricht, also known as the Treaty on European Union, stated in Article 128 that the community 'shall contribute to the flowering of cultures of the Member States' and support 'the culture and history of the peoples', their cultural heritage, and 'artistic and literary creation, including in the audiovisual sector'. Conversely, the Treaty of the EU (Article 92-3) was the first to recognise that state aid rules should account for cultural objectives, emphasizing that 'aid to promote culture and heritage conservation should not affect trading conditions and competition to the common interest' (Treaty of the EU, 1992:17).

In 2001, the European Commission introduced the '*Cinema Communication*', which established the assessment criteria for state support for film production and other audiovisual works. Following three significant extensions (2004, 2007, 2009), the Commission ultimately adopted new rules for film support on 15th November 2013. The Communication on State Aid for Films and Other Audiovisual Works² outlined the parameters within which member states could provide financial assistance (in the form of grants, tax incentives, or other financial measures) for film production, provided that they met certain criteria, such as contributing to the promotion of European culture, including storytelling diversity and access to creative works. Moreover, the financial aid must be proportional to the objectives pursued and should not distort competition in the internal market.

1 Katsarova, I. (2014). *An overview of Europe's film industry* (Briefing No. PE 545.705). European Parliamentary Research Service.

[https://www.europarl.europa.eu/RegData/etudes/BRIE/2014/545705/EPRS_BRI\(2014\)545705_REV1_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2014/545705/EPRS_BRI(2014)545705_REV1_EN.pdf)

2 European Commission. (2013). *Communication from the Commission on State aid for films and other audiovisual works* (Text with EEA relevance). Official Journal of the European Union, C 332/1. [https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013XC1115\(01\)](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013XC1115(01))



From 1992 to 2013, substantial efforts were made to support the European film industry, with the establishment of the *Creative Europe Programme* in 2014 standing out as the most significant. This initiative, which superseded the previous MEDIA, MEDIA Mundus, and Culture 2007-2013 programmes, is dedicated to supporting the audiovisual and cultural sectors. The inaugural *Creative Europe Programme* ran from 2014 to 2020, with a total budgetary allocation of €1.8 billion, signifying a 37% increase compared to the preceding Media and Culture programmes³. The *programme* is structured into three sub-programmes: the *Culture Strand*, the *MEDIA Strand*, and the *Cross-sectoral Strand*.

The overarching objective of the Creative Europe Programme is to cultivate collaboration and the exchange of knowledge among cultural institutions and artists across Europe and beyond, covering areas such as cultural heritage, literature and publishing, music, and performing arts. Additionally, it aspires to promote competitiveness, innovation, and sustainability within the European film and audiovisual industries. It encourages collaborative actions, including media literacy and the development of diverse news media environments. On the whole, the programme is open to Cultural Creative Sector (CCS) organisations from EU Member States, as well as from non-EU countries under certain conditions, assisting them in adapting to globalisation, digitalisation, and transnational challenges. The European Commission oversees the overall administration and management of the *Creative Europe Programme*, developing policies, setting priorities, evaluating grant applications, monitoring project implementation, and providing guidance and support to beneficiaries.

Regarding the second area, the Commission announced the creation of a platform for structured dialogue between the European VR / AR ecosystem and policy makers, known as the *European Virtual and Augmented Reality Industrial Coalition*, with the aim to help EU media benefit from these immersive technologies and the new ways of storytelling.

The global COVID-19 pandemic posed unprecedented challenges to European cinema, prompting the co-legislators to reinforce the 2021-2027 Creative Europe Programme in 2020, increasing its budget⁴ to €2.44 billion. Concurrently, the Commission adopted an *Action Plan*⁵ in December 2020 to support the *recovery and transformation* of the media and audiovisual sectors. This initiative focused on three principal objectives: first, facilitating recovery from the crisis; second, supporting the sector's green and digital transitions; and third, empowering individuals and enterprises across Europe. In relation to the second priority, the Commission announced the initiation of a platform for

³ The Creative program replaced the previous MEDIA, MEDIA Mundus and Culture 2007-2013 programs.

⁴ <https://culture.ec.europa.eu/creative-europe/about-the-creative-europe-programme>

⁵ https://ec.europa.eu/commission/presscorner/api/files/document/print/en/ip_20_2250/IP_20_2250_EN.pdf



structured dialogue between the European VR / AR ecosystem and policymakers. This initiative, known as the European Virtual and Augmented Reality Industrial Coalition, seeks to enable EU media actors to harness the potential of immersive technologies and to explore new forms of storytelling.

Two years later, on 14th September 2022, the *Virtual and Augmented Reality Industrial Coalition* was officially launched. Until 2023, it held a series of workshops, engaging over 100 participants focused on VR / AR technologies and competitiveness. Subsequently, a citizen panel convened from February to April 2023 to provide recommendations that reflected their expectations for virtual worlds, placing emphasis on fairness, safety, and societal benefit. This process culminated in the development of a new strategy for *Web 4.0 and Virtual Worlds*, highlighting the importance of Europe's Single Market, its diverse cultural heritage, creative content, industrial strength, excellence, innovation capacity, educational systems, and robust legislative framework as key factors in establishing leadership, competitiveness, and technological sovereignty in this domain.

With the publication of the *Communication on Web 4.0 and Virtual Worlds* in July 2023, the Commission formally affirmed the pivotal role of virtual world technologies in crafting the future of the creative industries within Europe. In response, the EU, through the Creative Europe Programme, allocated nearly €85 million⁶ in 2023. A significant portion of this support was directed towards European cooperation projects, the circulation of European literary works, platforms promoting emerging artists, pan-European cultural entities, and networks of cultural and creative organisations. In greater detail, under the MEDIA Strand, a total of €139 million in grants was allocated for the promotion of digitalisation in the audiovisual industries and the development of immersive content within the augmented and virtual reality sectors. The following section outlines the funding schemes of five European member states, alongside their respective budgets dedicated to immersive technologies.

5.4.7. State Funding Mechanisms for the Audiovisual and Film Industries

European countries supply state aid not only for the development, production, and distribution of films to wider audiences, but also to support the broader audiovisual economy. This includes grants, subsidies, and fiscal incentives aimed at attracting both new and established filmmakers. Furthermore, national schemes promote cinema and protect cultural heritage. These support mechanisms vary across countries, covering all stages of film production - scriptwriting, development, production, distribution, and promotion. On top of that, they extend beyond feature

⁶ https://commission.europa.eu/strategy-and-policy/eu-budget/performance-and-reporting/programme-performance-statements/creative-europe-programme-performance_en



films to encompass other audiovisual works, including TV series, VR / AR / XR projects, interactive media, video games, and user-generated content.

This section examines the film industries of five EU member states (Belgium, France, Germany, Italy, Luxembourg), focusing on their respective funding programs and their transition towards immersive technologies (AR / VR / XR). This transition is not merely technological; it represents a fundamental redefinition of the viewer experience, transforming EU audiences from passive consumers into active participants within hybrid physical and digital environments. It is important to highlight that this shift aligns with the European Commission's broader strategy and initiatives surrounding Web 4.0 and Virtual World Technologies.

5.4.8. The Belgian Film Industry

The Belgian film industry boasts a rich and dynamic history, spanning more than a century and playing a pivotal role in shaping the nation's cultural identity. Its varied cinematic output mirrors Belgium's unique multilingualistic and cultural composition. As a federal state, Belgium comprises three Communities - the Flemish Community, the French Community, and the German-speaking Community - and three Regions: The Brussels-Capital Region, the Flemish Region, and the Walloon Region. The first automatic aid schemes for film production were introduced in 1952⁷. Today, support for cinematic and audiovisual works is systematically organised at both the community and regional levels⁸.

Mapping the Film Funding Landscape in Belgium

The *communities* lay out the main regulatory basis governing film and audiovisual funding. In particular, the *Centre du Cinéma et de l'Audiovisuel* (CCA) oversees the support policy of the French-speaking Community of Belgium. The CCA is financed through contributions from the Community itself, along with a levy system obliging television service editors and distributors to invest either in co-productions or directly into production funds managed by the Centre. The renowned public service broadcaster RTBF serves as a central partner within this ecosystem.

The CCA bestows financial support for an extensive assortment of works, covering feature films, short films, experimental projects, and television productions, as well as for distribution, promotion, and a network of specialised production workshops and training programmes. In addition, the CCA collaborates with its Flemish counterpart, the *Vlaams Audiovisueel Fonds* (VAF), through a joint feature co-production fund and reciprocal support for television documentaries.

⁷ https://orbi.uliege.be/bitstream/2268/322271/1/Public_funding_for_film_and_audiovisual.pdf

⁸ <https://rm.coe.int/mapping-film-funds-be/1680aed573>



The audiovisual industry in Flanders benefits from the support of the *Vlaams Audiovisueel Fonds* (VAF), which is funded by the Ministry of Culture of the Flemish-speaking Community of Belgium. Since 2005, the VAF has experienced a positive trend in its income. However, funding for VAF's traditional activities - such as film and television production, promotion, research and development, and training - experienced a slight decline in 2010, coinciding with the establishment of a new fund, Mediafonds. The Mediafonds was created to tackle challenges faced by local production companies, particularly the decline in broadcaster investment in independent productions. In 2011, the Mediafonds had a total budget of EUR 6.5 million, funded jointly by the Ministers for Media and Culture.

At the regional level, *Wallimage* operates as the official fund in the Walloon region. It serves as a development-oriented entity and is the only regional fund in the area. Wallimage is divided into two subsidiaries: Wallimage Coproductions, which invests in co-productions beneficial to the region, and Wallimage Entreprises, which supports innovative audiovisual companies operating locally. Since 2009, a specific initiative, *Wallimage / Bruxellimage*, has been in place, funded equally, with 50% provided by the Walloon Region and 50% by the Brussels-Capital Region. This initiative aims to invest in productions that meet qualifying spending levels in both regions⁹ (p.116).

In the Flemish region, *Screen Flanders*¹⁰ delivers capital support to audiovisual productions that earmark all or part of their budget to activities within the region. Belgian producers can apply for refundable advances of up to €400,000 to cover production expenses in Flanders, while foreign producers may access this funding by entering into co-production agreements with eligible Belgian producers. Screen Flanders also functions as the central film commission for the Flanders region, offering support and guidance to both domestic and international filmmakers regarding location scouting, incentives, and production and post-production services. The fund operates with an annual budget of €3.5 million, allocated by the Flemish Agency for Innovation and Entrepreneurship (VLAIO), and managed by the Flanders Audiovisual Fund (VAF).

Finally, *Screen Brussels*¹¹ is an audiovisual economic fund offering financial support to audiovisual productions in the Brussels-Capital Region. Its goal is to generate long-term innovative benefits for the region's audiovisual industry, with positive outcomes extending to European filmmakers. To qualify for funding, projects must meet specific cultural and economic criteria, such as demonstrating a minimum eligible expenditure within the Brussels-Capital Region, securing part of the required funding before applying, and/or being affiliated with a commercial production company based in Belgium. Screen Brussels operates with an annual budget of €3 million to support a range of

⁹ <http://www.catalogus.boekman.nl/pub/P19-0348.pdf>

¹⁰ <https://screenflanders.be/en/about-us/>

¹¹ <https://screen.brussels/en>



audiovisual formats, including feature films, television series, animated films, documentaries, web series, and emerging formats like virtual reality (VR) and 360° or 180° media. Belgian producers can apply for refundable advances of up to €500,000¹² for eligible expenses within the Brussels-Capital Region, while foreign producers may access the fund by forming co-production agreements with qualifying Belgian producers. To qualify, (co-)productions must demonstrate a minimum investment of €250,000¹³ in the Brussels-Capital Region.

Regarding *indirect public funding*, Belgium has implemented a robust tax shelter system, which applies across all Communities to incentivise audiovisual productions within the country. The *tax shelter* is a mechanism supervised by the federal state of Belgium that enables producers to raise funds while allowing investors to receive a small return by directing part of their tax payment directly to an audiovisual or film production. Thus, the tax shelter system serves a dual purpose: on one hand, it promotes cultural diversity by enabling the financing and realisation of numerous audiovisual projects; on the other, it aims at an economic goal by raising funds, boosting the film industry, and increasing expenditure within Belgian territory simultaneously.

The tax shelter mechanism can be summarised as follows: an investment company commits to financing an approved audiovisual work from a producer, who must not be a production or broadcasting company. The investment company must either be based in Belgium or be a Belgian (subsidiary) establishment of a foreign company. This rule also applies to production companies. The commitment is formalised through an agreement, which is typically supervised by an intermediary company. The investor then has three months to pay the full amount promised, while the producer has 18 months to cover the planned expenses that will contribute to the development and production of the audiovisual work. Moreover, the investment company receives tax advantages. The investment can be deducted from the investor's taxable income, thus lowering their tax liability. Finally, the system follows a strict approval process. Only audiovisual works that meet specific criteria - such as cultural relevance, economic impact, and potential for success - are eligible for the tax shelter mechanism.

Critical Analysis

Belgium's public film funding model is not centralised at the national level; rather, it adopts a distinctly decentralised¹⁴ character. This implies that various linguistic communities - Flemish, French, and German - as well as different regions - Brussels, Flanders, and Wallonia - offer distinct mechanisms for film funding. As Steele (2016) observes, public film support in Belgium emerges from a complex

12 EAO (2019) Mapping of film and audiovisual public funding criteria, p.131

13 EAO (2019) Mapping of film and audiovisual public funding criteria, p.133

14 Compendium of Cultural Policies and Trends. (2017). *Belgium: Cultural policy profile* (November 2017 ed.). Retrieved from https://www.culturalpolicies.net/wp-content/uploads/pdf/belgium/belgium_112017.pdf



interplay of regional, communal, and transnational networks. More specifically, regional production subsidies such as Wallimage, while primarily aimed at fostering local talent and production, frequently engage in transnational co-productions - particularly with France - driven by both cultural affinity and strategic opportunity. The international success of Francophone Belgian cinema, especially in France and at global film festivals, often translates into tangible benefits for the regional industry, by attracting further investment and raising the profile of local filmmakers and production resources.

In addition, Belgium's internal regional divisions - both linguistic and territorial (between Wallonia and Brussels) - further complicate the concept of a unified 'national' cinema, thereby rendering the 'region' a more fitting framework through which to analyse film production and identity. As such, it becomes evident that both the funding and production of Francophone Belgian cinema are deeply enmeshed in transnational collaborations, chiefly with France, alongside robust regional support and the solidarity fostered by linguistic communities. Steele's (2016) 'transnational regional' perspective thus offers a valuable lens through which to understand how these intersecting dynamics shape the Belgian film landscape - from funding schemes and co-production strategies to distribution practices and the evolving definition of cinematic identity.

5.4.9. The French Film Industry

France has exerted a profound influence on global cinema for over a century and remains one of the world's leading film-producing nations. According to data published by *Statista*¹⁵, 2023 marked the strongest year for French film and television exports since the onset of the pandemic. Furthermore, the CNC Report (2023) indicates that a total of 287 feature films were approved that year - including 54 documentaries and 13 animated productions - with overall investment reaching €1.18 billion.

The French film industry is heavily subsidized by a variety of funding bodies and initiatives, consisting of a complex system of subsidies, tax credits, and other funding initiatives. France has always encouraged the creative and industrial components of cinema, from production to distribution. Therefore, as cinema evolves, so do the funding systems designed to support it. As it will be shown in the following paragraphs, the French state has lately welcomed immersive technologies (virtual reality, augmented reality, mixed reality, extended reality) as critical components of its cinema industry, and has applied several related funding mechanisms, recognizing in this way their impact both on storytelling and the experiences for audiences.

15 Statista Research Department. (2024). *French movies and TV shows exports - statistics & facts*. Statista. <https://www.statista.com/topics/12082/french-movies-and-tv-shows-exports/>



Architecture of National Support Schemes and Institutions

France's film industry benefits from a diverse range of state aid mechanisms operating at both national and regional levels. These mechanisms play a vital role in ensuring that French cinema remains both competitive and at the forefront of innovation. The principal institution responsible for administering public support is the *Centre National du Cinéma et de l'Image Animée* (CNC), established in 1946. As the primary governmental body overseeing the French film and audiovisual sector, the CNC sustains and promotes national production through a wide array of targeted programmes. Notably, the 1992 *Décret n°91-1131* formally recognised cinema as an art form, thereby justifying its eligibility for public support. Under the authority of the Ministry of Culture and Communication, the CNC manages numerous funding schemes aimed at fostering production, distribution, technological innovation, and the integration of emerging formats such as virtual reality (VR), augmented reality (AR), and mixed reality (MR). It is also responsible for regulating and promoting the industry both nationally and internationally.

The support provided by the CNC¹⁶ divided into two main categories: 'automatic' and 'selective' funding. Automatic support functions as a form of virtual credit based on a film's financial performance - namely box office receipts, DVD sales, and television distribution revenues. This mechanism serves as a barometer of a film's commercial success: the higher the revenue generated, the greater the available funding. Importantly, these funds are restricted and must be reinvested in future productions. In contrast, selective support is awarded to projects deemed culturally valuable, irrespective of their commercial prospects. This type of funding is typically allocated to independent producers in the form of recoupable loans. As part of the French government's broader strategy to stimulate the cultural and creative industries, two notable funding instruments have recently been introduced: the *Fonds d'aide au jeu vidéo* (FAJV), which supports video game development, and the *Fonds d'aide à la création immersive* (FACI), dedicated to the creation of works incorporating immersive technologies.

The *Fonds d'aide au jeu vidéo* (FAJV) is a selective funding mechanism designed to promote innovation and creativity within the video game sector. It primarily targets the pre-production phase, offering support to developers in the creation of non-commercial prototypes. Applications are assessed by a commission of experts, which submits its recommendations to the President of the CNC, who ultimately makes the final decision regarding the allocation of funds. The aid is capped at 25% of eligible R&D expenditure¹⁷, defined as all pre-production costs incurred up to the

16 Serra, F. (n.d.). *Management of creative business processes* (Master's thesis, Copenhagen Business School). CBS Research Portal. https://research-api.cbs.dk/ws/portalfiles/portal/58432630/francesca_serra.pdf

17 Centre national du cinéma et de l'image animée (CNC). (n.d.). *Support Fund for Videogames*. Retrieved April 21, 2025, from https://www.cnc.fr/web/en/funds/support-fund-for-videogames_191823



development of a non-marketable prototype. For Small and Medium-sized Enterprises (SMEs), this ceiling is raised to 35%. Half of the aid is granted in the form of a repayable advance. Once approved, the aid remains valid for one year, within which the agreement between the beneficiary and the CNC must be formalised.

The *Fonds d'aide à la création immersive* (FACI) was established in 2022 to support authors and producers - whether associations or companies - wishing to develop interactive and immersive audiovisual works. The fund offers support across various stages of the creative process, including writing, development, and production. It is open to production entities based in France, provided that their chairperson, director, or manager, as well as the majority of board members, hold French nationality. As with the FAJV, grants are awarded by the President of the CNC following evaluation by a professional committee. This committee assesses projects based on their alignment with the selection criteria specific to each scheme.

In addition to the CNC, the role of SOFICA (*Sociétés de Financement du Cinéma et de l'Audiovisuel*), public investment companies established in 1985, is also noteworthy. Their primary function is to raise private funds for audiovisual and cinematographic projects that have already received approval from the CNC. Private investors who choose to subscribe to a SOFICA can benefit from a tax reduction equal to 100% of their investment, up to a maximum of €18,000.

Regarding tax incentives, the French state provides funding for both national and international productions. For national productions, the Crédit d'Impôt Cinéma (CIC) reduces the production costs of films made in France. It offers a 20% tax credit for French production companies, applicable to 80% of the below-the-line budget. To qualify for the CIC, producers must pass a cultural test, requiring at least 38 points out of 40. Factors such as the nationality of the cast, shooting locations, and post-production activities are crucial in the evaluation process.

For international productions, the Tax Rebate for International Productions (TRIP) applies to works wholly or partly made in France by a foreign company. These productions must incorporate elements of French culture, heritage, or territory. The TRIP is selectively awarded by the CNC to the line producer in France and covers 20% of eligible film expenses incurred within the country. However, the eligible expenses cannot exceed 80% of the total film budget.

Finally, foreign production companies and/or producers can access the services provided by *Film France*¹⁸, a network of 40 local film commissions across the country. Film France offers comprehensive information on studio facilities, locations, post-production services, crews, and suppliers.

18 Film France. (n.d.). *About us*. Retrieved April 21, 2025, from <https://www.filmfrance.net/en/about-us/>



At the regional level¹⁹ (European Commission 2019: 271), several regions, departments, and cities have established funds to support film production. Among the most significant in terms of investment are Île-de-France (the largest film production centre in France), Nouvelle-Aquitaine (a leader in developing immersive experiences), Hauts-de-France, Provence-Alpes-Côte d'Azur, Grand Est, and Bretagne. These regional funds work in conjunction with national initiatives to provide additional support to filmmakers, especially those working on projects that promote local culture, attract tourism, or incorporate immersive technologies. Most regional bodies establish their own support policies, with the cultural value of the film project being the primary factor for funding. While the majority of funding supports French-language films, some regions also welcome foreign productions.

Critical Analysis

France serves as a quintessential example of a highly interventionist film subsidy culture in Europe (Messerlin & Vanderschelden, 2018). The French government has long adopted a 'promotive and/or protective policy' model (Messerlin & Parc, 2014) aimed at fostering both quality and diversity within the film sector. While direct public aid, provided by the CNC and the regions, constitutes the primary source of funding, it is further complemented by tax incentives, an indirect public funding mechanism. However, as noted by Messerlin and Vanderschelden (2018), the film support system in France is complex and somewhat dysfunctional due to the blending of grants and public subsidies with tax relief for private investors. Specifically, they argue that despite the country's robust funding mechanisms, the subsidy scheme yields mixed results: while it has been successful in cultivating a strong French cinema industry (largely through the efforts of the CNC), it falls short when it comes to enhancing audience engagement and demand.

To assess the effectiveness of the subsidy system, Messerlin and Vanderschelden (2018) estimate the 'true' size of the French film industry and the subsidy rate. Their findings reveal that the 'subsidy rate' constitutes approximately one-third of the industry's value added. Notably, they identify a gap between the steady appeal of French films and the sharply increasing subsidies, suggesting that the subsidy policy has not succeeded in enhancing audience engagement. They argue that while film production has risen with the availability of subsidies, this increase can be viewed as an automatic response rather than a result of strategic policy success.

While the French subsidy regime has contributed to increasing the diversity of the French audiovisual industry, it has done little to boost audience demand for French films. According to Messerlin and Vanderschelden (2018), this is due to the high cost of the French film funding policy,

19 Commission Européenne. (2019). Film funds: Final report (Rapport CB944929). Commission Européenne.



which ultimately proves ineffective in engaging audiences. They conclude by questioning whether a non-subsidised film industry could thrive as well as one that is heavily subsidised, pointing to evidence that supports this possibility.

It is clear that the French film production system faces several challenges, which could be addressed through a comprehensive modernization process aimed at achieving global leadership and capitalizing on the opportunities presented by market internationalization and production scaling. This strategic shift towards internationalization, diversification, and adaptation is embodied in the France 2030 Plan²⁰, announced by President Emmanuel Macron in 2021. The plan is primarily focused on enhancing the attractiveness and appeal of France, positioning the country as a leading international hub²¹ for film and digital productions. Central to this initiative is the coordination of investments in technical manufacturing resources and training to align with market trends. This integrated approach presents an opportunity to strengthen local ecosystems, bringing together top-tier studios, training, and talent, while adhering to the highest international standards in film and digital production.

5.4.10. The German Film Industry

After WWII and the devastation of the German film industry, German cinema has successfully transformed into one of the strongest in Europe and worldwide. According to Statista²², the revenues of the German film industry in 2023 saw a sharp increase (929.1 million euros) compared to the three years affected by the pandemic. On a global scale, Germany consistently ranks among the top ten²³ film markets, highlighting its critical role in the international cinema landscape. This prominence is bolstered by a robust network of four federal/national and fifteen regional film funding institutions that offer various support mechanisms, including grants, loans, tax incentives, and both automatic and selective funding.

Presentation of Funding Bodies and Schemes

The German Federal Film Board (FFA)²⁴ is the national film funding institution of Germany, supporting all aspects of the country's cinema. It functions both as a funding body and as the central

20 Centre national du cinéma et de l'image animée (CNC). (n.d.). *Appel à projet France 2030 - La grande fabrique de l'image : sur les studios et la formation*. Retrieved April 21, 2025, from https://www.cnc.fr/professionnels/aides-et-financements/multi-sectoriel/appel-a-projet-france-2030--la-grande-fabrique-de-l-image--sur-les-studios-et-la-formation_1672282

21 https://www.cnc.fr/web/en/news/the-national-centre-for-cinema-and-moving-images-cnc-develops-new-means-to-promote-the-french-image-industry_1580634

22 Statista Research Department. (n.d.). *Cinema revenue in Germany from 2003 to 2023*. Statista. Retrieved April 21, 2025, from <https://www.statista.com/statistics/382665/cinema-revenue-germany/>

23 Film Distributors' Association. (n.d.). *Worldwide box office: Top 10 territories*. Retrieved April 21, 2025, from <https://filmdistributorsassociation.com/the-industry/databank/worldwide-box-office/top-10-territories/>

24 Filmförderungsanstalt (FFA). (n.d.). *Home*. Retrieved April 21, 2025, from <https://www.ffa.de/home.html>



service hub for the German film industry. Its budget is primarily funded through the film levy', a contribution collected from cinemas, the video industry, and television.

The FFA offers direct public financial support for feature films across all stages of production and exploitation, from script development and production to distribution, sales, and video distribution. Beyond film funding, the FFA plays a vital role in preserving German film heritage, promoting German cinema internationally, and supporting film education initiatives. As a central service provider for the German film industry, the FFA also analyses and publishes key market data on the film, exhibition, and video sectors within the country.

The FFA provides funding for film production in two forms²⁵: a) *selective*, project-based funding and b) *automatic*, performance-based funding, known as reference film funding. Selective funding is granted based on decisions made by committees that assess the screenplay's quality, audience figures, and the project's economic viability. It is provided as a repayable loan of up to one million euros for both German film projects and international co-productions. In contrast, reference film funding is allocated according to performance indicators that measure the output at various stages of the film production and market process. This funding is in the form of grants and is primarily intended for new film productions. However, producers may use the funding either for the development of new projects or to increase the nominal capital.

The second national funding scheme is the *German Motion Picture Fund* (GMPF)²⁶, which aims to strengthen Germany's competitiveness and innovation as a film production hub. With an annual budget of 10 million euros, the GMPF operates similarly to the DFFF, offering automatic funding without requiring a jury review. The GMPF can be combined with other public subsidies, but the total funding cannot exceed 50% of a project's overall budget. The smallest national funding body in Germany is the *Kuratorium junger deutscher Film*, which receives support from the German states. This foundation focuses on promoting emerging filmmakers (talent films) and children's cinema.

Furthermore, the Federal Government Commissioner for Culture and Media (BKM) is responsible for the support, development, and production of feature films, documentaries, children's films, and short films. Overall, BKM aids the production of cultural films through several mechanisms. Firstly, the German Federal Film Fund²⁷ (DFFF), an indirect public support measure, aims to enhance Germany's appeal as an international film production hub. According to the DFFF report, if a feature, documentary, or animated film is produced in Germany with at least 25% of the budget spent locally, the producer may be eligible for a grant of up to 20% of the approved costs. In some cases, this

25 https://www.ffa.de/files/ffa/en-download/ffa_overview_englisch_2020_web-1.pdf

26 Federal Government Commissioner for Culture and the Media (BKM). (2024). *Guidelines for the German Motion Picture Fund (GMPF)*. https://www.kulturstaatsministerin.de/SharedDocs/Downloads/DE/2024/2024-Guidelines-GMPF-EN.pdf?__blob=publicationFile&v=2

27 file:///C:/Users/minak/Downloads/24_DFFF_GMPF_AtAGlance_EN-2.pdf



grant may reach 25% depending on the amount spent in Germany. A production service provider may apply for DFFF II if the film's budget exceeds €20 million and the German production costs exceed €8 million. In such cases, a grant of up to 25% of the approved costs can be obtained. Since its launch in 2007, the *DFFF I* scheme²⁸ has allocated a total of €777 million in subsidies to 1,489 film productions. In 2017, *DFFF II*²⁹ was introduced, providing €133 million to 19 film productions. By 2023³⁰, these schemes had attracted €5.5 billion in investments within Germany, meaning that every euro contributed by the fund generates an additional €6 in investment. Secondly, BKM supports the production of cultural films through selective funding and awards. For example, the German Film Prize (formerly known as the Federal Film Prize) is awarded to productions with a culturally outstanding program. It is granted annually in spring or summer and is juried by members of the German Film Academy.

At regional level, film funding schemes are available in each German region. By and large, they provide grants in the form of repayable loans, to be repaid from the proceeds of the exploitation - usually after the recoupment of the producer's own costs. The main objective of these regional schemes is to promote the regional film culture and industry; consequently, territorial spending obligations constitute the main criterion used in the selection process. The main regional funds are Film- und Medienstiftung North Rhine-Westphalia (NRW), FFF Bayern, Medienboard Berlin-Brandenburg (MBB), Filmförderung Hamburg Schleswig-Holstein (FFHSH), MFG Baden-Württemberg, Mitteldeutsche Medienförderung (MDM), operating in Saxony, Saxony-Anhalt and Thuringia, Nordmedia fonds in Lower Saxony and Bremen, Hessische Filmförderung in Hessen, and Kulturelle Filmförderung MV Mecklenburg-West Pomerania (KFF).

Critical Analysis

The German film industry presents a *federalist, multilevel structure* (Bomnüter, 2019), which distinguishes itself from other European governance models. A key element of the German model is that it is decentralized and involves substantial central state funding alongside extensive regional schemes of funds throughout its federal states (Länder) (Murschetz et al. 2019). The system utilizes diverse public funding schemes, including both automatic and selective ex-ante grants. Financial grants are the main tools utilized to achieve film policy objectives and are run by national bodies like the German Federal Film Board (FFA) and the German Federal Film Fund (DFFF), as well as

28 German Federal Film Board (FFA). (2024). *DFFF & GMPF - At a glance*.

https://assets.ctfassets.net/22n7d68fswlw/1LoxYcnsALXEA5WsnHX7zG/f0cbb5a9320979c8df88dacf39d31480/DFFF_GMPF_AtAGlance.pdf?utm_source=chatgpt.com

29 Federal Government Commissioner for Culture and the Media (BKM). (n.d.). *Welcome message*. DFFF. Retrieved April 21, 2025, from <https://dfff-ffa.de/index.php?grusswort-bkm-engl>

30 Filmförderungsanstalt (FFA). (2024). *Spotlight on film funding in Germany 2024*. https://www.ffa.de/files/ffa/av-info-publikationen-downloads/spotlight_on_film_funding_in_germany_2024.pdf



approximately 15 regional film funding authorities. These agencies are engaged at various stages of film production, distribution, and display (Bomnüter, 2018).

According to Bomnüter (2018), Germany adopted the New Public Management (NPM) paradigm during the 1990s and it is exactly this paradigm that has contributed extensively to the formulation of German film policy. In this way, the integration of economic considerations into the organizational logics of film funding institutions was achieved, as well as traditional cultural policy goals. Thus, the current system represents a hybrid model that balances market-oriented reforms with cultural orientations (Bomnüter, 2018). Broadly speaking, German media and cultural policy aim to guarantee media freedom and diversity. Specific film policy objectives are to advance the quality and diversity of German films and support emerging talents. Federal-level funding initiatives also focus on the economic aspects of filmmaking and the promotion of culturally significant national projects.

Despite its major support from the public, the German film governance system is beset by several serious challenges. For instance, the complex and fragmented nature of its multilevel and multi-institutional funding landscape can give rise to inefficiencies, like in the field of 'subsidy tourism' where producers overtly navigate regional funds (Bomnüter, 2018). Furthermore, there is a weak linkage between the funding allocation processes and the non-monetary public benefits, raising concerns over the actual cultural value that gets prioritized. Apart from that, there are also concerns regarding the risk of misdirected investment, where securing state aid might overshadow the pursuit of profitability or audience needs. Lastly, the general ambiguity in overarching policy objectives, particularly for the support of national cultural identity, can also appear very problematic.

On the other hand, it is undeniable that public funding has been crucial in the establishment and maintenance of the German film industry's image. Economically oriented funding bodies have contributed to the augmentation of domestic market shares as well as the promotion of global co-productions. In general, the growth in co-productions reflects Germany's appeal as a location for film shooting and contributes to the representation of German films at international film festivals. Nevertheless, while co-productions have augmented, the international market presence of purely German productions, particularly in film markets such as the US, is comparatively weak. Bomnüter (2018) further states that the governance system may support film production effectively, but the challenges of international distribution and market penetration remain inadequately addressed.

To conclude, the German film governance system is complex, characterized by heavy public investment and a unique federalist structure. While this governance system has been essential for the establishment of a relatively strong domestic film industry and in encouraging international co-production, the system presents some serious problems regarding its complexity, the direct correlation between funding and cultural impact, and the misallocation of funds. A possible reform



of the governance structure might thus be required to improve the efficiency and efficacy of public film funding concerning both cultural and economic objectives of the German film industry (Bomnüter, 2018).

5.4.11. The Italian Film Industry

Italy is considered to be one of the birthplaces of cinema and the home of the Venice Film Festival, which was created in 1932. It is one of the oldest film festivals in the world and serves as a foundation upon which the Italian film industry thrives, setting amidst a wide array of showcased international films. The Italian Ministry of Culture actively supports the film industry through funding, incentives, and policies for the production and distribution of Italian films. Italian filmmakers often collaborate with international partners in co-productions and take part in various global film projects. Nowadays, Italian cinema is one of the most dynamic and influential ones in filmmaking history, from its rich cinematic heritage to the contemporary contributions that continue to take place in world cinema.

Presentation of Funding Bodies and Schemes

The Italian Constitution³¹ recognises cultural heritage and sponsorship as fundamental rights (Article 9), making this a widely debated issue across all institutional levels of the Italian government. After the constitutional reform in 2001, the government also introduced the principle of 'horizontal subsidiarity'³² to support cultural activities. In Italy, public funding plays a determining role in the support and promotion of investment in the film and audiovisual industry, and it can take the form of tax credits and national and regional incentives, which are regulated by Law 220/2016³³. Nowadays, Italy has a well-established system of state aid for its creative industries, with several national and regional funding bodies playing key roles in supporting today the development of films, video games and immersive technologies.

The **Italian Ministry of Culture (Ministero della Cultura, MiC)** is one of the principal funding institutions supporting Italy's cultural industries, including cinema and digital media. *MiC* administers the *Film Distribution Fund* which is a support scheme introduced into the Italian legislation (Law no. 220 of 2016) for the granting of contributions to support the distribution of Italian films with primary theatrical exploitation beyond Italian borders. This fund provides three types of financial support: *automatic grants, selective grants, and tax credits*³⁴.

31 Italian Senate. (n.d.). *Constitution of the Italian Republic* [English translation]. https://www.senato.it/documenti/repository/istituzione/costituzione_inglese.pdf

32 Horizontal subsidiarity is the sharing of powers between several levels of authority, a principle which forms the institutional basis for federal states.

33 Italy for Movies. (n.d.). *Automatic contributions (Law No. 220/2016)*. Retrieved April 21, 2025, from <https://www.italyformovies.com/bandi/detail/76/automatic-contributions-law-no-2202016>

34 FIPADOC. (n.d.). *Focus Italie*. Retrieved April 21, 2025, from <https://fipadoc.com/en/focus-italie>



On one hand, automatic grants support Italian production companies by evaluating their past works' artistic, economic, and cultural impact. Results are determined using a points-based system. The awarded funds can be reinvested in developing, producing, and distributing new documentaries. On the other hand, selective grants cover both TV series and single productions and their distribution on cinema, TV and web. Selective grants are attributed for *Screenplay Development* (exclusively for authors), *project development and pre-production series*, *production*. Finally, a tax incentive system was introduced in Italy in 2009 and operates for production, distribution and exhibition as well as for investment in production by companies and individuals external to the sector. The *tax credit* allows the possibility of offsetting tax liabilities with credit matured following investment in film. A *tax shelter* is also available for film production and provides the opportunity to benefit from a tax shield for the portion of profits invested in the production of films. Production tax credits apply to films of all genres, including shorts, but not to television works. All films must pass a test to ensure eligibility. To produce Italian films, the tax credit percentage is 15% based on total production cost: producers' fees and distribution costs are excluded. The annual tax credit cap is 3.5 million euros per company and per year for Italian productions and 80% of the credit must be spent in Italy. Foreign films are eligible via an Italian executive producer or production service provider. Here the tax credit percentage is 25%, calculated on the basis of Italian expenses, which shall not exceed 60% of the total cost of the film. The tax credit cap is 5 million euros per project. Expenses incurred in other EU countries up to a maximum of 30% of the total cost of the film are also eligible. For official international co-productions, the film must qualify as an Italian film and the Italian co-producer may request the tax credit only for the percentage of rights that belongs to him or her. The tax credit percentage in this case is 15%, calculated on the basis of the percentage of total costs corresponding to the percentage of rights which the Italian producer holds.

Other Italian funds are the '*Minority co-production Fund*', which concerns documentaries for theatrical release with an Italian minority co-producer and the '*International Co-production Funds*' which concerns the co-production with one or more foreign countries. Funding is available for feature films (minimum 60 minutes, theatrical release), TV series (co-development only; episode length between 20-90 minutes), fiction, animation, and documentary. This grant can be combined with selective grants. The aforementioned structured system fosters the growth of the Italian audiovisual industry, supporting projects of cultural significance while incentivizing international collaboration and market expansion. Another key-funding institution in Italy is the **Istituto Luce-Cinecittà**³⁵ involved in the production and distribution of documentaries and films that aim to be screened in cinemas. Since 2024, it organizes courses in 'Digital Humanities' for audiovisual archivists,

35 Cinecittà. (2024, April). *100 years of Luce*. Retrieved April 21, 2025, from <https://cinecitta.com/en/2024/04/100-years-of-luce/>



researchers, and training activities for the workforce, managers, students, and aspiring professionals in the film and audiovisual sector.

At the regional level, Lazio, Lombardy, Campania, and Piedmont offer funding programs that support the production and development of digital media. These regional initiatives are particularly important for promoting local talent and ensuring that the benefits of the digital media revolution are distributed across the country. Finally, the existence of the **Italian Film Commissions Association**³⁶, comprising 20 Film Commissions located all over Italy, is a reference point for national and international productions, investors, authors, professional operators and institutions active in the cinema and audiovisual sector. The Italian Film Commissions are organizations of associations that provide free of charge services such as logistic assistance, access to financial resources, the granting of permits, a mapping of qualified personnel and service providers and the search for locations. It aims at stimulating investments in the cinema and audiovisual sector in the individual regions, offering a unified image of the Italian world of cinema narrated in its regional specificities, promoting the different territories in correlation with their distinctive cultural, artistic, touristic, landscape and industrial features. Encouraging territorial development on a global scale, the Italian Film Commissions association works to reinforce relations with institutions and organizations at the national and international levels. It ensures its members receive constantly updated information on activities within the sector and develops system initiatives for the promotion and development of the Italian audiovisual industry. Particularly important are the actions related to the organization of joint activities and presence at the most important film festivals and fairs in Italy and abroad. The Italian Film Commissions encourage the realization of international co-productions and operational and development partnerships. The mission of the association includes the promotion and protection of the quality of services for audiovisual productions and the operational enhancement of structures associated with the organization of initiatives for training and update. One of Italy's newest commissions is **Veneto Film Commission** which was founded in 2020. It is the only regional commission to provide calls for XR and virtual proposals. It offers location scouting grants and production funding beyond that to assist local film and TV shoots. The production fund distributes 4.4 million euros per year in two calls. Features and TV series can receive up to 300,000 euros, if they spend at least 30% locally. Documentaries, shorts, and XR content can receive up to 50,000 euros a project if they spend 60% locally. A points system considers the screenplay quality, production company and proposal solidity, the director's and team's credits, and promotional benefits for the region. In the Venice region, **La Biennale di Venezia** is the central cultural institution that hosts the Venice Film Festival. It collaborates with **Veneto Film Commission** for the promotion

36 Italian Film Commissions. (n.d.). Homepage. Retrieved April 21, 2025, from <https://www.italianfilmcommissions.it/>



of the local film sector, the support of filmmakers, and the promotion of the region as a prime destination for high-level filmmaking. Apart from that, *La Biennale di Venezia* is also well-known for its prestigious prizes like the *Golden Lion* (for the best national participation), *the Golden Lion* (for the best individual participant in the main show), and the *Silver Lion* (for the most promising young participant in the main show). Finally, there is also the **Venice Immersive** section in the Venice International Film Festival of La Biennale di Venezia which is entirely devoted to immersive media, and awards prizes to productions of creative expression: immersive videos and XR works of any length, including installations, haptics and virtual worlds.

Critical Analysis

Film public funding is widely regarded as one of the most significant mechanisms for the management of a nation's film industry. However, its efficacy remains a contentious issue within academic and policy debates. In the case of Italy, Teti et al. (2018) argue that the system of state subsidies in place from 1995 to 2003 failed to revitalize the national film industry. The central issue, they contend, was the inability of state-funded films to recoup their production costs at the box office. Notably, films designated as being of 'national cultural interest' often underperformed commercially, despite receiving public financial support.

This era has been characterized as a case of government failure, attributed to a confluence of factors including bureaucratic inefficiencies and the political influence of Prime Minister Silvio Berlusconi, whose dual role in media policymaking and private media ownership raised concerns about conflicts of interest. According to Teti et al. (2018), the political environment fostered a subsidy mechanism that prioritized production entities over the development of a robust and competitive cinematic ecosystem.

Overall, the Italian subsidy framework during this period is broadly viewed as ineffective in achieving its dual cultural and economic objectives. While it succeeded in supporting films with niche cultural significance, it largely failed to generate popular appeal or sustainable industry growth.

Building on this critical perspective, Meloni et al. (2018) investigated the impact of public subsidies on the success of Italian films produced between 2002 and 2011. Their study employed a comparative approach, analysing a range of indicators - including box office revenues and accolades from film festivals - to assess the effectiveness of Italy's public film financing system. The results reinforced the concerns raised by Teti et al. (2018), suggesting that public funding did little to enhance either the commercial performance or the perceived quality of Italian cinema.

Meloni et al. (2018) concluded that subsidized films tended to underperform in comparison to their non-subsidized counterparts, both in terms of quantitative success (box office receipts) and



qualitative recognition (festival awards). These findings further challenge the assumption that state support necessarily leads to cultural or commercial enrichment in the cinematic sector.

In sum, the Italian state film funding system has long been plagued by structural shortcomings, particularly with regard to generating positive economic outcomes and fostering sustainable industry growth. In an effort to address these persistent weaknesses, the Italian government introduced Law 220/2016 (see Section 1.1.1.5), seeking to establish a more effective and coherent framework inspired by the French model. As part of this legislative reform, the 'Fund for the Development of Investments in Cinema and Audiovisual' (*Fondo per lo sviluppo degli investimenti nel cinema e nell'audiovisivo*) was launched in 2022. The fund was designed to stimulate private investment and enhance the overall competitiveness of Italy's film and audiovisual sector.

Nonetheless, a fundamental challenge endures: the system remains heavily reliant on public subsidies, which are both limited in scale and subject to political and fiscal volatility³⁷. Despite policy efforts to incentivize private sector participation, the actual involvement of private investors remains marginal. Leogrande (2025) underscores the critical need for greater diversification of funding sources, advocating for a more balanced model in which public subsidies are complemented by robust industrial policies, international collaboration, and the strategic use of tax credits. In this view, fiscal incentives and broader industrial strategies are not peripheral tools, but essential pillars for ensuring the long-term viability of Italy's audiovisual industry.

5.4.12. The Luxembourg Film Industry

Luxembourg, despite its modest geographical scale, stands as a sovereign and independent state whose film industry has emerged as a remarkable example of creative dynamism and immersive innovation. Since the 1980s, the country has experienced a significant cinematic transformation, marked by a sustained growth in both production and international collaboration. According to a 2017 report by the European Audiovisual Observatory³⁸, Luxembourg produced 53% more films as a majority co-producer than as a solely national producer - an indicator of its strategic positioning within transnational production networks.

Guy Daleiden, director of the Film Fund Luxembourg, has highlighted the substantial evolution of the sector, which now supports the production of between 25 and 30 films annually, spanning feature films, documentaries, and animated works. Notably, the Luxembourgish film funding model is

37 NSS Magazine. (2024, April 9). *The reform of public funds for Italian cinema is causing criticism*. <https://www.nssmag.com/en/lifestyle/39028/reform-public-funds-italian-cinema-new-rules-criticism>

38 Talavera, J. (2017). *Film production in Europe: Production volume, co-production and worldwide circulation*. European Audiovisual Observatory. <https://rm.coe.int/filmproductionineurope-2017-j-talavera-pdf/1680788952>



entirely state-financed, underscoring the vital role of public support in cultivating this vibrant and outward-looking industry.

Presentation of Funding Bodies and Schemes

Luxembourg's film sector is supported by two principal public institutions. The first is the *Centre National de l'Audiovisuel* (CNA)³⁹, established in 1989, which is entrusted with the preservation, conservation, presentation, and promotion of the nation's audiovisual heritage. The CNA plays a multifaceted role that spans production, distribution, archiving, and educational outreach. It also maintains a media library (*médiathèque*) and a specialized research library that serve as key resources for both professionals and the public.

Although the CNA does not directly fund film productions - except in the form of scholarships for student graduation films - it does participate in the production of documentary works that are thematically aligned with Luxembourg's national heritage. In this capacity, the CNA acts less as a financier and more as a cultural custodian, shaping national memory through audiovisual storytelling.

The principal funding body dedicated to the audiovisual sector in Luxembourg is the *Fonds National de Soutien à la Production Audiovisuelle*, more commonly referred to as the *Luxembourg Film Fund*⁴⁰. This specialized public institution operates under the authority of the Ministry of Communications and Media (*Service des Médias et des Communications*) and is tasked with implementing the government's audiovisual and cinematographic policy.

The Luxembourg Film Fund plays a central role in supporting the industry's development by allocating financial aid across various stages of the creative process, including scriptwriting, project development, production, and distribution. Its support spans a wide array of formats - from feature films and short films to animation, documentaries, and television series. With an annual budget of approximately €30 million, the Fund promotes both domestic and international co-productions, all of which are eligible under a unified, selective funding scheme. This structure reflects Luxembourg's strategic ambition to position itself as a competitive and attractive hub within the European and global audiovisual landscape.

The Luxembourg Film Fund operates under the joint supervision of the ministers responsible for culture and for the audiovisual sector and serves as the primary instrument for the implementation of national support policy in the field of cinema and media. Beyond its financial support role, the Fund is also charged with the promotion of the Luxembourgish audiovisual sector, the negotiation

39 Centre national de l'audiovisuel. (n.d.). *Centre national de l'audiovisuel*. <https://cna.public.lu/fr.html>

40 <https://filmfund.lu/>



and development of international co-production agreements, and the certification of the nationality of audiovisual works.

The Fund offers two main support schemes for audiovisual productions: the *Audiovisual Investment Certificate Program* (*Certificat d'investissement audiovisuel*, CIAV) and the *National Audiovisual Production Support* (*Aide Financière Sélective*, AFS). Introduced in 1988, the CIAV provides financial support for film and television productions undertaken by nationally registered and approved companies based in Luxembourg. Projects are assessed via a cultural test, and successful applicants may receive up to €2.5 million per project.

The Luxembourg Film Fund collaborates actively with industry stakeholders such as the Luxembourg Film Academy, the Union Luxembourgeoise de la Production Audiovisuelle (ULPA), and the Luxembourgish Association of Filmmakers and Scriptwriters (LARS). It also represents Luxembourg in European and international frameworks, including the *Creative Europe* programme, thereby ensuring the country's continued visibility and strategic positioning within the broader audiovisual ecosystem.

In recent years, the Fund has notably intensified its support for animated films and extended reality (XR) projects, seeking to establish Luxembourg as a leader in immersive storytelling. This ambition was affirmed at the Venice International Film Festival, where two Luxembourg co-productions were featured among the five immersive works in competition⁴¹: *Oto's Planet* by Gwenaël François - primarily a Luxembourgish production involving Quebec and France - was awarded the *Venice Immersive Special Jury Prize*, while *Ito Meikyu* by Boris Labbé, a co-production with France, also received critical acclaim.

5.4.13. Critical Analysis for Europe

This section introduces the key dimensions identified across the national reports of five EU member states (Belgium, France, Germany, Italy, and Luxembourg). These criteria form the analytical foundation for assessing the structure, function, and strategic orientation of their respective film funding systems.

Funding Criteria

The five countries under examination employ varying institutional frameworks and funding mechanisms to stimulate their national film industries. Belgium, France, Germany, and Luxembourg have established dedicated public bodies tasked specifically with promoting and supporting

41 Fonds national de soutien à la production audiovisuelle. (2024, 18 juillet). *Le Luxembourg fait sensation avec 5 œuvres immersives en compétition à la 81e Mostra de Venise*. Gouvernement du Grand-Duché de Luxembourg.

https://cgid.gouvernement.lu/fr/actualites.gouvernement2024%2Bfr%2Bactualites%2Btoutes_actualites%2Bcommuniques%2B2024%2B07-juillet%2B18-mostra-venise.html



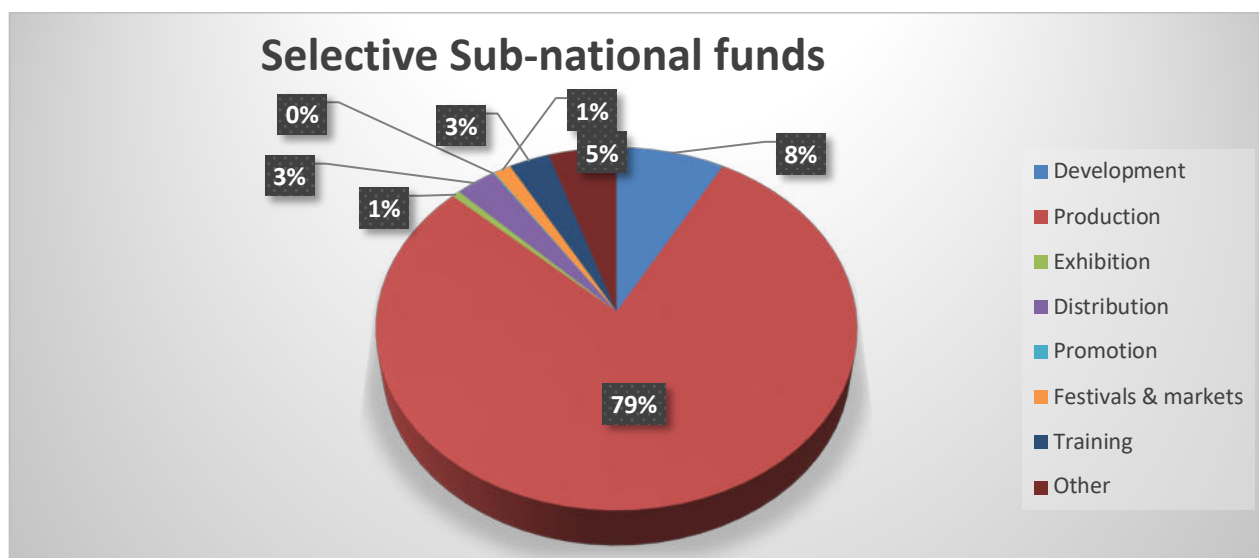
audiovisual production. These agencies operate with a degree of autonomy and strategic focus, often in close collaboration with the industry. In contrast, Italy's primary funding entity remains the Ministry of Culture, whose broader mandate encompasses the promotion of arts and heritage across the national territory, including cinema. This distinction reflects differing administrative philosophies - between specialized agencies focused on sectoral development and more centralized, culturally embedded approaches to film support.

When referring to direct public funding, we denote the financial support allocated by public film funds to facilitate the development and production of cinematic works. This type of funding is typically granted at an early stage of the production process and may originate from national, regional, or community-level public agencies within the film's country of origin, as well as from minority co-financing countries participating in the project.

Our analysis reveals that the funding landscape in the five EU member states under study is broadly structured around two principal categories. The first consists of national or federal funds, which often require prior commitments - such as pre-sales or letters of intent - from distributors, broadcasters, or other market players as a condition for eligibility. The second category includes sub-national or regional funds, which tend to base their support on the projected number of shooting days and local expenditure within a given territory.

According to the 2024 report by the European Audiovisual Observatory (Graph 1), sub-national film funding bodies predominantly provide selective support, with 87% of their activity focused on the creation of new works. These funds are typically guided by dual objectives: to stimulate local audiovisual production and to advance regional cultural and identity-related goals.

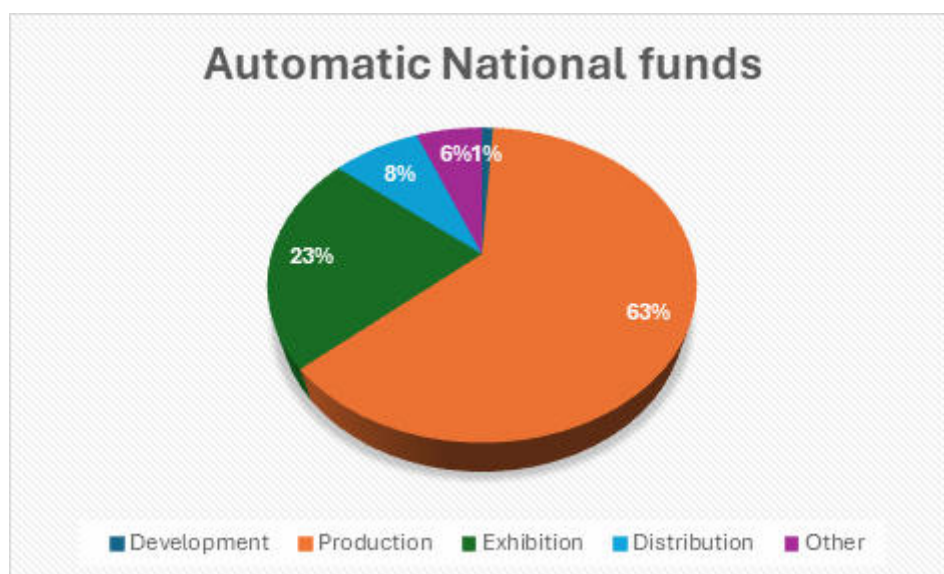
Figure 1: Selective Sub-national funds (Source: European Audiovisual Observatory Report 2024)



In addition, direct public funding is granted through either *automatic* or *selective* mechanisms in the countries under study (Belgium, France, Germany, Italy, and Luxembourg). *Automatic funding* is primarily linked to the past performance of a work and is generally intended to sustain and incentivize ongoing investment in national and regional film and television production (Cucco, 2018: 266-268). Such funding is typically awarded based on a points system or other predetermined eligibility criteria: once a production or producer meets the requirements - often tied to an inward investment scheme - the funds are allocated with limited evaluative discretion.

Automatic schemes place little to no emphasis on the artistic or narrative quality of the projects and they are mainly designed to maximize local economic benefits, particularly through production expenditure within a specific territory. As illustrated in Graph 2, most automatic funding is directed towards production activities (63%), with smaller portions allocated to exhibition (23%), distribution (8%), development (6%), and other areas (1%). This distribution reflects the economic logic underpinning automatic schemes, which prioritise industry infrastructure and employment over content curation.

Figure 2: Automatic National funds (Source: European Audiovisual Observatory Report 2024)



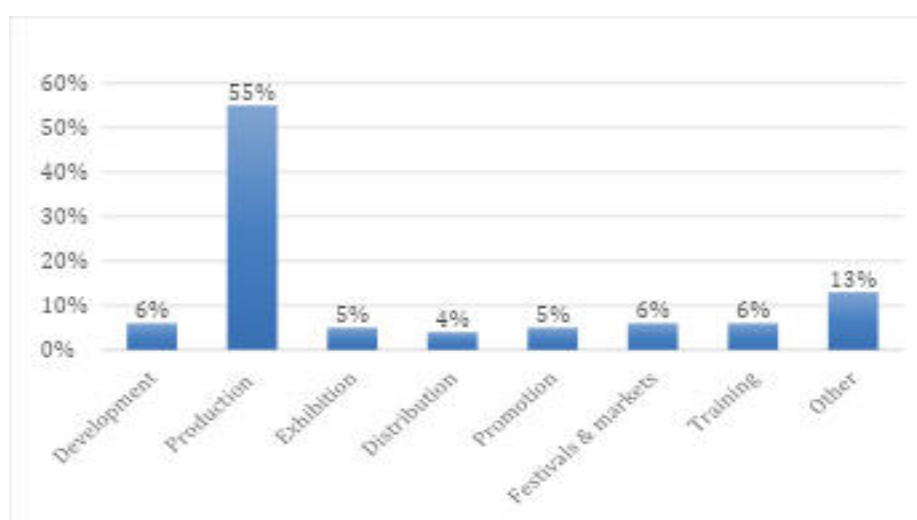
Selective funding mechanisms, encompassing loans, awards, unconditional grants, grants-in-aid, and match funding, are characterised by direct state or regional financing and are therefore subject to public and industry scrutiny. Selection is typically based on qualitative criteria and is administered by committees or advisory boards, with support targeting creative projects such as screenwriting, film co-production (including animation and documentary), television productions, and XR / VR projects.



Owing to the requirement for formal project assessments, selective funding is generally perceived as a strategic tool for promoting high-quality creative outputs aligned with national cultural priorities. Data from the countries examined indicates that selective funding predominates in public support schemes for film producers. As shown in Graph 3, selective funding spans a broader set of activities compared to automatic funding, including production (55%), development (6%), exhibition (5%), festivals and markets (5%), promotion (5%), training (6%), distribution (4%), and other activities (13%).

Thus, comparative analysis confirms that selective funding offers more diversified and widespread support across the film sector, while automatic funds remain narrowly focused, particularly on production. Selective mechanisms therefore constitute the principal mode of sustaining film-related activities in the European states analysed.

Figure 3: Selective funding (European Audiovisual Observatory Report 2024)



Indirect public funding takes the form of fiscal incentives, which were first introduced in countries such as France and Germany during the 1980s and 1990s. These measures encompass a variety of financial tools - including tax shelters, tax rebates, and tax credits - designed to stimulate investment in audiovisual production. Typically, such incentives are calculated as a percentage of eligible production expenditures and are reimbursed *ex post*, once the spending has been completed and verified.

Fiscal incentives are primarily aimed at encouraging international co-productions and inward investment, thereby contributing both to the cultural enrichment and to the economic vitality of local communities. Rather than replacing direct public funding, these schemes generally function as complementary instruments. As noted by Talavera & al. (2016: 79) and Lind (2023), the introduction of new fiscal incentive mechanisms in a given country rarely leads to a corresponding reduction in



the volume of direct state support, highlighting the increasing complexity and layered nature of national film funding ecosystems.

According to the *Cambridge Dictionary*⁴², a tax shelter is defined as 'a way of investing or spending money that allows a person or company to avoid tax or to pay less tax than they would normally'. In practical terms, tax shelters refer to legally sanctioned strategies that enable individuals or corporations to reduce their taxable income. These schemes are often structured to attract high-net-worth individuals or firms with substantial tax liabilities, allowing them to deduct investments made in eligible audiovisual productions from their taxable income. While any long-term profits accrued from such investments remain subject to taxation, investors can still benefit significantly from these fiscal arrangements (Lind, 2023).

Lind (2023) further distinguishes between tax rebates and other forms of fiscal incentives. She argues that 'rebates are primarily driven by production spend rather than levels of investment', emphasizing that a tax rebate reimburses producers for a percentage of qualifying expenditure based on a set of regulated criteria. Unlike general tax incentives - which reduce a company's tax burden - rebates are paid directly from the state budget and are disbursed only after production expenditures have been completed and audited.

While tax credits and tax rebates serve comparable purposes - namely reimbursing a portion of eligible production costs - their mechanisms differ. A tax credit offsets the taxpayer's liability and becomes applicable only upon filing the annual corporate tax return. In contrast, a tax rebate constitutes a direct payment from a designated government fund, issued regardless of the taxpayer's existing liabilities. As such, tax credits benefit only those with outstanding tax obligations, whereas tax rebates can be accessed by producers irrespective of their tax position, thus offering a more universally accessible incentive.

Across the five countries analysed, all have implemented some form of tax incentive scheme to support audiovisual production (Table 1). However, the specific mechanisms and accessibility of these schemes vary significantly. With the exception of Belgium, Germany, and Luxembourg, film producers in the remaining countries - namely France and Italy - are eligible to apply for tax credits, which are granted based on qualifying production expenses and serve to reduce the producer's corporate tax liability.

In Luxembourg, by contrast, no tax credit system is in place. Instead, public financial support is channelled primarily through the National Audiovisual Production Support (*Aide Financière Sélective*, AFS), which operates under the Luxembourg Film Fund. The AFS provides discretionary loans to producers for the development, production, co-production, distribution, and scriptwriting of

42 <https://dictionary.cambridge.org/dictionary/english/tax-shelter>



various types of works, including animation, fiction, documentaries, and extended reality (XR) projects. These loans are repayable from the future revenues of the funded works, thus combining public support with a performance-based repayment model that encourages commercial viability while mitigating financial risk.

Table 1: EU states' funding bodies and mechanisms

Country	Funding Body	Direct public funding	Indirect public funding: Fiscal Incentives	
			Scheme name	Scheme type
Belgium	CCA		Tax shelter	Tax shelter
Germany	FFA		DFFF	Rebate
France (run by CNC)	CNC		SOFICA	Tax shelter
			Credit d'Impot Cinema	Tax credit
			Credit d'Impot Audiovisuel	Tax credit
Italy	Ministry of Culture		External tax credit	Tax shelter
			Producers tax credit	Tax credit
			International tax credit	Tax credit

While the core structure of film funding schemes across the analysed European states reveals a high degree of similarity - particularly in their use of direct subsidies and fiscal incentives - important divergences emerge in terms of strategic emphasis and policy priorities. Certain countries place greater focus on territoriality, using funding mechanisms to anchor production activities within national or regional borders, whether through inward investment conditions or local spending requirements. Others foreground the cultural dimensions of funded projects, incorporating criteria related to language, national identity, or gender equity.



Still others underscore the role of film funding as a driver of innovation and sustainability, aligning audiovisual policy with broader economic and technological agendas. These variations reflect not only national priorities but also evolving conceptions of the film industry's function - whether as a cultural good, an economic asset, or a vector of soft power in the global creative economy.

Cultural Criteria

State funding schemes often emphasize the cultural dimension of the projects they support. In Belgium (EAO 2019: 121-125), for example, the cultural test evaluates how closely a given production aligns with national or European identity by assessing several criteria. These include 1) the extent to which Belgium or another EEA member is represented in the setting of the film, 2) the nationality of the director or screenwriter, 3) the origin of the characters, and 4) the actors in lead and supporting roles. Additional elements considered are 5) whether the script is written in an official language of Belgium⁶, whether the project is based on a literary work of Belgian or EEA origin, and 7) whether the main theme relates to art or artists. The test also accounts for 8) the presence of historical figures or events, 9) the exploration of social issues relevant to Belgium or the EEA, and 10) the project's contribution to the preservation or revaluation of Belgian or European audiovisual heritage. These criteria reflect Belgium's commitment to supporting cultural specificity within a broader European framework, positioning film funding as both an economic tool and a vehicle of cultural policy.

In the case of the Luxembourg Film Fund, the amount of financial support awarded is calculated on the basis of the cultural, social, and economic impact of the audiovisual or cinematographic work. Eligibility for funding is strictly limited to individuals who are fully taxable residents of Luxembourg and whose primary professional activity is audiovisual production (see *Mapping*). In addition to production and co-production grants, the Luxembourg Film Fund also provides support for scriptwriting and project development. These forms of assistance may only be allocated to registered production companies based in Luxembourg, thereby reinforcing the Fund's strategic aim of fostering a nationally embedded, professionally structured audiovisual sector.

Both France and Italy assess film projects through structured cultural tests, which play a central role in determining eligibility for public funding. In France (EAO 2019: 274-281), the cultural test evaluates four main dimensions: 1) the cultural content of the production, particularly the original language used, which must be either French or a recognized regional language; 2) the nationality of key personnel, including the director, screenwriters, composers, and members of the cast and crew; 3) the geographical location of the production; and 4) the production company, which automatically receives 10 points if it meets certain eligibility criteria.



In Italy (EAO 2019: 377-378), the evaluation framework is more quantitatively detailed. To qualify for basic public funding, a film must obtain at least 50 out of 100 points on a cultural test and satisfy a minimum of two cultural content criteria. These criteria include, among others, references to Italian or European literary works, history, folklore, society, art, culture, or the use of Italian locations for shooting. Projects that are designated as being of 'cultural interest' are eligible for enhanced levels of support. To receive this designation, a project must achieve at least 70 points on an additional evaluation, which considers 1) the quality of the project, including the script, creative team, and production feasibility, and 2) the track record of the director and screenwriter, such as past critical acclaim, awards, or festival recognition.

In the case of Germany (EAO 2019: 178-182), the cultural test is structured around three core categories: 1) the cultural content of the production, 2) the nationality of key personnel, and 3) the geographical location of the production. Each category comprises several sub-criteria, with points awarded on a scale depending on the degree of compliance. This scoring system allows for a flexible evaluation, where a project may earn between one and the maximum number of points available per category.

Within the cultural content dimension, eligible criteria include the use of the German language, the presence of German or EEA-specific landmarks and locations, the inclusion of main characters who are German or from an EEA member state, and thematic engagement with art, culture, history, religion, philosophy, or social issues. The *Bundesregierung für Kultur und Medien* (BKM) specifically rewards films that are deemed to have a tangible impact on German culture, which may include factors such as the language of the film, the nationality of the producer, or the producer's professional base being located in Germany.

Additionally, the *Filmförderungsanstalt* (FFA) requires that applicants commit to delivering a German-language version of the film as a condition for receiving support, thereby reinforcing the emphasis on national linguistic accessibility and cultural relevance.

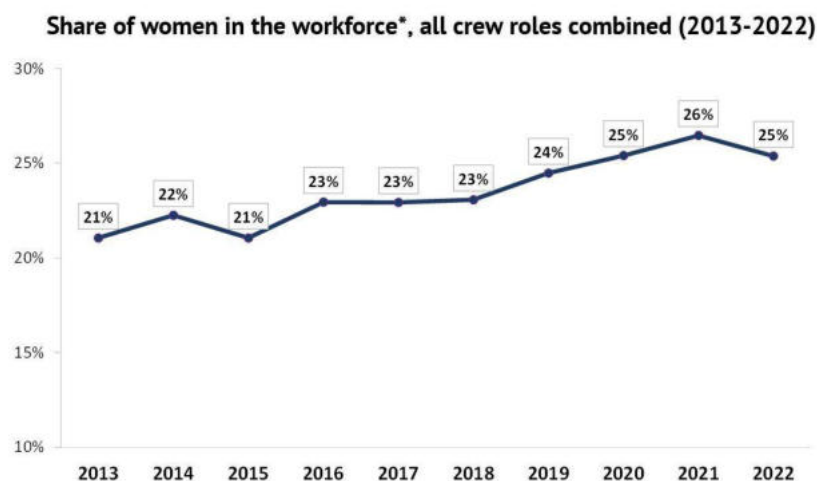
Gender representation in film production is increasingly being integrated into the cultural criteria of EU member states' funding schemes. Projects led by female producers or directors are receiving growing institutional support, reflecting broader European objectives aimed at achieving gender equity within the audiovisual sector. According to the European Audiovisual Observatory⁴³ (Graph 4), the share of women among active professionals in the industry has steadily increased between 2013 and 2022, albeit with significant variation across countries.

⁴³ European Audiovisual Observatory. (2023, October 26). Only 26% of directors of European feature films are women. https://www.obs.coe.int/en/web/observatoire/2023-press-releases/-/asset_publisher/0t9kVBabnl8V/content/only-26-of-directors-of-european-feature-films-are-women



Italy's Ministry of Culture⁴⁴ has reported a 52% increase in the number of productions directed by women compared to 2022, underscoring national efforts to reduce gender disparities in creative leadership. Similarly, the French *Centre National du Cinéma et de l'Image Animée* (CNC)⁴⁵ has introduced policy instruments specifically designed to incentivize gender-balanced productions, further embedding gender equity into the logic of public support.

Figure 4: Share of women in the workforce



Source: European Audiovisual Observatory / LUMIERE

In sum, the structure of European audiovisual funding mechanisms reflects a complex and evolving interplay of cultural, linguistic, gender-related, and economic factors. Far from being neutral instruments, these funding programmes are deliberately crafted to advance the sociopolitical and cultural priorities of each EU member state. Whether through the reinforcement of national identity, the promotion of diversity, or the pursuit of economic competitiveness, public support for cinema serves not only as a financial tool, but also as a strategic expression of each country's vision for its cultural future.

Sustainability and Innovation Criteria

In recent years, the film industry has increasingly sought to reduce its environmental footprint by adopting a range of sustainable practices. These include the use of renewable energy sources, the integration of AR / VR / XR technologies into production workflows, and the implementation of waste

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<https://www.italyformovies.it/res/documents/public/Presentazione%201%20numeri%20del%20cinema%202023%20inglese.pdf>

45 https://www.cnc.fr/professionnels/etudes-et-rapports/etudes-prospectives/les-oeuvres-audiovisuelles-aidees-en-2022-realisees-et-ecrites-par-des-femmes_2029589



reduction and resource efficiency programmes. This shift toward greener practices reflects not only a growing ethical awareness, but also compliance with evolving regulatory frameworks and the rising expectations of audiences for environmentally responsible content creation.

However, data on immersive film production and distribution in Europe remain fragmented. As of 2023, European-level funding bodies have not provided consolidated figures regarding the number of immersive projects supported. Instead, such data are only available at the national level, revealing a marked asymmetry between EU member states. Disparities are evident both in terms of total financial support allocated (in euros) and the number of funded projects, with significant variation in scale and intensity across national funding systems (Table 2).

Table 2: Financial Support and Immersive Funded projects

Country	Funding body	Number of immersive projects	Allocation
Belgium	Screen.brussels	3 VR projects	No data
France	CNC	103 immersive creation projects	3.6 million euros
Germany	MBB	21 XR / AI projects (6XR & 15AI)	2.5 million euros
Italy	Ministry of Culture	No data	No data
	Biennale di Venezia	14 XR projects	No data
	Ministry of General Contemporary Creativity (digital & green investment)	1.860 projects	108 million euros
Luxembourg	Luxembourg Film Fund	8XR projects	No data

For the Brussels-Capital Region, data are provided by the community funding body *screen.brussels*, whose 2016-2023⁴⁶ the report indicates that out of a total of 29 film projects granted funding in 2023,

⁴⁶ <https://screen.brussels/sites/default/files/media/documents/2024-02/screen-brussels-bilan-2023-en-infographies-tableaux.pdf>



only 3 were virtual reality (VR) productions (Table 3). Statistically, this represents approximately 10% of the total number of supported projects that year.

This relatively modest proportion underscores the limited presence of immersive formats in the regional funding landscape, particularly when compared to more traditional genres such as feature films (14 funded projects) and documentaries (8 projects). The data suggest that while there is some openness to innovation, VR remains a niche category within Brussels' publicly funded audiovisual ecosystem.

Table 3: Belgium Funding (Screen Brussels Report 2023)

Belgium (Screen Brussels) - Funding 2023		
Genre	Numbers in 2023	Numbers 2016-2023
Feature Film	14	110
Documentary	8	54
Animation (Feature & Series)	4	47
Live action series	3	Not specified
VR projects	3	6
Total	29	217

A similar pattern emerges when examining the broader period from 2016 to 2023, during which VR projects constituted only a small fraction of the total number of funded productions. Out of 110 feature film projects, there were 54 documentaries, 47 animated works (including both feature-length and series), and just 6 VR projects that received public support. The same report by *screen.brussels* also provides a breakdown of investment by project type for the year 2023, revealing that the majority of funds were allocated to feature films (48%), followed by live-action and animated series (28%)



and documentaries (14%). In this distribution, VR projects were grouped within the 'other' category, which collectively received only 1% of the total investment.

In summary, while immersive productions are present within the funding landscape of the Brussels-Capital Region, they remain significantly underrepresented both in number and in financial support when compared to more traditional formats. Nevertheless, their continued inclusion - however marginal - suggests a space for growth, particularly as audience demand, technological infrastructure, and policy frameworks evolve to better accommodate the expanding field of XR storytelling.

In the case of France, the *Centre National du Cinéma et de l'Image Animée* (CNC) published its annual report in 2023 (Table 4), offering a detailed analysis of public financial support for digital creation and video games. This type of funding plays a vital role in stimulating creativity and innovation across a wide range of digital art forms, including video games, immersive audiovisual experiences, and experimental contemporary works. The CNC's objective is to provide comprehensive support throughout the entire lifecycle of digital projects - from pre-production and prototype development to the creation of intellectual property. The scheme also includes targeted support for writers and creators in the early conceptual stages, thereby fostering a fertile environment for new forms of storytelling and artistic exploration.

Table 4: Support for immersive creation (Source: CNC Report 2023)

CNC - Support for immersive creation			
Aid	Beneficiaries	Objectives	Report 2023
Immersive creation support fund	• authors • producers	• promote the development of interactive and immersive audiovisual projects • stimulate the renewal and diversification of creative methods	€3.6 million for 103 projects: 29 beneficiaries of writing support (€288,000), 30 beneficiaries of pre-production support (€1.1 million), 30 beneficiaries of production support (€1.7 million) and 16



			beneficiaries of event support (€477,000)
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More specifically, the *Fonds d'Aide à la Création Immersive* (Immersive Creation Support Fund) supports interactive and immersive audiovisual works, including those employing virtual reality (VR) and augmented reality (AR) technologies. Designed to stimulate the development of immersive content and promote creative innovation, this fund allocated €3.6 million in 2023 across 103 projects. Funding was distributed across various phases of development, including writing, pre-production, production, and professional events.

While this financial support is essential in nurturing digital creativity, the amount dedicated to immersive creation (€3.6 million) remains relatively modest when compared to the budget of a single large-scale film production. Nevertheless, the fund's strategic allocation across different stages of the production pipeline reflects a long-term vision aimed at ensuring both sustainability and structural growth in France's audiovisual sector.

In conclusion, the CNC's initiative represents a significant step toward supporting digital creativity and facilitating the broader digital transition of the French audiovisual landscape. It signals not only institutional recognition of immersive media as an emerging art form, but also a commitment to fostering the creative ecosystems that will shape the future of storytelling.

Germany can be regarded as a pioneer in the support of immersive content in 2023, having recognized early on the transformative potential of these technologies within the audiovisual sector. Through targeted funding for virtual reality (VR), augmented reality (AR), mixed reality (MR), and other interactive formats, German institutions have strategically positioned the country as a leader in innovative storytelling and next-generation content production. This proactive approach reflects not only a commitment to fostering technological experimentation, but also an understanding of immersive media as a key vector for cultural expression and industrial renewal in the digital era.

According to its 2023 annual activity report, the *Medienboard Berlin-Brandenburg* (MBB) funded a total of 21 XR / IAC (Innovative Audiovisual Content) projects, allocating €2.5 million to immersive and interactive works. This included €1.1 million for six XR games and €1.4 million for fifteen innovative audiovisual content projects. The funded works were actively represented at major international film festivals, including Cannes and Venice, underlining both the artistic calibre and the global visibility of Germany's immersive sector.



Beyond national support, the MBB has played a pivotal role in fostering international co-productions. Notably, it partnered with the Canada Media Fund to support three interactive co-produced media projects with a combined funding of approximately €400,000. This collaborative initiative exemplifies Germany's outward-looking strategy and commitment to cross-border innovation.

More broadly, MBB has emphasized the rapid growth and global orientation of the XR sector, investing not only in production but also in networking opportunities and transnational collaborations. These efforts contribute to positioning Berlin as a significant media innovation hub on the international stage. Finally, the MBB is also an active participant in the *Creative Europe MEDIA* programme, which further supports innovative projects and strengthens European cooperation in the audiovisual sector.

Such investments significantly contribute to strengthening Germany's creative industries while also demonstrating a clear commitment to diversifying the mediums through which stories are told. Projects such as *The Emperor* (winner of the Venice Immersive competition) and *From the Main Square* (recipient of the Grand Prize at the NewImages Festival and Best VR Animation at Kaboom) exemplify Germany's capacity to produce globally competitive immersive content. These accolades not only validate the strategic investment in immersive media but also serve to enhance Germany's visibility and credibility on the international cultural stage.

In the German context, traditional film production - particularly in the domain of large-scale feature films - often presents financial challenges due to high production costs. Immersive media, by contrast, appears to offer a more cost-effective alternative for audiovisual storytelling, particularly when combined with technological innovations such as artificial intelligence. The growing number of AI-related funding applications indicates a deliberate national effort to integrate AI into the content creation pipeline, thereby optimizing both creative potential and production efficiency.

Altogether, Germany is actively paving the way for a dynamic, technologically forward-looking, and creatively open audiovisual ecosystem - one that aligns cultural ambition with innovation-driven transformation.

In the case of Italy, all financial and production data are provided by the *Direzione Generale Cinema e Audiovisivo*⁴⁷. According to its 2023 report on film and audiovisual production (Table 5), the Italian industry experienced a notable resurgence, with figures exceeding both 2022 and pre-pandemic levels. A total of 402 films were produced in 2023, marking a 13% increase compared to 2022 and

⁴⁷ <https://www.italyformovies.it/res/documents/public/Presentazione%20l%20numeri%20del%20cinema%202023%20inglese.pdf>



a 23.7% increase compared to 2019. Of these, 262 were fully Italian productions, while 92 were co-productions, reflecting a sustained engagement with international collaboration.

In terms of gender representation, the report highlights a substantial increase in the number of female directors involved in both fiction and documentary filmmaking. Women accounted for 17% of all directors in 2023, representing a 52% rise compared to the previous year - an encouraging development in the broader effort to address gender imbalances in the sector.

The total production expenditure for films in 2023 surpassed €700 million, constituting a 21% increase compared to 2022. These figures collectively indicate not only a strong recovery of the Italian film industry but also a progressive shift toward greater inclusivity and sustained investment.

Table 5: Italy's Film & Audiovisual Production (Italian Ministry of Culture Annual Report 2023)

Italy's Film & Audiovisual Production (2023)	
Cinema Production Growth	• 402 films were produced in Italy in 2023 (+13% on 2022), an increase on pre-pandemic numbers (+23,7% on 2019). • 262 films were 100% Italian productions and 92 co-productions. • increase in female directors (films and documentaries) both as a percentage of the total (17%) and in unit terms (+52% on 2022). • total cost of the films produced tallies to over €700M (+21% on 2022). • cost breakdowns demonstrate that approximately 57% of budgets come from 'other', attributable mostly to broadcaster and platform investment. • The largest quota of domestic public investment derives from tax credit: in 2023 tax credit for production alone came to €206.13 M (+17.6% on 2022). • 2023 registered an increase in tax credit requests in number of films (398) and credit amount (€225.26 M). • 60 to 80% of the films completing classification between 2019 and 2023 were distributed theatrically.



International Tax Credits	
Cinema	• 186 films requested international tax credit for a total of > € 513 M (from 2016 to 2023). • International tax credit was requested for 31 films in 2023 (40 in 2022) for a total of € 167M. • a total of € 1.38 B was requested in international tax credit di euro (from 2016 to 2023).

With regard to the total funding and the number of AR / VR / XR projects produced in Italy in 2023, the Ministry of Culture does not provide comprehensive or publicly accessible data. This absence of centralised information highlights a persistent gap in institutional transparency concerning immersive media within the Italian funding landscape.

However, more detailed insights⁴⁸ are available through the *Venice Gap-Financing Market* (Table 6), an initiative organised under the *Biennale di Venezia* as part of the *Venice Production Bridge*. In 2023, this platform reported support for 14 immersive works, several of which were structured as international co-productions, notably involving partners from Germany and Quebec.

It is also noteworthy that the *Venice Production Bridge* benefits from additional funding provided by the *Creative Europe MEDIA* programme, specifically dedicated to the development and promotion of immersive audiovisual content. This reflects a growing reliance on European-level instruments to support emerging formats in the absence of detailed national-level strategies or reporting mechanisms.

Table 6: *Venice Gap-Financing Market Report 2023*

Venice Gap-Financing Market (2023)	
Number of projects	Genre
34	26 Fiction Films

48 Out of a total of 283 project submissions, 48 were selected for participation in the 2023 *Venice Gap-Financing Market*, including 34 feature-length films and 14 immersive projects. This selection highlights the increasing visibility of immersive formats within the broader landscape of international co-production and market development. Several of the selected immersive projects were developed in collaboration with German partners, while others received support from SODEC (Société de développement des entreprises culturelles), the cultural funding body of the Government of Quebec. This illustrates the strategic role of transnational partnerships in advancing immersive media and securing diversified sources of funding across national and continental lines.



	8 Documentary projects
14	Virtual Immersive Story projects
11	Biennale College Cinema - Virtual Reality projects
3	Biennale College Cinema projects

Lastly, it is important to note that the Italian state has made substantial investments in digital and green innovation as part of a broader strategy for cultural and technological transformation. According to the 2023 report published by the *Ministry of General Contemporary Creativity*⁴⁹, a total of 1,860 projects were selected for funding under national programmes supporting innovation and digital transition, with a total allocation of €108 million.

These investments signal a strong institutional commitment to aligning cultural production with contemporary priorities such as environmental sustainability and digital modernization. While not all of these projects are strictly audiovisual in nature, they contribute to shaping an ecosystem conducive to cross-sectoral innovation - including immersive media, creative industries, and hybrid forms of artistic expression.

In the case of Luxembourg, the 2023 annual report of the *Film Fund Luxembourg* revealed that €38.2 million were allocated to support 75 projects across a variety of formats, including feature films, series, documentaries, and XR productions (Table 7). Despite its small size, Luxembourg continues to position itself strategically as an agile and innovative hub for both traditional and immersive filmmaking, leveraging public support to attract international collaborations and technological experimentation.

Table 7: Numbers of funded projects per genre (Source: Film Fund Luxembourg Annual Report 2023)

Numbers of funded projects per genre	
Feature-length fiction films	32

⁴⁹ [TOCC - Azione A2 - Direzione Generale Creatività Contemporanea](#)



Feature-length animated films	14
Fiction series	8
Animated series	3
Documentaries	6
XR projects	8
Short films	4
Total	75

Among the 75 audiovisual projects supported by Luxembourg in 2023, 46 were feature films, including 32 fiction films and 14 animated productions, thereby reaffirming the country's continued commitment to traditional cinema. However, 8 of the funded projects were dedicated to immersive content creation, reflecting Luxembourg's strategic engagement with XR technologies. This shift aligns with broader European trends that seek to integrate technology into storytelling, offering new modes of audience engagement beyond conventional formats.

Luxembourg appears to be diversifying its audiovisual portfolio in a deliberate and calculated manner. By investing in XR, the country reduces its exposure to the high financial risks typically associated with large-scale traditional productions, while enhancing its potential cultural and commercial impact on both European and international stages. XR projects thus offer a lower-cost entry point into innovative markets, while still contributing to national cultural output.

Moreover, the fact that 38 out of the 75 supported projects were directed by Luxembourgian filmmakers, and 37 by international directors, illustrates the state's balanced approach between supporting local talent and fostering international collaboration. This openness to cross-border partnerships is especially valuable in the immersive sector, where projects often rely on global expertise in both technology and narrative innovation.



To summarize, Luxembourg's investment in immersive technologies illustrates a clear ambition to position itself as a competitive player in the evolving global content market. Through financial support for XR initiatives, the country is fostering a dynamic and sustainable audiovisual sector capable of adapting to the challenges of the global film economy. Its strategy reflects a broader European tendency to integrate technological innovation into cultural production, with a focus on audience engagement and new forms of storytelling.

However, the data presented throughout this study reveal a fragmented and polarized funding landscape for XR projects across Europe. While countries such as Belgium (Screen Brussels), France (CNC), Germany (via MBB), and Luxembourg (Film Fund Luxembourg) have established dedicated mechanisms to support immersive content, others - such as Italy - continue to concentrate predominantly on traditional film and television formats through institutions like the *Direzione Generale Cinema e Audiovisivo*.

A recurring tension emerges between national funding priorities and the structural need for international collaboration. Although countries like France, Germany, and Luxembourg promote co-productions and transnational partnerships, funding criteria often require that expenditures be made within national borders. This results in a paradox: while internationalization is encouraged rhetorically and strategically, territorial constraints embedded in funding mechanisms may in fact reinforce fragmentation. The CNC's focus on national production, for instance, can at times limit the scope of cross-border cooperation, even though the institution also funds international co-productions.

Despite the presence of collaborative frameworks - such as the *Creative Europe MEDIA* programme, or bilateral partnerships like that between MBB and the Canada Media Fund - competition for resources remains a significant obstacle. National ambitions to strengthen domestic studios and production companies often lead to prioritizing local expenditure, thereby inhibiting the development of a truly integrated European XR ecosystem.

Nevertheless, co-production remains indispensable. The screen.brussels data highlight frequent collaborations with France, while Italy's main co-production partners include France, Switzerland, and Belgium. Germany's MBB has also demonstrated a strong commitment to international agreements and cooperative funding models.

In conclusion, while the European XR production landscape in 2023 is marked by innovation and regional dynamism, it continues to suffer from fragmentation, opaque data practices, and a lack of harmonized strategies. Each country maintains its own policies, priorities, and eligibility criteria,



making collaboration more complex than it should be. The successes of regional hubs are real, but they are not yet embedded within a cohesive European vision for immersive media.

There are, however, signs of convergence. XR innovation is increasingly aligned with EU-level cultural and digital agendas, and the growing number of cross-border partnerships signals a latent potential for integration. Still, realizing a truly unified and competitive European XR ecosystem will require more coordinated policies, greater transparency, and robust support for international co-productions - building not only bridges between nations, but a common foundation for the future of storytelling in Europe.

A notable distinction emerges when comparing XR production trends between Northern and Southern European member states. Northern countries - including Germany, France, Belgium, and Luxembourg - have established robust, often well-funded ecosystems for immersive content development. These nations benefit from a combination of long-standing cultural funding policies, strong digital infrastructures, international networking capacity, and dedicated XR funding lines (e.g. *screen.brussels*, *Medienboard Berlin-Brandenburg*, CNC, and Film Fund Luxembourg). These structures allow for experimentation and early adoption of immersive technologies, reinforced by access to EU-level instruments such as *Creative Europe MEDIA* and collaborations with global partners.

By contrast, Southern European countries - with the Italian case as a core example - have tended to prioritize more traditional film and television formats in their national funding agendas. While there are emerging efforts to embrace digital and green transitions (based on the data by the *Ministry of General Contemporary Creativity*), immersive projects still represent a marginal share of the total audiovisual output. Limited institutional specialization, fragmented data collection, and a slower integration of XR-specific funding mechanisms contribute to this disparity.

This North-South divide reflects broader asymmetries in technological infrastructure, institutional agility, and access to innovation funding. It also mirrors discrepancies in how cultural innovation is positioned within national development strategies. While Northern states increasingly frame XR as a pillar of digital sovereignty and soft power, Southern states are still consolidating their foundational support systems before fully embracing immersive formats.

Addressing this imbalance requires more than isolated investments - it demands EU-level policy alignment, capacity building, and enhanced support for cross-border knowledge sharing, especially to include emerging XR creators and producers from the South in the larger European immersive ecosystem.



5.5. International Policies and Funding Schemes in the Audiovisual / Film Sector

This section focuses on the film industries of Canada and South Korea, with particular attention to the structure of their respective national/federal and regional funding institutions. The analysis centres on public funding mechanisms and tax incentive systems, examining how these instruments shape the development of national film sectors and support the integration of immersive technologies. By doing so, the chapter explores the broader role of state aid in fostering innovation and competitiveness within these two dynamic non-European film markets.

In its final part, the section offers a comparative analysis of international and European funding frameworks, highlighting the implications of these diverse models for global film production and distribution. Through this lens, the study seeks to illuminate how funding strategies influence not only national creative ecosystems, but also the global positioning of countries within the increasingly transnational audiovisual landscape.

5.5.1. The Canadian Film Industry

The term '*Hollywood North*' is commonly used to describe Canada's film and television industry, particularly concentrated in Vancouver and Toronto. This expression reflects a long-standing perception of Canada as a northern extension of the U.S.-based Hollywood system, owing to its close industrial ties, skilled labour force, and geographic proximity. Canadian actors and directors enjoy global recognition, and the country's audiovisual sector is showcased through numerous international film festivals that celebrate both domestic and international productions.

In recent years, the Canadian industry has experienced significant growth. The demand for production, post-production, and studio infrastructure has intensified, especially in the country's two major markets: Vancouver, which has become a key global production hub, and Toronto, a centre for both production and post-production. Meanwhile, Québec - particularly Montréal - has emerged as a strong contender, supported by a distinct cultural identity and robust provincial funding mechanisms. Calgary, Alberta, is also witnessing growing interest in studio development, signalling a diversification of production centres across the country.

April 2021 marked a turning point in the recognition of Canada's expanding role in North American film and television production. That month, Netflix⁵⁰ - the California-based digital streaming giant - announced the opening of its first Canadian corporate office in Toronto, a move widely interpreted

⁵⁰ <https://betakit.com/netflix-chooses-toronto-for-canadian-headquarters/>



as a strategic acknowledgement of Canada's growing importance within the global content production landscape.

Subsequent industry reports confirmed this upward trajectory. According to a 2022 publication by the Canadian Media Producers Association (CMPA)⁵¹, the Canadian film and television industry experienced a 'robust rebound' in production activity between April 2021 and March 2022. During this period, total production volume surged by more than \$2.5 billion, reaching a record-breaking \$11.7 billion - an increase of nearly 22% compared to the previous high of \$9.6 billion recorded in 2019-2020, prior to the COVID-19 pandemic.

The most significant growth was observed in foreign location and service (FLS) productions, which increased by 27.3% to \$6.71 billion, as well as in Canadian television production, which rose by 38.9% to \$3.51 billion. In the following year, the CMPA's 2023 report indicated continued growth⁵², with total industry volume rising by 4.4% to \$12.19 billion in 2022-2023. Once again, FLS activity played a central role, with foreign investments reaching \$7.86 billion - a 3.5% increase from the previous year.

However, despite this sustained growth, the Canadian sector faced new challenges in 2022-2023. Labour strikes in the United States significantly disrupted production activity, both in Canada and globally, leading to notable slowdowns across the industry. This underscores the extent to which Canadian production remains intricately linked to U.S. industry cycles, particularly in the FLS segment.

Presentation of Funding Bodies and Schemes

Several federal and regional film funding institutions play a pivotal role in the success of Canada's audiovisual sector. The country's decentralized support structure fosters the emergence of new filming hubs beyond the major centres of Toronto, Vancouver, and Montréal. This geographical diversification not only stimulates regional economic development but also promotes the use of immersive technologies in smaller cities, offering filmmakers increased flexibility and creative options.

At the federal level, Telefilm Canada stands as the cornerstone of national film funding policy. Established in 1967 under the name *Canadian Film Development Corporation (CFDC)* with an initial government allocation of \$10 million, the agency aimed to support the domestic feature film industry. The first office opened in Montréal in 1968, and later expansions led to the creation of offices in

51 <https://cmpa.ca/wp-content/uploads/2023/09/Profile-2022-EN.pdf>

52 https://www.mpa-canada.org/research_docs/profile-2023-an-economic-report-on-the-screen-based-media-production-industry-in-canada/



Vancouver and Halifax in 1984. It was at this point that the organization was renamed *Telefilm Canada* to reflect its broader mandate (Telefilm, 2023⁵³).

Today, Telefilm administers ten distinct funding programs, primarily in the form of grants, to support filmmakers across all phases of production - from script development to marketing and distribution. The agency also funds film festivals and promotional activities at the regional, national, and international levels, helping to amplify Canadian cinema's global visibility. Special support is given to international co-productions, particularly with France and other Eurimages member states, further reinforcing Canada's integration into global content networks.

Each funding stream has its own set of eligibility criteria, often differentiated by format (short films, documentaries, or feature-length works) or thematic focus. In addition, Telefilm Canada holds the authority to recommend projects for official recognition as audiovisual treaty co-productions to the Department of Canadian Heritage.

Finally, Telefilm is also responsible for administering the programs of the Canada Media Fund (CMF), a major financial instrument for television and digital content, which allocated a total of \$360.3 million in 2022-2023. This integration of feature film, immersive media, and digital television funding under a unified structure makes Telefilm Canada a central player in shaping both the present and future of Canadian content production.

The *National Film Board of Canada (NFB)* - originally known as the *National Film Commission* - was established in 1939. Its foundational mission was formally defined in the *National Film Act* (1985), which states that the NFB is to 'produce and distribute and to promote the production and distribution of films designed to interpret Canada to Canadians and to other nations'. This mandate reflects the central role the institution plays in shaping Canada's audiovisual identity, both domestically and internationally.

As a public producer and distributor, the NFB is widely recognized as a cornerstone of Canada's creative industries and a steward of its audiovisual heritage. It produces or co-produces more than 50 new works annually, spanning genres and formats - from documentaries and animation to interactive and immersive projects. Since its inception, the NFB has produced over 14,000 works, with approximately 7,000 available to the public free of charge. Its productions have received over 7,000 awards, including 12 Oscars⁵⁴, positioning the institution as one of the most celebrated public film bodies in the world.

⁵³ https://telefilm.ca/wp-content/uploads/2023/10/Telefilm_AR23_English.pdf

⁵⁴ <https://www.nfb.ca/about/>



The NFB supports production through several programmatic streams, including the French Program, the English Program, the Institutional Program, and a range of filmmaker support initiatives. For the French Program, specific eligibility criteria must be met. These include the requirement that the project could not be realized without the support of the NFB, as well as a demonstrated emphasis on artistic merit, originality of creative approach, narrative quality, and potential for international reach. This reflects the NFB's dual commitment to excellence in authorship and to the global dissemination of Canadian stories.

The *Canada Media Fund (CMF)* is a non-profit organization established through a partnership between Canadian Heritage and the Canadian cable industry. Its mandate is to promote the development of innovative, high-quality Canadian content and digital media, including software applications, through a range of targeted funding programs.

Among its many initiatives, the CMF administers a portion of the *Changing Narratives Fund*, which is specifically designed to support creators from diverse and underrepresented communities. These include Indigenous peoples, Black and racialized individuals, ethno-religious minorities, persons with disabilities, and 2SLGBTQ+ creators. The program provides financial support for a variety of activities, such as training, mentorship, and professional development, as well as initiatives that connect creators, organizations, and companies to industry opportunities.

Through these targeted investments, the CMF seeks to amplify voices that have historically been marginalized in the Canadian audiovisual landscape, contributing to a more inclusive and representative media ecosystem.

In addition, the *Canada Media Fund (CMF)* has partnered with the *Indigenous Screen Office (ISO)* to launch the *Interactive and Immersive Program*⁵⁵, a funding initiative created to support Indigenous storytellers in the development and production of projects using recent technologies and immersive media. Introduced in 2023, this fund is specifically aimed at applicants undertaking works in augmented reality (AR), virtual reality (VR), mixed reality (MR), immersive applications, and other interactive formats that incorporate audiovisual content.

The program reflects a dual commitment to technological innovation and Indigenous cultural expression, seeking to empower Indigenous creators through access to cutting-edge media forms. To be considered for funding, applicants must meet specific eligibility criteria, including confirmation of Indigenous identity and project alignment with the objectives of both the CMF and the ISO. The initiative not only expands access to immersive technologies but also contributes to the diversification and decolonization of the Canadian media landscape.

⁵⁵ <https://cmf-fmc.ca/document/cmf-iso-interactive-and-immersive-program/>



In 2023, the *Canada Media Fund*⁵⁶ (CMF) allocated a total of \$23 million to support 37 interactive and immersive film projects, reflecting its sustained commitment to innovation in audiovisual content. Of these, 19 games and two software-based projects received a combined total of \$4,495,191 under the *Prototyping Program*. Meanwhile, the *Experimentation & Innovation Program* awarded \$9,539,454 to nine projects, including six games, two immersive experiences⁵⁷, and one software application. The *Commercial Projects Program* provided \$8,853,265 to fund seven game projects with high market potential.

Beyond these federal-level initiatives aimed at positioning Canada as a global hub for film and immersive media production, a network of regional film commissions also plays a vital role in promoting Canada's territorial diversity. These commissions are instrumental in attracting domestic and international productions by showcasing the country's wide-ranging landscapes, urban settings, and technical infrastructure - contributing not only to economic development at the local level but also to Canada's international image as a multifaceted production destination.

*Creative BC*⁵⁸ (British Columbia's Creative Industry Catalyst) adopts an integrated approach to the development of the province's creative sector by centralizing all production-related services within a single organization. It offers a wide range of production support, including funding opportunities, location scouting, technical expertise, and informational resources aimed at both domestic and international producers operating in British Columbia.

A key component of its mandate is the administration of tax incentive programs, such as the *Digital Animation or Visual Effects Tax Credit (DAVE)*⁵⁹, which is designed to stimulate all aspects of motion picture production within the province. In parallel, Creative BC supports a variety of Development Programs that provide funding for both traditional and digital media production activities, thereby encouraging innovation across multiple content formats.

In addition to its production and funding initiatives, Creative BC has demonstrated a strong commitment to environmental responsibility through its *Reel Green* initiative. This program offers tools, training, and best practices to help reduce the ecological footprint of audiovisual productions, promoting sustainability as a core value within British Columbia's entertainment industry.

Through these comprehensive programs, Creative BC plays a pivotal role in maintaining Vancouver's status as a major player in global film and television production, while also positioning the province as a forward-thinking leader in sustainable and technologically advanced filmmaking.

⁵⁶ <https://cmf-fmc.ca/news/cmf-to-invest-nearly-23m-in-37-interactive-digital-media-projects/>

⁵⁷ It refers to 2 participants that won the inaugural Immersive/Interactive Producer Fellowship: They are Claudia Skunk (Vancouver) and Neegan Siou Trudel (Montreal) who were called to develop (in a 6-month period) expertise in the fields of VR, XR, AI and games, and to tap into the exciting job opportunities available in this growing area of production.

⁵⁸ <https://creativebc.com/>

⁵⁹ <https://creativebc.com/wp-content/uploads/2024/09/DAVE-Tax-Credit-Info-Bulletin-FAQ.pdf>



The *Société de développement des entreprises culturelles* (SODEC), founded in 1955, is a provincial agency that plays a central role not only in supporting Quebec's film and television industries, but also in fostering the broader cultural ecosystem. Its mandate extends across multiple sectors, including literature, publishing, crafts, music, visual arts, and even heritage real estate, thereby positioning SODEC as a uniquely comprehensive cultural development institution within Canada.

In the fiscal year 2023-2024⁶⁰, SODEC provided \$142.6 million in funding to 1,031 cultural enterprises, covering a wide range of disciplines such as audiovisual production, music, performing arts, literature, digital creation, crafts, and the art market. Notably, the organization also launched a new program targeting producers of digital and immersive experiences, further reflecting its commitment to innovation in cultural production.

Within the audiovisual sector specifically, 345 projects were supported across the province, including 49 in development, 96 in production, and 97 in promotion and distribution. Additionally, SODEC funded 74 projects in emerging creation, 14 in the pre-development of Quebec television series or literary adaptations, 12 in television production and production enhancement, and 3 projects through corporate production assistance programs. Beyond domestic production, 253 projects focused on export and cultural outreach were also supported, underlining the province's dual emphasis on both cultural vitality and international visibility.

SODEC's approach exemplifies a hybrid model of regional cultural policy and industry support, balancing artistic development, economic sustainability, and global reach - all while adapting to new technological trends such as immersive storytelling and digital innovation.

While SODEC offers a broad range of financial assistance programs across multiple cultural sectors, its recent strategic shift toward emergent creation is particularly noteworthy. In 2023, the organization introduced new funding initiatives specifically aimed at supporting the development and production of works using digital media and immersive technologies, including virtual and augmented reality (VR / AR) and other interactive formats. This initiative reflects SODEC's intention to foster innovative storytelling techniques, offering artists and cultural enterprises new creative avenues beyond traditional production models.

In addition to its sector-specific mandates, SODEC operates in close collaboration with provincial, federal, municipal, and regional partners to promote the economic development of cultural businesses and to amplify the impact of its actions across Quebec. Its financial instruments include

⁶⁰ <https://sodec.gouv.qc.ca/wp-content/uploads/resume-rapport-annuel-sodec-2023-2024.pdf>



grants, repayable contributions, and loans, tailored to the distinct needs of industries such as audiovisual production, publishing, crafts, the art market, music, and digital creation.

Crucially, SODEC remains attuned to emerging trends that shape the evolution of cultural enterprises and professional associations. It functions as a catalyst for innovation, production, and export, positioning itself as a key driver of both cultural and economic development in Quebec. Furthermore, SODEC operates a merchant bank and administers seven tax credit programs that support the creation and production of cultural works, thereby offering a multi-tiered and flexible funding ecosystem that addresses both artistic and commercial objectives.

The *Toronto Film Television and Digital Media Office* (Toronto Commission) is internationally recognized for fostering innovation and creativity in screen-based industries. In 2023, these industries contributed \$1.8 billion to Ontario's economy, generating 25,862 high-value full-time equivalent jobs, both direct and spin-off, across the province. Toronto has become a central hub for audiovisual production, offering world-class talent both in front of and behind the camera, internationally respected production and digital media companies, and a highly developed network of studios and suppliers.

The city's infrastructure and its architectural diversity also enable it to double as a wide range of global filming locations, making Toronto North America's third-largest screen-based production centre and one of the world's most prominent hubs for entertainment production.

Toronto is also home to IMAX Corporation, a global leader in high-resolution film formats and projector technologies. Renowned for its large-format screens, exceptional image fidelity, and immersive sound, IMAX partners with major studios to produce both 2D and 3D films designed for premium cinema experiences.

Moreover, the city hosts the internationally acclaimed Toronto International Film Festival (TIFF)⁶¹, one of the most prestigious annual events in the global film calendar. Attracting filmmakers, industry professionals, and large audiences from around the world, TIFF functions as a major platform for cultural and technological exchange, as well as an influential space for industry networking, distribution deals, and critical recognition.

With reference to Canada's tax incentives, there are two major programs: the Canadian Film or Video Production Tax Credit (CPTC) and the Film or Video Production Services Tax Credit (PSTC). The CPTC⁶² is a refundable tax credit designed to support the development of Canada's domestic independent production sector. It provides a tax credit of 25% on qualified labour expenditures, which cannot exceed 60% of the total budget (net of assistance). This results in a maximum tax

⁶¹ <https://www.tiff.net/>

⁶² <https://www.canada.ca/en/canadian-heritage/services/funding/cavco-tax-credits/canadian-film-video-production/application-guidelines.html>



credit equal to 15% of the total production costs. The eligible assistance includes public and private grants, government equity, and provincial tax credits (Edwards, 2018).

To qualify for the CPTC, film projects must meet several criteria:

- The production company must be a taxable Canadian corporation, and the producers must be Canadian citizens or permanent residents.
- The production must satisfy a points-based test focused on key creative positions (such as director, screenwriter, lead performers, etc.).
- The project must be a linear and non-interactive film or video production. According to CPTC⁶³ application guidelines, *'a 360° / virtual reality (VR) production can be eligible, as long as the storyline progresses in a linear way without requiring any active viewer intervention'*.
- Formats such as news programming, games, apps, or other similar interactive products are not eligible for CPTC certification.

The *Film or Video Production Services Tax Credit* (PSTC)⁶⁴ is the second major federal tax incentive supporting Canada's audiovisual industry. Unlike the CPTC, which focuses on Canadian content and independent production, the PSTC is designed to promote Canada as a destination of choice for both foreign and Canadian-owned film and television productions. It also plays a crucial role in sustaining a production infrastructure of international calibre across the country.

This tax credit is available to production companies or production service companies operating in Canada and is calculated at a rate of 16% of the qualified Canadian labour expenditure for a given production. The qualified Canadian labour expenditure corresponds to all eligible labour costs incurred in Canada, minus any financing amounts classified as assistance, including public grants and other forms of financial support.

5.5.2. The South Korean Film Industry

Over the past decade, the South Korean film industry has significantly expanded its global reach, effectively exported its productions and strengthened its influence across Asia, Europe, and North America. Today, Korean cinema is widely associated with the broader cultural phenomenon known as *Hallyu*, or the 'Korean Wave', which encompasses music, television, fashion, and digital media, and has become a powerful tool of soft power and cultural diplomacy.

Currently, there are general tax provisions applicable to the audiovisual sector, as the Korean film financing system is not governed by a specific, standalone tax framework. Nevertheless, the Korean film industry offers a particularly compelling case study of successful cultural policy. As noted by

⁶³ [cptc-cavco-application-guidelines.pdf](#)

⁶⁴ <https://www.canada.ca/en/canadian-heritage/services/funding/cavco-tax-credits/film-video-production-services.html>



Parc (2014), South Korea endured significant upheaval in the 20th century - first under Japanese colonial rule (1910-1945), followed by the devastation of the Korean War. Although the post-war years brought brief periods of prosperity, the industry faced renewed challenges between the 1970s and mid-1990s, including censorship, market instability, and foreign competition.

However, beginning in the late 1990s, the Korean film industry entered a period of dynamic renewal. Supported by targeted cultural policies and an evolving domestic market, it has since achieved remarkable success both at home and abroad, becoming a leading example of how state-supported cultural industries can thrive in a globalized media environment.

Presentation of Funding Bodies

The principal national body responsible for financing films and advancing the audiovisual and film industry in South Korea is the *Korean Film Council* (KOFIC). In addition to promoting Korean cinema abroad, KOFIC administers a range of programmes supporting production, development, distribution, and marketing. Similar to Canada, South Korea encourages film production through the provision of tax credits, particularly for domestic films and international co-productions. Moreover, KOFIC offers direct financial assistance to filmmakers in the form of grants, loans, and development funding. Major production companies and conglomerates, such as CJ ENM and Lotte Entertainment, have made substantial investments in film production, illustrating the strength of South Korea's private funding sector.

There are currently thirteen film commissions operating across almost every region of the country. South Korea ranks among the world's leading film-producing nations and constitutes the largest cinematic force within the Asian entertainment industry⁶⁵. The South Korean state provides a wide range of incentives to support international audiovisual productions, including assistance with location scouting and filming. In 2013, the *Korea Film Commissions and Industry Network* (KFCIN) was established as a nationwide system of mutual cooperation, further enhancing the country's already exceptional network of film commissions.

In Asia⁶⁶, South Korea's film policy offers a compelling case study for the development of cultural policies (Murschetz & al., 2019). Successive Korean governments have largely sought to promote and protect Korean culture - an approach comparable to that adopted by certain EU member states, such as France. The success of South Korea's film industry has been predominantly attributed to the state's protectionist measures. Initially, the country's import quota system encouraged domestic

⁶⁵ International Trade Administration. (2023, October 3). *South Korea - Entertainment and media*. U.S. Department of Commerce. <https://www.trade.gov/country-commercial-guides/south-korea-entertainment-and-media>

⁶⁶ Murschetz, P. C., Teichmann, R., & Karmasin, M. (Eds.). (2019). *State aid for film and audiovisual services: A synoptic review of key principles and governance models in Europe and abroad*. In P. C. Murschetz, R. Teichmann, & M. Karmasin (Eds.), *Handbook of state aid for film: Finance, industries and regulation* (pp. [pages]).



filmmakers to produce low-quality films rather than effectively restricting Korean audiences' access to foreign productions. Furthermore, the screen quota system did not guarantee substantial domestic attendance at Korean films. In addition, subsidy policies were largely insignificant prior to the late 1990s and thus cannot be credited with influencing the industry's success, which had already begun to emerge in the early 1990s. Parc (2018) argued that the critical factor in enhancing the competitiveness of South Korea's film industry was the establishment of a market-friendly business environment. He further suggested that, to bolster the competitiveness of other national film industries, policymakers should reconsider and redefine existing protectionist regulations.

Regarding fiscal incentives, the *Korean Film Council* (KOFIC)⁶⁷ offers targeted financial support to encourage both international co-productions and foreign productions conducted in South Korea. For eligible international co-productions - such as feature films and documentaries that meet the legal criteria - KOFIC provides support covering up to 25% of the expenses incurred on Korean territory. This incentive also applies to films, series, and documentaries developed and produced by foreign production companies, provided that at least 80% of the total production budget is financed by foreign capital.

For domestic filmmakers and Korean production companies, KOFIC also offers a cash rebate of up to 25% on eligible production expenses incurred within South Korea. The final grant amount is determined not only by the project's eligibility but also by the remaining program budget at the time of application, which introduces a dynamic element to the allocation process.

These fiscal incentives reflect South Korea's broader strategy to position itself as a competitive and attractive hub for international audiovisual production, while simultaneously strengthening its domestic industry through financial support mechanisms that reward investment and global collaboration.

South Korea benefits from a robust and well-coordinated network of regional film commissions, which has been in place since 2010. Today, ten regional commissions operate across the country, offering a film-friendly environment in all major cities and provinces⁶⁸. These bodies play a crucial intermediary role by facilitating the administrative and logistical aspects of film production. Their responsibilities include assisting with the acquisition of film permits, coordinating with local authorities, managing traffic control, supporting human resources recruitment, and offering a range of additional production services.

In some cases, these commissions also operate equipment rental services, studios, and post-production facilities, thereby enhancing local infrastructure and reducing production costs for both domestic and international filmmakers. A notable example is the Seoul Film Commission (SFC),

⁶⁷ www.kobiz.or.kr

⁶⁸ <https://www.koreanfilm.or.kr/eng/locKorea/filmOrg.jsp>



which provides comprehensive filming support for national and international productions taking place in Seoul. As part of its broader mandate to strengthen the city's audiovisual industry and enhance its global visibility, the SFC offers targeted financial and logistical support to attract a wide range of projects.

According to its official website⁶⁹, the SFC operates three main incentive programs, which include the following:

- Production Cost Support:

As part of its strategy to position Seoul as a leading international filming destination, the Seoul Metropolitan Government offers a reimbursement scheme for selected productions. Under this program, producers of internationally co-produced films and foreign films shot in Seoul may receive up to 30% reimbursement of eligible production costs. The initiative is designed to enhance the city's global reputation while stimulating the development of the local film industry.

Each project is subject to a reimbursement cap of approximately USD 265,000, although this ceiling may be adjusted downward in the case of projects deemed to have exceptionally high marketing value. The scheme is administered by the Seoul Film Commission (SFC), which oversees the selection process and disbursement of funds. Importantly, these reimbursements are non-repayable, and applications are open to producers of all nationalities, reinforcing Seoul's openness to international collaboration.

- Location Scouting Support:

To further encourage the use of Seoul as a filming location, the Seoul Metropolitan Government - through the Seoul Film Commission (SFC) - offers a dedicated program to support location scouting for foreign visual content productions. This initiative targets a selected group of international professionals and aims to familiarize them with the city's cinematic potential.

Eligible applicants include foreign directors, assistant directors, producers, directors of photography, production designers, and location managers. The support package typically includes two round-trip airline tickets, accommodation, access to a domestic location coordinator, and the provision of a rental car. By covering these key logistical costs, the program seeks to lower the entry barrier for international productions and promote Seoul as a viable and attractive filming destination at the earliest stages of project development.

- Seoul Screenplay Development Support:

In addition to its support for production and location scouting, Seoul City also invests in the preliminary stages of audiovisual creation through the Seoul Screenplay Development Support

⁶⁹ <https://english.seoulfc.or.kr/ict/ov/>



Program. Managed by the Seoul Film Commission (SFC), this initiative is designed to promote the planning and development of foreign visual media projects that incorporate Seoul as a key narrative or production setting.

The program provides round-trip airfare and access to a dedicated screenplay writing room in Seoul for selected foreign filmmakers, producers, and screenwriters. By offering an environment conducive to creative work, the initiative encourages international creators to embed the city into the conceptual core of their projects. This early-stage support reinforces Seoul's positioning not only as a filming location but also as a source of inspiration and narrative innovation.

Critical Analysis

The South Korean film industry has emerged in recent decades as one of the most dynamic and internationally recognized cultural sectors in the world. Driven by rapid technological advancement, sustained growth, and a strong domestic audience base, it is often cited as a model of successful cultural development within a globalized media economy (Jim, 2016).

Unlike many Western countries, where cultural industries are typically shaped by important levels of state intervention, South Korea has adopted a more hybrid approach, effectively combining public policy instruments with robust private sector engagement. This distinctive configuration has drawn considerable scholarly attention, particularly in comparative policy studies. Analysts frequently contrast South Korea's model with that of countries like France, where state involvement in the audiovisual sector has historically been more pronounced and centralized (see also section 4.9.1.). South Korea's case thus offers valuable insight into alternative pathways for cultural policy, blending market dynamics with strategic government support to foster both domestic success and global competitiveness.

In a 2019 comparative analysis, Messerlin examined the institutional and economic policies of South Korea and France, with a particular focus on the role of government subsidies in shaping national film industries. Challenging the widespread assumption that large-scale direct subsidies are essential for building a robust audiovisual sector, Messerlin contrasted the approaches of the *Korean Film Council (KOFIC)* and the *Centre National du Cinéma et de l'Image Animée (CNC)* in France. He argued that South Korea's indirect funding model has produced more cost-effective and sustainable results over the long term, as opposed to France's interventionist framework, which relies heavily on automatic and direct subsidies. In particular, Messerlin criticized France's use of a high seat tax to fund these mechanisms, suggesting that this model has limited audience engagement, stifled innovation, and consolidated power among established industry players, thereby reducing overall cultural diversity.



By contrast, South Korea's more moderate and targeted funding policies - combining limited state aid with market-driven incentives - are presented as fostering a more dynamic, pluralistic, and competitive cinematic ecosystem. Messerlin's findings have sparked renewed debate around the efficiency and cultural impact of different state-led funding strategies, particularly in the context of globalized media markets and the rapid evolution of digital and immersive storytelling forms.

Building on their earlier findings, Parc and Messerlin (2022) revisited the issue of screen monopoly regulation in the South Korean film industry. Their study challenges the widely held belief that South Korea's exhibition sector is highly monopolized. Contrary to this perception, they demonstrate that the Korean industry is, in fact, less concentrated and more diverse than that of France.

By analysing data on film turnover rates and domestic box office hit distributions, the authors argue that what may be interpreted as monopolistic behaviour in the Korean context is more accurately understood as the result of efficient screen turnover and flexible, market-responsive use of exhibition space. According to their findings, these dynamics allow for a high volume of content to circulate rapidly, rather than reflecting the dominance of a few major players.

Parc and Messerlin further caution against adopting a French-style regulatory framework in South Korea, arguing that such a shift would risk undermining the competitive forces and institutional flexibility that have contributed to the industry's vitality. Their study thus reinforces the notion that cultural policy models are not easily transferable across national contexts, and that regulatory interventions must be carefully adapted to local industry structures and audience behaviours.

The aforementioned studies offer a critical evaluation of regulatory and funding interventions in the cultural industries, particularly in the context of South Korea's film sector. They express scepticism toward France's strong reliance on anti-monopoly regulations and direct subsidization, pointing to the unintended consequences such measures may have on creative output and artistic innovation. In contrast, South Korea is presented as a compelling case in which indirect forms of financial support - when combined with competitive market mechanisms - can yield superior outcomes in both economic and cultural terms.

In conclusion, the comparative analysis of the South Korean and French film industries invites a broader reassessment of prevailing policy assumptions in the governance of cultural sectors. By emphasizing the relative effectiveness of South Korea's less interventionist, market-oriented strategy, these works challenge the notion that cultural industries necessarily require prominent levels of state protection and subsidy to thrive. Instead, they advocate for balanced, evidence-based policy frameworks that align with specific institutional, economic, and cultural contexts, and that prioritize strategic resource allocation, industry competitiveness, and creative innovation.



5.5.3. Concluding remarks

Despite its longstanding tradition in film production, Europe is increasingly confronted with challenges in the global competition for audiovisual innovation, particularly in the domain of XR (Extended Reality) technologies. The heterogeneity of EU funding policies and the fragmented integration of XR-related innovations across Member States stand in sharp contrast to the cohesive and strategically coordinated approaches adopted by countries such as Canada and South Korea. This divergence places significant constraints on Europe's competitiveness within the emerging global audiovisual ecosystem.

At the European level, national funding systems continue to invest heavily in the preservation of cultural identity and the promotion of traditional narrative forms. Programmes such as the French CNC and the German FFA offer substantial support for conventional film production, yet often relegate XR innovation to a peripheral concern, with only limited allocations dedicated to specialised media. Even within the broader Creative Europe Programme, the budget specifically earmarked for XR content — €139 million under the MEDIA strand — remains modest compared to the overall investment in traditional audiovisual formats. Moreover, although the European Virtual and Augmented Reality Industrial Coalition represents a positive step towards greater coordination, it has only recently commenced its activities and has yet to generate tangible structural outcomes.

In contrast, Canada has developed a significantly more integrated strategy. Canadian policies explicitly support XR production as part of broader national objectives for competitiveness agendas, with substantial public investment not only in content creation but also in infrastructure, research, and international market expansion. Through federal and provincial initiatives such as Telefilm Canada and the Canada Media Fund, funding is allocated to projects that explore interactive narratives and technological innovation. Critically, Canadian policymakers do not perceive XR as a niche creative sector, but rather as an essential component of a wider digital strategy closely aligned with economic growth, cultural diplomacy, and technological sovereignty.

South Korea provides an even more striking illustration. Through state-supported initiatives such as the Korean Film Council (KOFIC) and the Korea Film Commission and Industry Network (KFCIN), the country has actively integrated XR and immersive media into its mainstream audiovisual policies. National strategies explicitly support the production of VR, AR, and XR content through direct grants, equipment subsidies, and the development of XR infrastructures, including immersive theatres and specialised creative hubs. Furthermore, South Korea's cultural policy adopts a holistic approach, integrating cinema, gaming, and interactive media, and recognising that the future of storytelling will be inherently hybrid and multi-platform. Unlike the fragmented national funding systems observed in Europe, South Korea's approach is nationally coordinated and globally oriented, thereby securing a leading position in the evolution of the global audiovisual ecosystem.



The differences in these strategic approaches have tangible consequences. While Europe continues to lead in artistic innovation and the production of high-quality traditional cinema, it faces an increasing risk of lagging behind in domains that will drive new audience engagement and future revenue streams. As younger audiences worldwide increasingly gravitate towards interactive and gamified experiences, the regions that successfully master these technologies are likely to play a decisive role in shaping the future of cultural production and consumption. The European Union's strong emphasis on cultural preservation, coupled with a relatively slow pace of technological convergence, places it at a comparative disadvantage when measured against the Canadian model of innovation and the comprehensive, export-oriented strategy pursued by South Korea.

A fundamental reassessment of Europe's audiovisual policy strategies is necessary to counter the risks identified in the preceding analysis. Firstly, XR and VR content should no longer be regarded as experimental or peripheral but instead be integrated as core components within national and EU-level funding schemes. Secondly, the development of a harmonised European framework for XR innovation is required to address inter-State disparities, stimulate cross-border initiatives, and establish a continental market capable of competing with those of North America and East Asia. Thirdly, while safeguarding its cultural identity, Europe must actively reinterpret its narratives, values, and aesthetic traditions within immersive formats, ensuring their relevance and vitality in the evolving media environment.

The hybridisation of classical film and XR technologies represents both a technological challenge and a significant cultural opportunity. As evidenced by the policy successes of South Korea and Canada, strategic investment in XR infrastructures and hybrid content development not only consolidates national cultural industries but also enhances international competitiveness. For Europe, the adoption of a 'VR mindset' is therefore not an option but a necessity in securing a sustainable and forward-looking audiovisual sector.

The present comparative analysis highlights that, while the European audiovisual policy framework remains strong in the defence of cultural heritage, it requires significant adaptation to meet the demands of a globalised media ecosystem characterised by hybridity and interactivity. Drawing lessons from the Canadian and South Korean experiences, Europe must place technological innovation, cross-border networking, and the establishment of an integrated XR / VR ecosystem at the heart of its strategic priorities. It is through the pursuit of such a strategy that the European Union will be able to sustain its film heritage and maintain a leading role in the evolution of global storytelling practices. The following recommendations propose a roadmap to support this necessary transformation.



5.5.4. Recommendations for New Policy

The European Union has long prioritized the promotion of emerging technologies and the advancement of innovation within its cultural and creative industries. However, this study has demonstrated clear disparities in both the **accessibility** and **implementation** of VR / AR / XR technologies across the European continent. In order to foster a more coherent hybridisation of 'cinema-XR' and to align **state and private support policies**, the following recommendations are proposed:

Firstly, it is imperative to **increase the overall volume of XR funding**, with the explicit aim of enabling the **coexistence of traditional and immersive technologies** within audiovisual production. Enhanced funding would foster experimentation, encourage technological integration, and support creators working across multiple formats. At present, significant disparities exist among EU member states: while countries such as **Germany and France** offer relatively well-structured programs (characterised by high production quality but limited in financial scope), others such as **Belgium and Italy** lag in terms of systemic support for immersive works. A **coordinated pan-European effort** is therefore necessary to ensure that creators in all member states can access the financial and technical resources required to innovate in this field.

Secondly, there is an urgent need to **standardize and harmonize public and private funding frameworks** for immersive and XR projects across Europe. A more unified regulatory and financial structure would not only simplify the application process and increase **transparency** for creators but also reduce the **funding inequalities** that currently separate well-resourced countries from those with minimal XR investment. Harmonization would also facilitate **cross-border collaborations**, creating an environment where European creators can cooperate more easily and benefit from shared infrastructures and joint financing mechanisms.

Lastly, the study highlights the fact that **younger creators are often more receptive to immersive technologies**, and thus **emerging technologies should be integrated into higher education curricula**. Universities and film schools must play a key role in shaping a skilled and adaptable workforce, capable of navigating and innovating within a rapidly evolving audiovisual landscape. By investing in **technological literacy, interdisciplinary training, and production-oriented education**, Europe can position itself as a **global leader in the XR film industry**, ensuring that future generations of filmmakers are not only technologically proficient, but also creatively empowered.



5.6. Empirical Studies as an Argument for the Growth of 'Cinema / XR' Hybridisation

5.6.1. Comparison of Social Spatial Cognition Induced by Cinema and by 'Cinema / XR'

Another important dimension of this research focuses on the **social and cognitive mechanisms** triggered by both the production and viewing of audiovisual content, considered independently from traditional cinema and the emerging 'cinema / XR' hybrid forms. This line of inquiry serves as a conceptual and empirical foundation for making scientifically grounded arguments concerning the future development of cinema and the cultural policy strategies the European Union could pursue to enhance the global attractiveness of its cinematographic output - particularly in light of **evolving patterns of spatial cognition** within contemporary societies.

The theoretical and empirical basis of our comparison is rooted in the question of **how space is constructed and perceived** in media more broadly, in conventional film representation, and in works arising from the hybridisation of cinema and immersive technologies (XR). By analysing the shifts in spatial perception induced by these diverse formats, this research aims to identify concrete recommendations for cultural policy, geared towards emerging narrative forms, altered modes of spectator engagement, and new paradigms of spatial storytelling.

5.6.2. Main Hypotheses of Empirical Research

Hypothesis I

Based on the study of the **experimental features** and **contrastive routines of social cognition** observed in the domain of spatial orientation - on the one hand through the practices and reception of classical cinema, and on the other through the creative use and reception of XR technologies - it is possible to demonstrate that **XR experiences induce distinct cognitive patterns** in users.

Compared to traditional cinematic formats, immersive XR technologies engage users in **more active and embodied modes of perception**, thereby prompting **novel spatial and social cognitive processes**. These include altered relationships between viewer and space, enhanced sensorimotor coordination, and a shift from observational to participatory modes of narrative involvement. The contrast highlights a fundamental transformation in the way individuals construct meaning and orient themselves within mediated environments.

The hypothesis corollary

These emerging **perceptual and cognitive structures** reflect broader developments in media environments and the ways in which contemporary media ecosystems shape users' cognitive



schemas - whether as viewers, consumers, media designers, or content creators. The dominant **medial landscape** is increasingly immersive, interactive, and multisensory, fostering new forms of engagement and interpretation.

If cinema remains confined to the **spatial and perceptual model** developed between 1897 and the 1970s - characterised by directional and frontal image capture, passive viewing in a darkened theatre, reduced perceptual openness to the real scene, and limited social interaction among spectators - it risks falling out of step with the evolving dynamics of **social cognition**, particularly as experienced by younger audiences immersed in contemporary digital culture.

To enhance the **attractiveness and cognitive relevance of European cinema**, one essential strategy would be to **acknowledge the transformative potential of XR technologies**, and to **clarify and strengthen policy incentives** aimed at supporting creators and distributors working in this field. Such a shift would not only modernise the cinematic experience but also align it more closely with the perceptual and social habits of emerging generations.

Hypothesis II

By demonstrating that young and creatively inclined individuals are best positioned to lead the integration of XR technologies into both the creative and spectatorial dimensions of cinematic practice, it becomes evident that targeted interventions must go beyond mere funding or technical infrastructure. In parallel with incentive policies aimed at supporting hybrid cinema / XR creation and equipment, there is a pressing need for coordinated action at the European level to foster the emergence of specialised training programmes explicitly focused on cinema / XR.

Such programmes should be embedded within higher education institutions and film schools across Europe, offering interdisciplinary curricula that blend cinematic storytelling, immersive design, spatial cognition, and technical XR skills. By investing in education as a vector for transformation, European institutions can cultivate a new generation of creators, curators, and audiences attuned to the evolving languages of moving image, and capable of shaping the future of audiovisual culture at the intersection of art, technology, and society.

5.6.3. Theoretical Framework: Space in Film Studies

Conditions for the Possibility of the Comparison

In any comparative study, it is essential to compare elements that are methodologically comparable. Cinema, with its 130-year history, has had ample time to develop and stabilise its own narrative conventions - a grammar shaped both by its most influential auteurs and by the social practices of



its audiences. In contrast, XR videography remains an emerging and experimental medium, lacking fully codified and universally accepted storytelling structures.

One illustrative example is the contrast between the cinematic camera's directional framing, which guides the viewer's gaze through intentional composition, and the 360° camera's omnidirectional field of vision, which decentralises the viewer's point of focus and invites a more exploratory mode of engagement. This fundamental difference exemplifies the broader ontological and experiential divergence between the two media.

Therefore, to apply a valid contrastive methodology, it is first necessary to establish a set of general conceptual parameters, and to identify core narrative or communicative functions that are common across media forms. This foundational step allows for meaningful comparisons, not of forms or aesthetics alone, but of the function's media perform in relation to storytelling, perception, space, and user engagement.

Role of Space in the Media

The principal functions shared by all media may be summarised as follows: to represent the real world - that is, to provide information about the state of the world; to establish communication between members of a community; to provoke individual and collective emotional responses; and, finally, to argue for conclusions based on presented information.

With regard to the cinematic medium, film theorist Lev Manovich notes in his seminal article 'Spatial Computerisation and Film Language' (2001) that the most significant developments brought about by the computerisation of film concern the treatment of represented space. When focusing on the first fundamental function of media - representing the real world - it becomes clear that each medium structures information according to its particular relationship to space.

This insight finds further support in cognitive research. As Menzel and Sayers (2022) demonstrate, spatial cognition in primates, including humans, is deeply influenced by physical navigation. Movement through the environment impacts not only low-level neural pathways and perceptual processes, but also high-level cognitive functions, including emotional memory and abstract reasoning. In this light, media technologies - products of human cultural evolution - can be seen as various attempts to mediate and organise spatial experience.

Throughout history, the media have encoded space in different ways. With the digitalisation of photography and cinema, however, spatial representation has undergone a profound shift. Computer-generated environments have expanded the margins of representational possibility, giving rise to new grammars of space, motion, and point of view. The primacy of spatial representation in contemporary media is consistently emphasised in the critical literature (Marvin et



Sun-ha, 2017; Christie, 2024), suggesting that the evolution of immersive media may be best understood as a continuation - and radicalisation - of this trajectory.

Spatial Approach in Cinematographic Studies

The spatial approach in film studies was notably pioneered by David Bordwell, whose influential work *The Classical Hollywood Cinema: Film Style and Mode of Production to 1960* (Bordwell, Staiger et Thompson, 1985) examines how spatial organisation functions within classical narrative cinema. Bordwell highlights how filmmakers utilise techniques such as on-axis cuts, shot/reverse shot sequences, and relative continuity editing to construct a spatially coherent and intelligible diegetic world. These techniques are designed not only to support storytelling but also to guide the viewer's attention and to clarify the spatial relationships between characters and objects on screen. Building upon this foundation, and drawing upon more advanced empirical methods, Artur Shimamura launched a new interdisciplinary research agenda in the early 2010s under the label of *psychocinematics* (Shimamura, ed., 2013). This approach integrates psychology, neuroscience, and film theory, positing that our experience of cinematic media is grounded in both the physical properties of spatial representation and the cognitive mechanisms through which we perceive and interpret space - specifically, our innate systems of spatial orientation. Higher-order cognitive processes, such as narrative comprehension and emotional engagement, are theorised as being layered upon these foundational spatial frameworks.

A key innovation in Shimamura's work is the application of eye-tracking technology, which allows researchers to measure objectively where viewers focus their gaze on the screen and how their visual attention shifts over time. This empirical technique facilitates the study of cognitive responses such as attentional focus, emotional resonance, and narrative processing. Crucially, eye-tracking offers a way to supplement traditional film analysis with quantifiable data, thereby reducing the subjective bias often inherent in interpretative approaches to narrative structure and editing style. It has proven especially valuable in evaluating the effectiveness of different montage techniques, and in understanding how filmmakers guide and manipulate viewer experience at a perceptual level.

Space as the Common Denominator of Cinema and 'Cinema / XR'

According to Lev Manovich, the evolution of classical cinema towards its hybridised forms is fundamentally driven by changes in the mental representation of space. It is undeniable that both cinematic and XR content - as well as their hybridisation - generate diverse spatial representations in both creators and spectators. Although these representations differ in form and intensity, they each contribute, in distinct ways, to the development of cognitive skills related to the subject's spatial orientation.



A comparative analysis of these cognitive skills reveals that, while qualitatively different, they can lead to quantitatively comparable results when applied to real-world spatial tasks in physical environments. This suggests that spatial orientation and its underlying imaginary function as a shared cognitive foundation for both traditional cinematic and XR creative technologies. Consequently, this spatial dimension represents a common ground upon which the hybridisation of creative and spectatorial practices can be meaningfully developed.

From this theoretical premise emerges the central objective of our experimental study, which involves samples of young audiences. The study aims to compare the impact of classical cinema and hybrid audiovisual content on creative and spectatorial cognition, specifically in relation to spatial orientation.

This research seeks to update and extend the 'psychocinematics' framework initiated by Shimamura (2013), by integrating experimental approaches to spatial cognition with emerging cinematic and XR technologies. By doing so, it aims to offer robust scientific arguments in support of a closer integration of European cinema and XR technologies - thus fostering greater alignment between traditional film practices and the evolving dynamics of the contemporary media landscape.

5.6.4. Methodological Framework: Eye-tracking Applied to Extended Film Studies

Why is Eye-tracking useful in Film Studies?

Known since the early 20th century and digitised in the late 1990s, the eye-tracking method has been employed in film studies since around 2010, following significant advances in its technological development and refinement (Wade & Tatler, 2005). It now enables detailed analysis of the cognitive mechanisms involved both in the creative process of filmmaking and in the reception of audiovisual content by viewers.

For creative teams, eye-tracking serves as a tool for verifying the effectiveness of editing strategies, assessing the aesthetic impact of mise-en-scène and visual composition, and evaluating how visual attention is distributed across the cinematic frame. For audiences, eye-tracking provides an objective means of studying perceptual and mental processing in response to filmic images and sound.

Several psychophysiological parameters of the gaze can be used in analysing both the production and reception of cinematic messages, including:

- Gaze direction
- Saccadic trajectories
- Fixation duration and attentional persistence



Moreover, the attentional synchronisation between image and sound can also be investigated, offering valuable insight into multisensory narrative processing. Eye-tracking is fully compatible with other biometric measurements, such as galvanic skin response or heart rate variability, thereby enabling multimodal analysis of viewer experience.

On the stimulus side, eye-tracking data is typically correlated with salient and meaningful elements of the visual field - so-called points of interest - which can be mapped to narrative, aesthetic, or emotional functions. As vision is inherently spatial, eye-tracking is particularly well suited to evaluating cinematic theories of spatial construction. This was the principal direction of early empirical research by pioneers such as Arthur Shimamura and Tim J. Smith, whose work between 2010 and 2015 laid the foundations of the field.

The epistemological value of eye-tracking lies in its ability to quantify the gaze, offering precise measurements of eye movement and attention allocation. These metrics can be directly associated with higher-order cognitive processes involved in meaning-making, emotional response, and spectatorial engagement, thereby reducing the interpretative subjectivity that has traditionally characterised film theory. Eye-tracking thus allows for a fruitful oscillation between aesthetic interpretation and empirical validation, legitimising the application of scientific methodologies to the analysis of cinematic experience.

Since 2010, eye-tracking - together with brain imaging techniques - has become one of the two primary scientific approaches underpinning the emergence of psychocinematics, now widely recognised by the research community as a key element of **the computational turn** in film studies (Stelmach, 2024).

Place of Eye-tracking in the Study of 'Cinema / XR' Hybridisation

In the conclusion of his seminal chapter in *Psychocinematics*, edited by Shimamura, Tim J. Smith writes:

'To an external observer film viewers may appear highly passive. The intention of this chapter was to demonstrate how incredibly active viewers are in terms of how they both shift their gaze around the screen and cognitively process the presented information. The construction of the narrative is a collaborative process that requires suitable presentation of the relevant audiovisual information by the filmmaker and active acquisition and encoding of that information by the viewer.'

This statement highlights the active role of the viewer, not only in directing their gaze but also in cognitively engaging with audiovisual content. When applied to 'cinema / XR' hybrid experiences, this activity expands considerably, as the cognitive mechanisms involved in perception and orientation are mobilised in new and complex ways.

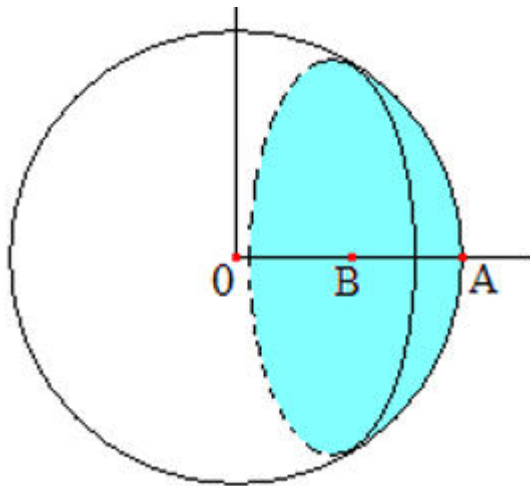


In comparing the visual ergonomics of XR to classical cinema, one observes that the viewer's gaze, previously constrained by the rectangular frame of the screen, becomes a spherical gaze defined by the spherical cap of vision. In head-mounted displays (HMDs) with 3 degrees of freedom (3DOF), this gaze is controlled by rotational movement around the neck's pivot axis (yaw, pitch, roll). In more advanced systems such as the Oculus Quest 3, which offer 6 degrees of freedom (6DOF), gaze interaction is enhanced by the ability to move freely through space, incorporating translational motion (up/down, left/right, forward/backward).

This transition from a static, framed visual experience to a dynamic, embodied spatial navigation reflects not only a shift in medium but a transformation in the cognitive architecture of spectatorship. The hybridisation of cinema and XR thus opens new horizons for understanding how viewers construct meaning, orient themselves in narrative space, and engage emotionally and sensorily with audiovisual content.

- The spherical cap

Figure 5: Fields of vision as a function of the extent of the spherical cap



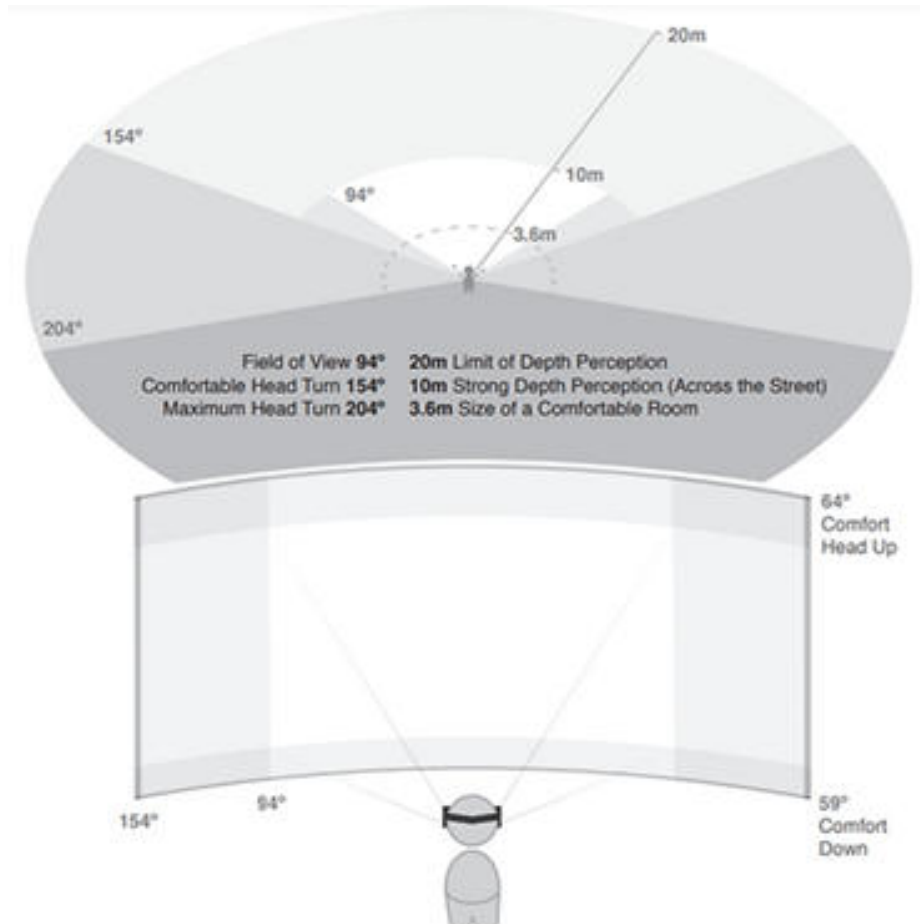
VR Sketch Sheets (VRSS) refer to the conceptual synthesis between the theoretical domain of vision - that is, the total visual coverage from an unconstrained centre, extending across all theoretically observable portions of three-dimensional Euclidean space - and the cognitive and perceptual structuring of the visual field. This structuring incorporates both physiological constraints and mental habits of vision.

Specifically, VRSS describes the section of the visual sphere situated on the ground plane and its categorisation based on the ratios between the width and depth of comfortable visual perception. These proportions correspond to ergonomic thresholds within which the viewer can maintain visual attention, orientation, and immersion without discomfort or disorientation.



This model allows for a more precise understanding of how XR environments should be designed to align spatial geometry with cognitive ergonomics, particularly in narrative-driven immersive experiences. It offers a valuable framework for creators working at the intersection of aesthetic composition, spatial cognition, and user-centred design in immersive media.

Figure 6: VR Sketch Sheets



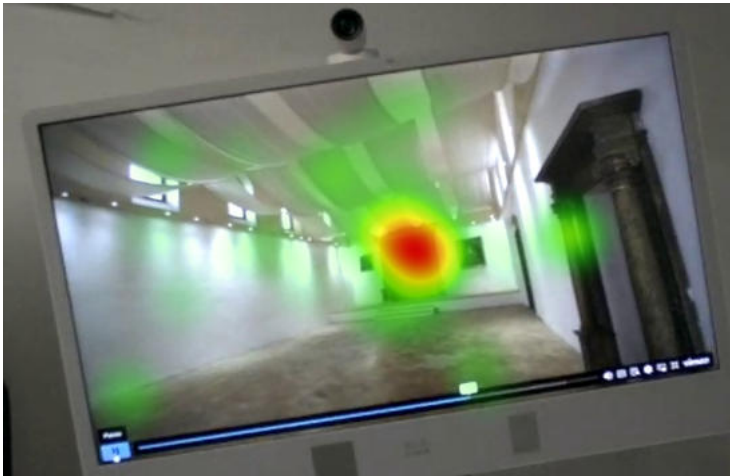
As a result, the eye movements of the XR viewer are significantly expanded and become markedly more mobile than in traditional cinematic contexts. The immersive environment invites the user to engage with the visual scene not from a fixed, frontal perspective, but through continuous repositioning of the gaze, driven by interest, curiosity, and spatial cues.

For instance, in an interior XR representation of a historical monument - such as the conference room of the Château de la Napoule - the space may be presented through a virtual tracking shot, allowing the viewer to explore the room from multiple vantage points. Despite this freedom of movement, the scene may still retain a clear central visual anchor, guiding perceptual attention without prescribing a fixed trajectory. This combination of spatial freedom and focal coherence exemplifies how XR reshapes the visual experience into a dynamically constructed perceptual



narrative, where the viewer plays an active role in assembling the scene's meaning through movement and gaze:

Figure 7: Central visual anchoring in 2D screen viewing



In the VR version of the same room, within a shot of comparable duration, the viewer's attention is engaged in three distinct directions, requiring, in this example, a 270° pivot of the head or body to observe the full extent of the scene. Unlike in traditional cinema, where spatial exploration is dictated by camera movement and framing, here the viewer's gaze and physical orientation actively determine the unfolding of the visual narrative.

This necessity for spatial repositioning not only enhances the sense of embodied presence but also transforms the viewer into an agent of spatial narration. The scene is no longer revealed sequentially by editorial choices but is instead constructed perceptually and cognitively by the viewer's own exploration of the environment. Such examples underscore the fundamentally different temporal-spatial grammar of XR media, and the need for new frameworks of analysis to understand how meaning is built through gaze mobility and spatial immersion.

Figure 8: Attentional points distributed in spherical vision





Our objective is therefore to extend the application of the eye-tracking method beyond traditional film studies, and to adapt it specifically to the comparative analysis of viewer reception between classical cinema content and 'cinema / XR' hybrid productions. This approach follows the foundational work of Clay, König, and König (2019), which coincided with the emergence of the first industrial eye-tracking solutions for immersive media - initially developed by Pupil Labs, Tobii, and FOVE, and now led by the Varjo system, which we have adopted for our own research.

5.6.5. Components of an Experimental Setup

Figure 9: Photos of the device and the experiment



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A complete experimental setup using eye tracking in virtual reality (VR) involves a combination of hardware and software components. Below is an overview of the essential elements typically included in such a configuration:

VR Hardware Set

This includes a virtual reality headset (HMD - Head-Mounted Display), motion sensors, and, where necessary, handheld controllers to enable interaction with the virtual environment (Figure 10).

Figure 10: Varjo XR-4 VR Eye Tracking System - HTC VIVE Focus 3 VR Eye Tracking System



A complete, high-quality configuration of these components is provided by the Varjo XR-4, a professional-grade headset developed by SpeederNet in collaboration with Varjo.

An alternative solution is the HTC VIVE Focus 3 (Figure 10), which supports application development via Unity, making it highly adaptable for experimental design.

Microsoft also offers consumer-grade VR headsets that are suitable for research purposes. These devices feature high refresh rates, enhanced computing power, and integrated eye-tracking capabilities, making them particularly well-suited to studies involving immersive interaction and gaze behaviour.



Microsoft also provides consumer-grade virtual reality headsets that support user-driven application development. These devices are well-suited for research contexts thanks to their high refresh rates, enhanced processing capabilities, and integrated eye-tracking technology.

Software

Common tools for designing virtual reality experiences include Unity and Vizard, the latter often used in conjunction with the SightLab library for eye-tracking analysis. Unity is a free and widely adopted game engine, supporting development in C# and JavaScript, whereas Vizard is more specifically tailored for virtual reality research applications, with programming carried out in Python.

Vizard, developed by the company WorldViz (founded by Peter Schlueer), is designed to provide researchers with user-friendly access to eye-tracking data while maintaining the low-level control and high data quality required for scientific rigour. As Andy Beall, founder and Chief Scientist of WorldViz, notes: *'It is incredible how easy it is to set up immersive eye-tracking experiences. With Vizard, you can quickly add eye tracking to your virtual scene and perform analyses, including recording and exporting your data.'*

Vizard supports integration with a variety of specialised research devices, including those developed by the CoCoLab, such as biophysiological sensors (e.g., EEG, ECG). Its Python-based interface not only simplifies development but also enables access to a vast ecosystem of existing libraries and tools. Together, Unity and Vizard allow researchers to design both simple and complex 3D environments, programme object behaviour, and extract detailed information on participant behaviour using eye-tracking and electrophysiological measurements.

These capabilities open new frontiers in experimental design across diverse fields, including psychology, neuroscience, performance assessment, training, and consumer behaviour research.

Figure 11: Photos of the experiment



PC Hardware

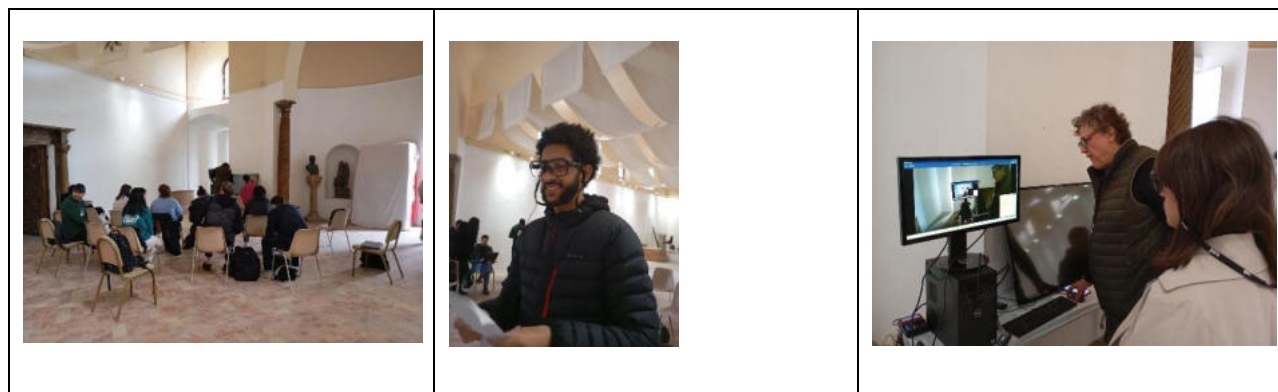
Despite the remarkable advancements in computer hardware over the past three decades, current VR applications still place substantial demands on computational power, even on the latest systems. This is particularly evident when rendering complex scenes with multiple dynamic objects, intricate



textures, or fluctuating lighting conditions. To ensure an optimal experience, it is essential that the VR environment operates at a high refresh rate; otherwise, response delays or jerky motion can easily induce motion sickness in participants.

The computer system typically functions as the interface between the eye-tracking technology and the VR headset, collecting and processing all behavioural data related to the subject's interaction within the virtual environment. For this purpose, the experiment will be conducted on a DELL Precision 3680 Tower workstation, equipped with a 14th Gen Intel Core i9 14900K processor, ensuring the required computational power for high-quality rendering and real-time data processing.

Figure 12: Photos of the experiment



Eye-tracker: XR Headset and Environmental Glasses

These devices are specifically designed to integrate with different types of VR headsets, providing advanced eye-tracking capabilities for immersive experiences. Companies currently offering eye-tracking technology for VR headsets include Varjo with the XR-4 and HTC Vive with the Eye Focus 3.

Among the leading devices is the Tobii Pro Glasses 3 (Figure 13), an advanced wearable eye-tracking solution designed for research purposes. This device enables the capture of detailed eye-tracking data in real time, offering scientific accuracy that propels research beyond controlled environments and into more natural, real-world settings. The Tobii Pro Glasses 3 are particularly valuable as they allow participants to behave naturally, without the interference typically associated with laboratory-based eye-tracking setups. Eye-tracking data is collected seamlessly while the participants engage in real-world activities, providing rich insights into cognitive and perceptual processes during immersive experiences.

Figure 13: Tobii Pro Glasses 3





Cable Management

Most VR setups involve multiple cables connecting the headset (and eye tracker) to the computer. As subjects typically move around in the virtual environment, they are at risk of becoming tangled in these cables, which can interfere with their immersion and performance. This issue can be mitigated by seating participants in a 360° rotating chair, ensuring freedom of movement without the risk of entanglement.

Some manufacturers, such as HTC, offer wireless solutions for VR headsets, such as the Focus 3 (Figure 11), which can serve as a useful alternative to traditional wired setups. However, despite these advances, the majority of eye-tracking systems for VR still rely on cabled connections, necessitating careful cable management to ensure that the participant's experience remains smooth and unobstructed.

Disposable Hygiene Protectors

VR headsets are primarily designed for individual use. However, in a laboratory setting, where multiple participants may use the same headset, concerns arise regarding hygiene and comfort. Specifically, the headset cushion comes into direct contact with the subject's face, and the body heat generated during use can promote perspiration, which may affect both the comfort of the participant and the cleanliness of the device.

To ensure a comfortable and hygienic experience, it is strongly recommended to use disposable cushion protectors where the headset comes into contact with the skin. Alternatively, dry wipes or sanitising wipes should be used to clean the headset thoroughly after each use. This practice not



only maintains hygiene but also ensures that each participant has a clean and comfortable interface with the VR system.

Development of an IT Solution for Research

The UniCA team oversaw two computer science internships aimed at developing tools to address the research challenges of the Reboot project.

Noé Mercier's Internship (September 23, 2024 - December 20, 2024)

The objective of Noé Mercier's internship was to develop real-time eye tracking data acquisition software for cognitive research, focusing on the viewing of film content projected in a VR headset. The first experimental version of the software was based on the Vizard software toolkit (a prospective study will determine whether the cost of using this toolkit is viable).

Key features that were developed include:

- Recording and playback of eye tracking behaviour for 'after-action review', including 3D path analysis.
 - In-depth data analysis capabilities.
 - Precise experimental time control and device synchronisation.
 - 360° videos and 3D files from a variety of sources as customisable stimuli.
 - Recording of gaze direction, pupil size, fixation times, and other low-level parameters.
 - Generation of heat maps to visualise eye tracking data.
- During the course of the internship, Mr. Mercier revisited and corrected the software code twice to address errors that emerged during development.

Rémi Orsini's Internship (April 7, 2025 - July 31, 2025)

The second phase of development focused on creating a more generic application in Unity using C#, with the aim of building two distinct functionalities.

Creator Mode: For researchers to integrate 360° scenes and define waypoints, all without coding. This feature enables researchers to integrate 360° film scenes of their choice easily, define waypoints between these scenes via defined objects or teleportation, all without requiring any programming. The software then generates an instance that can be used by participants to navigate seamlessly from scene to scene.

User Mode: This mode allows participants to use scenes created in Creator Mode, taking virtual reality tours while navigating through the scenes using the integrated eye tracking functionality of the Varjo headset. Participants follow the paths defined by the researchers, guided by the predefined waypoints.

After just one week of development, the first prototype of the software was successfully programmed. The current version allows the creator to move within panoramic scenes using



keyboard controls, manually switch between scenes, and create waypoints (represented as cubes) that link different scenes, specifying the destinations for each waypoint from a list of available scenes.

Looking ahead, future development will focus on the integration of new scenes using a template and the desired panoramic video. Another priority is the ability to export completed instances to the Varjo VR headset, enabling participants to experience the final VR tours.

Figure 14: Teleportation from one scene to another



The Reboot/UniCA team attended two days of in-person training and several online sessions focused on hardware usage and data processing:

- Tobii - December 9, 2024, at the Château de la Napoule
- SpeederNet - January 16, 2025, at the Maison des Sciences de l'Homme et de la Société Sud-Est, CoCoLab Technology Platform

Training sessions on the VR headset and Glasses 3 goggles were organised with SpeederNet and Tobii. Sylvain Dorriere, Account Manager for France & Switzerland - Products & Solutions for



Medical & Scientific Research, hosted a day of discussions on research methodologies using the Glasses 3 goggles and how to utilise the Tobii Pro Lab software.

Support for Varjo tools was provided by Stanislas Jordikian, Business Development Manager at SpeederNet, through collaborative sessions.

5.6.6. Experimental Protocol

In line with our theoretical and methodological framework, we propose to conduct the experiment on a historical architectural and artistic monument with a complex topology: the Château de la Napoule, which functions as a castle, museum, and event / exhibition space. This will serve both as the thematic content for our study and as the location for our experiment on viewing and itinerancy within the real landscape.

Building upon this setting, the team will create two audiovisual documents centred around the same subject matter.

First one, an 'heritage' presentation film using the entire classic cinematographic 'grammar' (the range of image planes, classical narrative editing schemes, voice-over, music, sound effects):

- La Napoule Art Foundation - Classic - <https://vimeo.com/1034496770>.

Second one, a journey in 360°/VR with circular vision, and free and voluntary movement interactivity:

- La Napoule Art Foundation - VR - <https://www.youtube.com/watch?v=jFchzIQQPNs>.

For technical reasons, for viewing in a commercial Oculus 3 headset and another in the Varjo experimental headset, the latter is presented in two versions:

- one with postural visual interaction via neck rotation,
- another with interaction via neck rotation and a manual controller.

We make watch separately these two media, classic and VR, by two distinct groups of young people, having no prior knowledge of the monument.

- a. We proceed to the recording of the attentional points management during two types of contents watching, respectively by:

- XR content by headset - using eye-tracking VR headset (Varjo technology) for XR content.



- Film content on screen display - using environmental eye-tracking glasses (Tobii Glasses technology).
- b. We invite each participant to draw a topographic map of the space memorized during viewing.
- c. We invite each group, 'cinema' and 'XR', to walk through the real monument with an injunction of specific tasks in spatial orientation (e.g. '*visit - 1. the conference room, 2. living room, 3. dining room, 4. balcony and 5. workshop*', etc.), in recording their attentional points management by means of environmental eye-tracking glasses (Tobii Glasses technology) and measuring performance (the time to complete the injunction).
- d. We record the journey execution times for each participant.

5.6.7. Data Corpus Collection

The data is stored in appendices, as well as in this document, containing the following sections:

- reference number,
- reduced labels of snapshots,
- reduced labels of visualization of heat maps obtained by attention filter,
- task execution times,
- drawings.

Comments follow, if required.

Data of 03/07/2025 Experience at Château de la Napoule

Environmental itinerancy with Tobii Glasses - 'cinema / XR' viewing group.

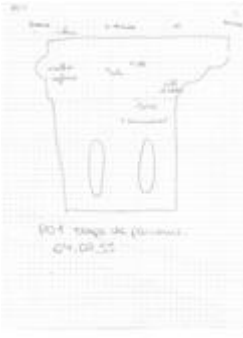
Each participant is represented with 5 snapshots and 5 visualizations from different locations of the castle visited.

(*Sampling limited to 3 participants, the dataset in the appendices.)

Table 8: Data of 03/07/2025 experience

N °	Snapshots	Visualizations	Times	Drawings

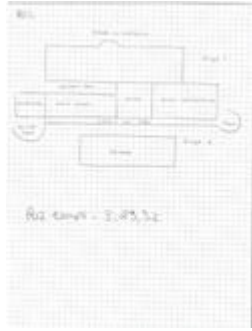


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2			03:29,3 2	
				
				
				
				



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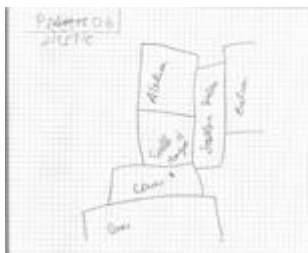


Data of 03/14/2025 Experience at Château de la Napoule

Environmental itinerancy with Tobii Glasses - 'classic movie viewing group'. Each participant is represented by 5 snapshots and 5 visualizations from different locations within the castle visited.

(*Sampling limited to 3 participants; the full dataset is provided in the appendices.)

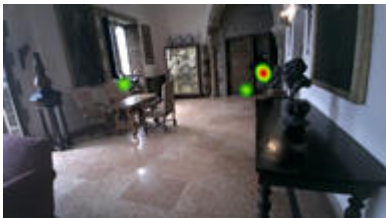
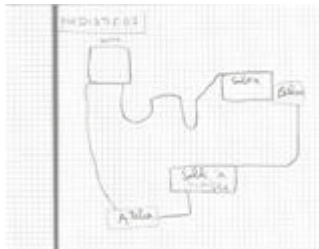
Table 9: Data of 03/14/2025

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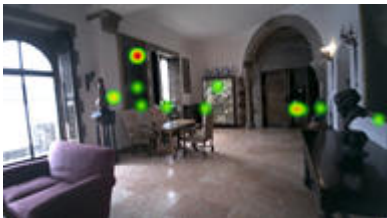
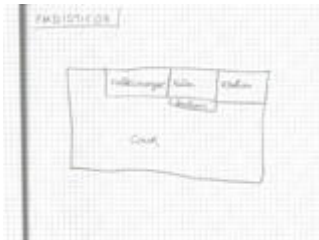
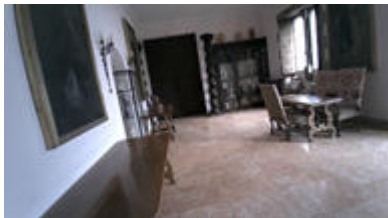
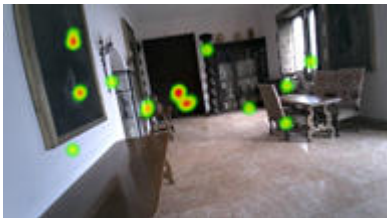


				
2			08:46,43	
				
				
				



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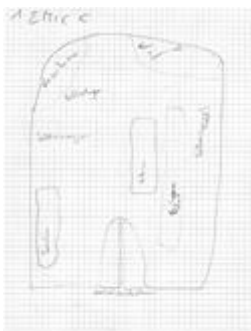
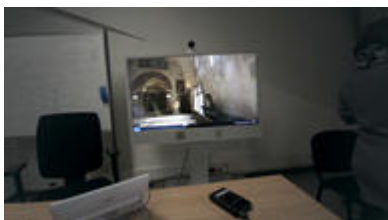
				
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Data of 04/01/2025 Experience at MSHS Sud-Est

With the use of Tobii Glasses, the 'Cinema watching group' participants are represented by 5 snapshots and 5 visualizations from different locations of the castle presented.

(*Sampling limited to 3 participants; the full dataset is provided in the appendices.)

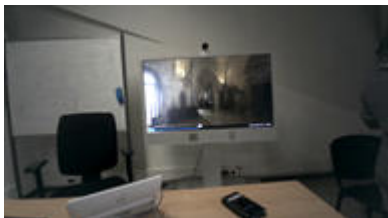
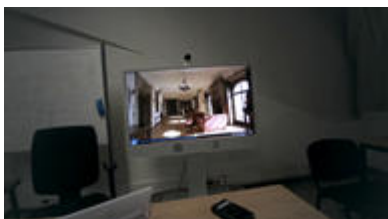
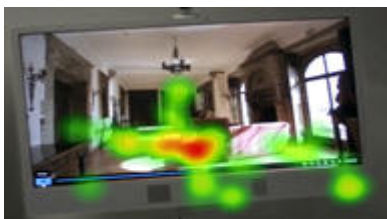
Table 10: Data of 04/01/2025 screen experience

N°	Snapshots	Visualizations	Drawings
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REBOOT (www.thereboot-project.eu) has received funding from European Union's Horizon Europe Research and Innovation programme under Grant Agreement No. 101094769.

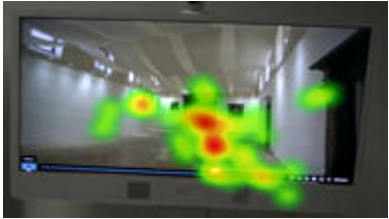
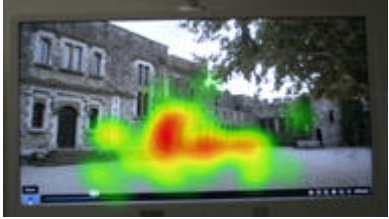
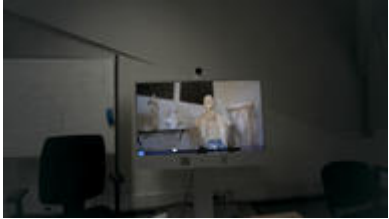
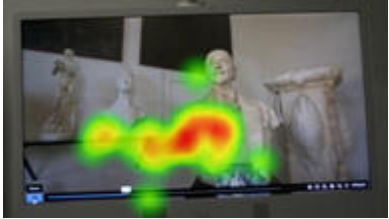


			
			
			
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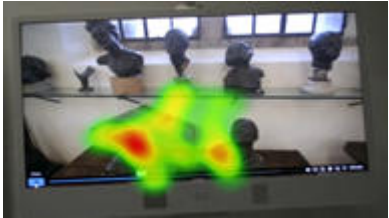
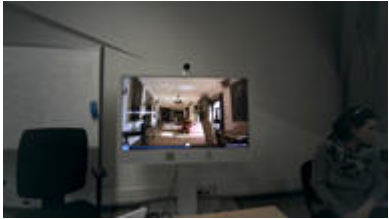
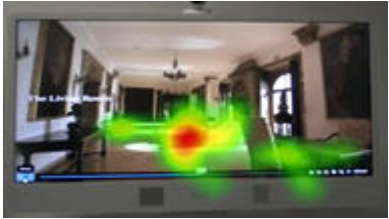


			
			
			
3			
			



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Data of 04/01/2025 Experience at MSHS Sud-Est

With the use of the Varjo headset, the 'VR watching group' participants are represented with three complementary views. These views correspond to the three most frequent gaze directions within the visual sphere of VR, as the retro-gaze is infrequent. Each participant's gaze is depicted in relation to three different rooms of the castle they are visiting.

(*Sampling limited to 3 participants; the full dataset is provided in the appendices.)

The drawings follow

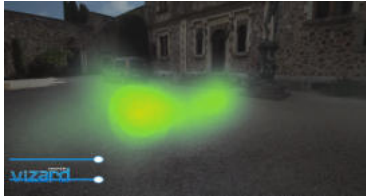
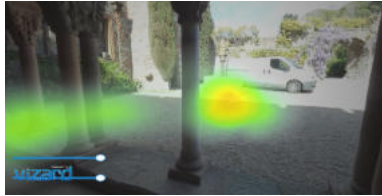
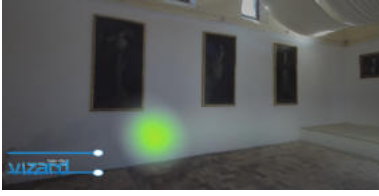
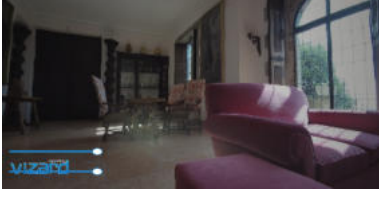
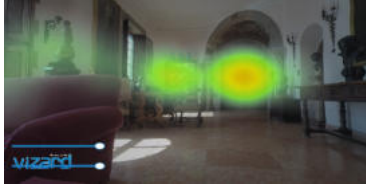
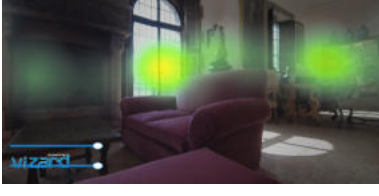
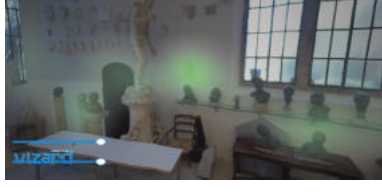
Table 11: Data of 04/01/2025 VR experience

N°	View 1	View 2	View 3



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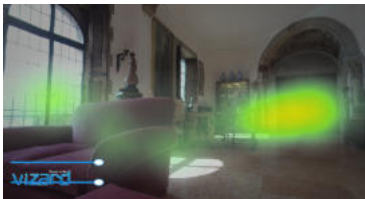
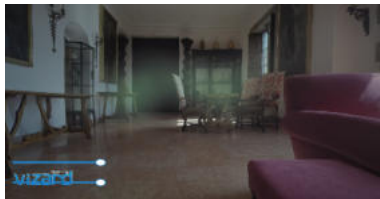
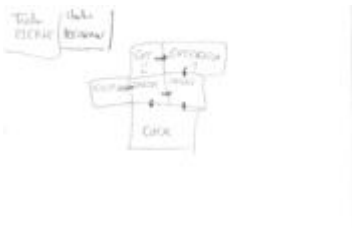


1.1			
1.2			
1.3			
2.1			
2.2			
2.3			



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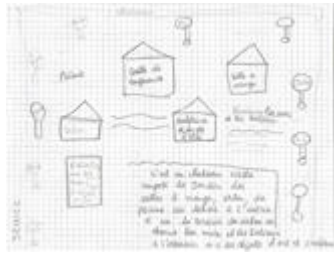
3.1			
3.2			
3.3			
N°	Drawings		
1			
2			



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3



5.6.8. Partial Conclusions – Interpretation of Results Method

We compare the spatial orientation skills of two groups by considering the following elements:

- The execution times of spatial orientation tasks.
- Restitutions in the form of drawings depicting the topography of the location viewed through two media.
- Visualization in the form of heat maps, generated by the Tobii Pro Lab software using the Gaze Filter - I-VT (Attention), which provides more relevant data in mobility situations compared to the Gaze Filter - I-VT (Fixation).
- Extraction of snapshots from the dynamic video stimulus, interpreted in terms of landscape semiotics.

The interpretation is carried out in two stages:

- First, individual cases are examined to gain a deeper understanding of our corpus.
- Second, statistical processing is applied to compare the two groups: 'cinema' and 'cinema / XR Hybridisation'.

We interpret the temporal data, drawings, and eye-tracking results in terms of the semiotics of landscape and its motor affordances (Renaud, 2003).

The primary objective of this comparative study of certain cognitive parameters common to classic cinema and the hybridisation of 'cinema / XR' is to provide supporting arguments for the new European policy on the creation and training of 'cinema / XR'. This aims to bridge the growing gap between the social cognition induced by all media, which is increasingly shaped by XR technologies, and the perceptual ergonomics of cinema, which remains overly tied to its historical modes.

Indeed, the results of the 'REBOOT' project, which focuses on the hybridisation of 'cinema / XR' result in the visualisation of attentional points, presented as 'heat maps' that align with both the direction of gaze and the auditory postures of spectators and listeners.

However, the cognitive support for the management of areas of interest should not be interpreted solely in terms of gaze directionality and auditory focus, but also as a function of the semiotic load, and ultimately the circumstantial semantics embedded in various parts of the landscape. Therefore, our results must be complemented by considerations concerning the semiotics of environments.



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This reflection may, in turn, suggest the existence of a cognitive, temporal, or persistent implementation of behavioural patterns related to both hearing and viewing, consisting, on one hand, of enaction (eye movements and aural postures) and, on the other hand, of figures of meaning that can be interpreted in terms of affordances, inherent to both the real environment and its audiovisual representation.

5.6.9. Partial Conclusion – Speed of Task Execution

Table 12: Speed of Task Execution

Person	Time VR	Time CC	Seconds VR	Seconds CC	Notes CC
1	04:02,55	03:40,61	242,55	220,61	PMHn
2	03:29,32	03:50,81	209,32	230,81	PMHn
3	02:47,29	02:53,94	167,29	173,94	PMHn
4	02:43,23	07:40,21	163,23	460,21	PMHn
5	03:05,99	06:43,69	185,99	403,69	PMHn
6	02:40,98	02:59,49	160,98	179,49	PdiSTiC
7	03:02,88	08:46,43	182,88	526,43	PdiSTiC
8	02:51,21	04:23,12	171,21	263,12	PdiSTiC
9	04:47,50	07:36,14	287,5	456,14	PdiSTiC
10	03:27,47	02:49,93	207,47	169,93	PdiSTiC
11	02:58,88	05:49,87	178,88	349,87	PMHn
12	04:12,45	04:48,04	252,45	288,04	PMHn
13	02:45,44	02:58,53	165,44	178,53	PMHn
14	04:32,83	07:02,84	272,83	422,84	PMHn
15	03:33,91	03:48,20	213,91	228,20	PMHn
16		03:32,02		212,02	PMHn
17		04:50,25		290,25	PMHn
18		02:42,53		159,14	PMHn
			Group VR	Group CC	
Average:			204,128667	289,63	
Standard deviation:			41,8378255	117,628505	
Average (minutes)			03:24,13	04:49,81	
Standard deviation (minutes):			00:41,8	01:57,6	



5.6.10. Partial Conclusion – Collective Statistics

Below is the snapshot utilised for the Tobii analysis for the two groups: the VR (Virtual Reality) group and the CC (Classic Cinema) group. This snapshot serves as the spatial reference for the analysis:

Figure 15: Snapshot of the workshop scene



Results – Group VR – Duration Plot (Oculus 3 headsets, room: atelier)

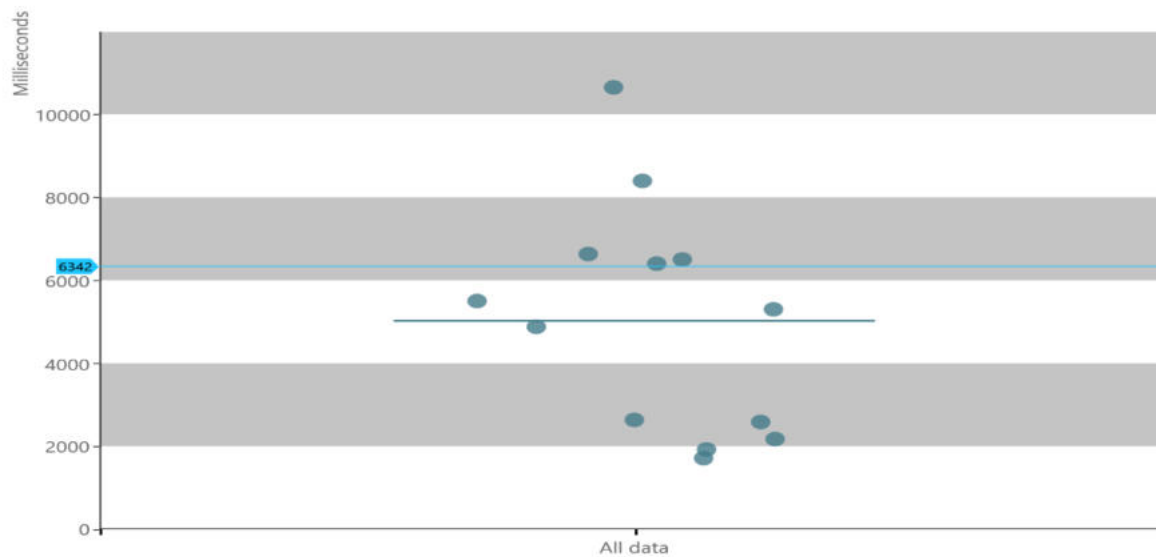
The eye-tracking data presented in the following graph was collected to assess the duration of intervals corresponding to each participant's presence in the 'atelier' of the Napoule Castle. The duration of interval refers to the amount of time between consecutive eye fixations along a given line, measured in milliseconds. Each point on the graph represents one such interval, while the horizontal blue line (approximately 6342 milliseconds) indicates the average interval duration across all participants. The grey shaded areas depict the range of standard deviation, illustrating the extent of variability within the data.

Figure 16: Duration of interval – Group VR



Duration of interval

Atelier_TOI



The relatively long average interval suggests that participants were not hurried in shifting their gaze from one point to another; rather, they appeared to take their time as they moved through the atelier. This indicates a degree of engagement with the visual stimuli, possibly reflecting moments of analysis or reflection upon the information perceived. The wide distribution of interval durations - ranging from less than 2000 milliseconds to over 10,000 milliseconds - further implies the absence of a singular, uniform pattern of visual exploration. At times, participants briefly scanned from one object to another (shorter intervals); at other times, they lingered longer, which may reflect either a deeper engagement with the material or, conversely, difficulty in processing the information (Just et Carpenter, 1976). In cognitive terms (Shimamura, 2013, pp. 16-21), these variations in fixation duration may be interpreted as evidence that participants' attention and engagement within the space were modulated by their emotional responses, narrative interpretations, and prior knowledge.

Fixation Heat Map

The heatmap fixation provides a graphical visualisation of where participants directed their gaze within the atelier and the duration of their fixations on specific areas. The following image presents the fixation patterns recorded across all participants within the VR group.

Figure 17: Fixation Heat Map of the workshop scene – Group VR



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Based on the direction and density of fixations, it can be observed that upon entering the room, participants' immediate attention was drawn to the portraits on the left. Subsequently, their gaze shifted towards the centre of the room, focusing on the busts and various sculptures. The gaze then progressed towards the back of the room, where a large statue is positioned beneath the glass roof. Finally, some attention was directed towards the right-hand side of the space, although this was notably less intense, characterised by shorter fixation durations.

In particular, the first plaster head on the left emerges as an area of high attentional focus, consistent with the well-documented tendency for faces to naturally attract human gaze. Its prominent position within the direct field of vision upon entering the room likely reinforces this effect. Conversely, the large windows on the right do not capture significant visual attention - a typical finding, as individuals tend to prioritise informational or aesthetic elements over sources of light (Shimamura, 2013). Finally, although the statue positioned against the back wall does receive some fixations (indicated by green dots), the level of attention it attracts is noticeably lower than might be expected given its imposing presence.

Attention Heat Map

The attention heatmap, similar in appearance to the fixation heatmap, is generated from a combination of data to estimate what elements attract attention, rather than solely reflecting the duration of gaze. In the following image, the areas of attention recorded across all participants are displayed. The red regions indicate zones where the majority of participants concentrated their attention.



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Figure 18: Attention Heat Map of the workshop scene – Group VR



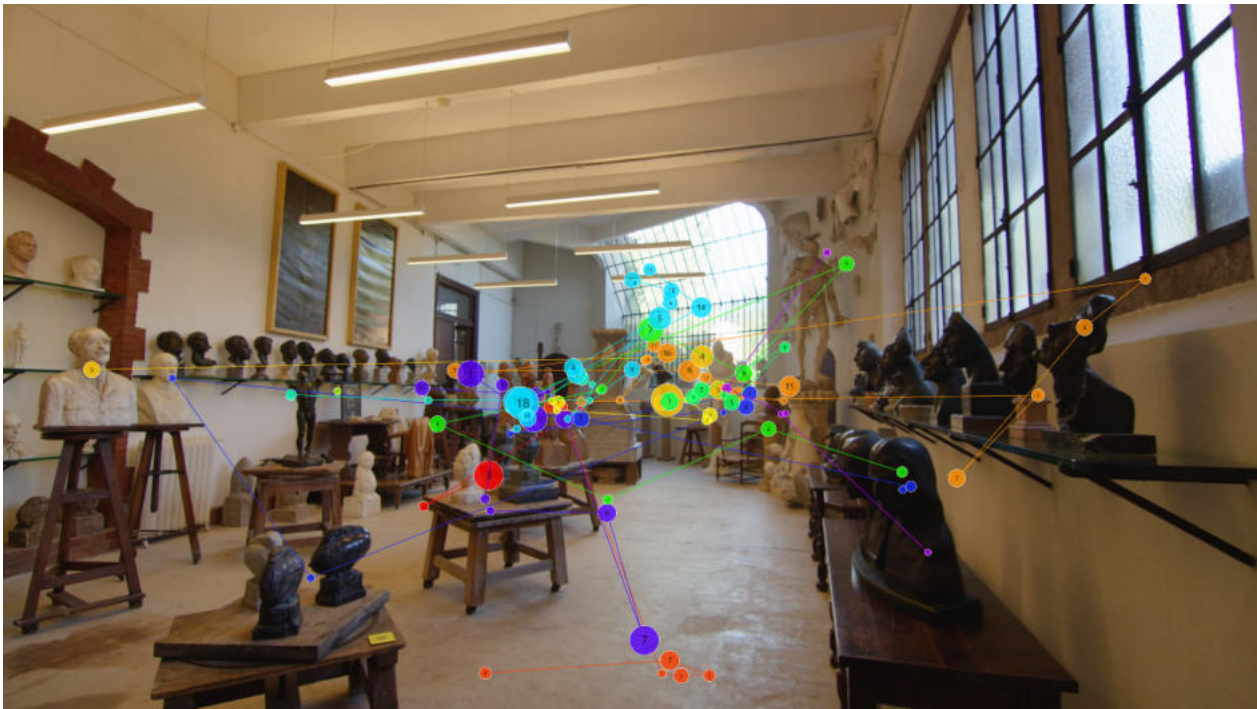
It is evident that the sculptures in the centre of the room immediately draw attention, more so than indicated by the fixation heatmap. Numerous hotspots are visible, particularly around the busts and statues in the central and deeper areas of the room. The two busts on the left also attract considerable attention, likely due to their human-like forms and the stark contrast they present against the neutral background. The attention heatmap results suggest that attention is not merely a reflection of human behaviour, but rather guided by factors that naturally capture the eye.

Attention Scan Path

The attention scan path refers to the sequence and order in which a person directs their gaze across different points within a scene, image, or screen. It consists of two principal elements: (1) fixations, which are the points where the eye pauses to focus on specific details (typically represented by circles), and (2) saccades, which are the rapid movements of the eye between successive fixations. In the following image, fixation points are illustrated as coloured circles, with the size of each circle corresponding to the duration of the fixation, while the connecting lines (saccades) trace the path of eye movement from one point to another.

Figure 19: Attention Scan Path of the workshop scene – Group VR





A distinct pattern emerges in the visual navigation of most participants within the atelier: the statue positioned at the centre of the room serves as a visual reference point from which participants begin to map the space. From a spatial cognitive perspective, this can be attributed to the tendency of individuals to select salient or significant objects to orient themselves within an environment (Wang et al., 2020). Following this initial focal point, participants then shift their attention to other sculptures and objects scattered throughout the room. The approach to scanning the space also varies among participants: some individuals move from left to right across the room, indicating an intentional exploration, while others adopt a more dynamic, non-linear process, transitioning from the foreground to the background. This strategy allows participants to actively construct a spatial map of the room, engaging not only with objects but also with their spatial relationships (ibid.).

In conclusion, the scan path data expounds how participants prioritise certain visual elements over others, how attention moves and flows throughout the room, and how individuals ultimately construct their mental map of the atelier.

Opacity Map

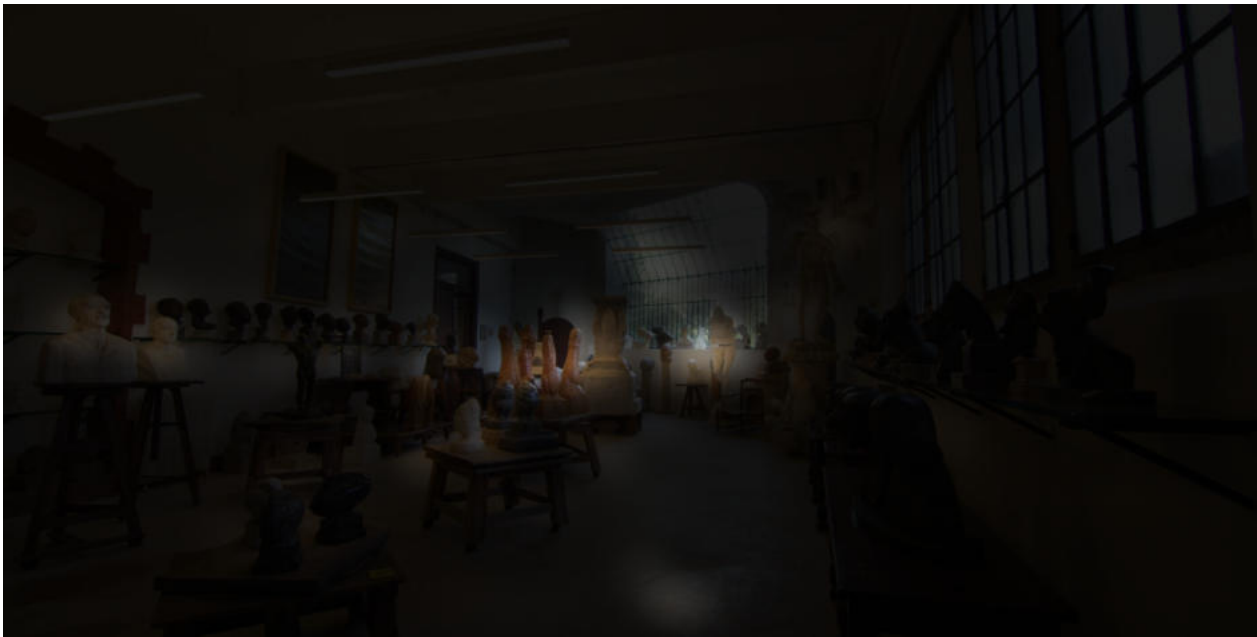
Opacity refers to the manner in which eye-tracking data is displayed on the visual stimulus, particularly in terms of visibility and intensity. In Tobii Pro Lab, the Opacity Map darkens regions that were not viewed, while areas that were observed gradually become more visible, represented by a grey gradient. In the following photo, the bright spots indicate the locations where most participants focused their gaze upon entering the atelier, highlighting the areas that the eyes and brain prioritised in the overall snapshot.



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Figure 20: Opacity Map of the workshop scene – Group VR



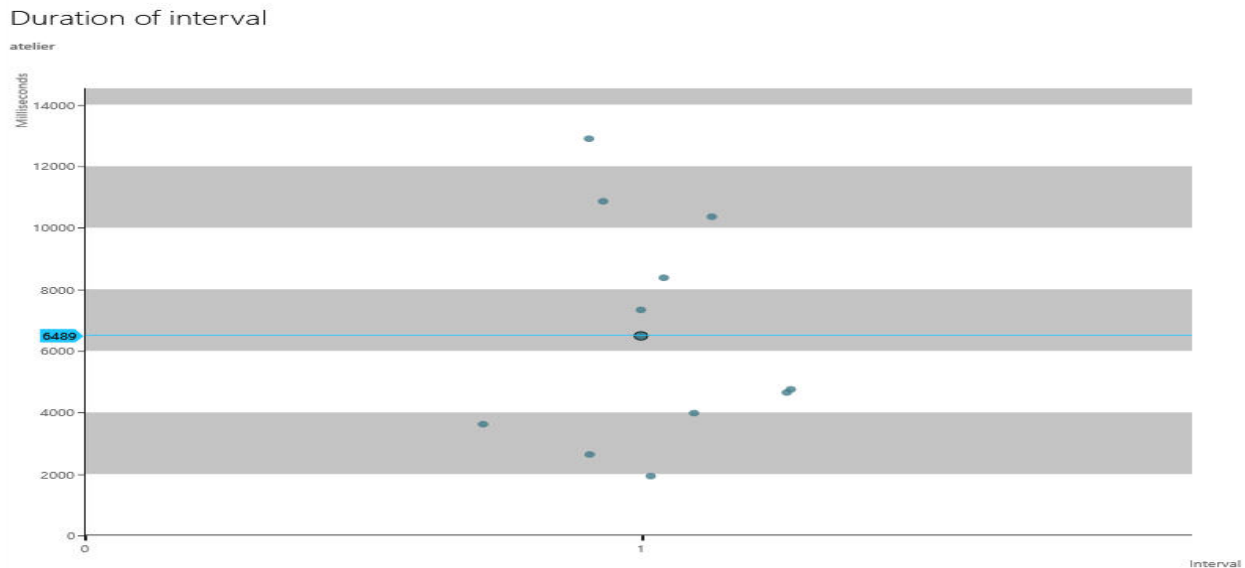
More specifically, the bright areas of the photo signify regions that attracted high visual attention, where participants either looked more frequently or for longer durations. In contrast, the darker areas were largely overlooked or ignored by the participants. The remaining sections of the image gradually faded in prominence, reflecting the density and duration of gaze directed towards them.

Results – Group CC – Duration Plot (Tobii Pro Glasses 3, room: atelier)

The following graph illustrates that certain participants experienced extended viewing episodes, with durations exceeding 10,000 milliseconds, and one instance approaching 14,000 milliseconds. In contrast, other participants exhibited relatively shorter gaze durations, ranging from approximately 2,000 to 4,000 milliseconds, suggesting either reduced interest or a more fleeting engagement. The data points also indicate that, while participants were generally aligned in terms of what they focused on, there was considerable variation in the duration of time they spent processing the content of the atelier.

Figure 21: Duration of interval – Group CC





According to the provided image, the focal points of interest are slightly concentrated in the middle-depth and left-centre of the room. The red and yellow areas demonstrate those participants repeatedly looked at the sculptures and busts positioned at eye level and centrally within the room.

Figure 22: Fixation Heat Map of the workshop scene – Group CC



The areas marked in green indicate that participants dispersed throughout the room, particularly on the side featuring the tall sculpture and near a few busts positioned on the right side of the room, close to the windows. These regions attracted relatively minor visual attention. In terms of lighting, the floor and the upper corners of the room exhibited little to no fixation activity. Consequently, it can



be concluded that participants demonstrated a 'controlled' and selective form of attention, focusing primarily on meaningful and informative elements, such as the sculptures, rather than non-informative features, such as the lighting or the floor (Shimamura, 2013).

Attention Heat Map

Based on the data presented in the accompanying image, it can be observed that there is a significant concentration of gaze in the central region, particularly around the sculpture tables. These areas are highlighted in red and yellow, signifying heightened attention from the majority of participants. In contrast, the large standing statue and the surrounding artworks in the background garnered moderate attention, suggesting that while the engagement was brief, it was shared by most individuals. With regard to the lighting, the corners of the room, certain artworks along the right-hand wall (beneath the windows), and the ceiling, did not attract significant attention from the participants.

Figure 23: Attention Heat Map of the workshop scene – Group CC



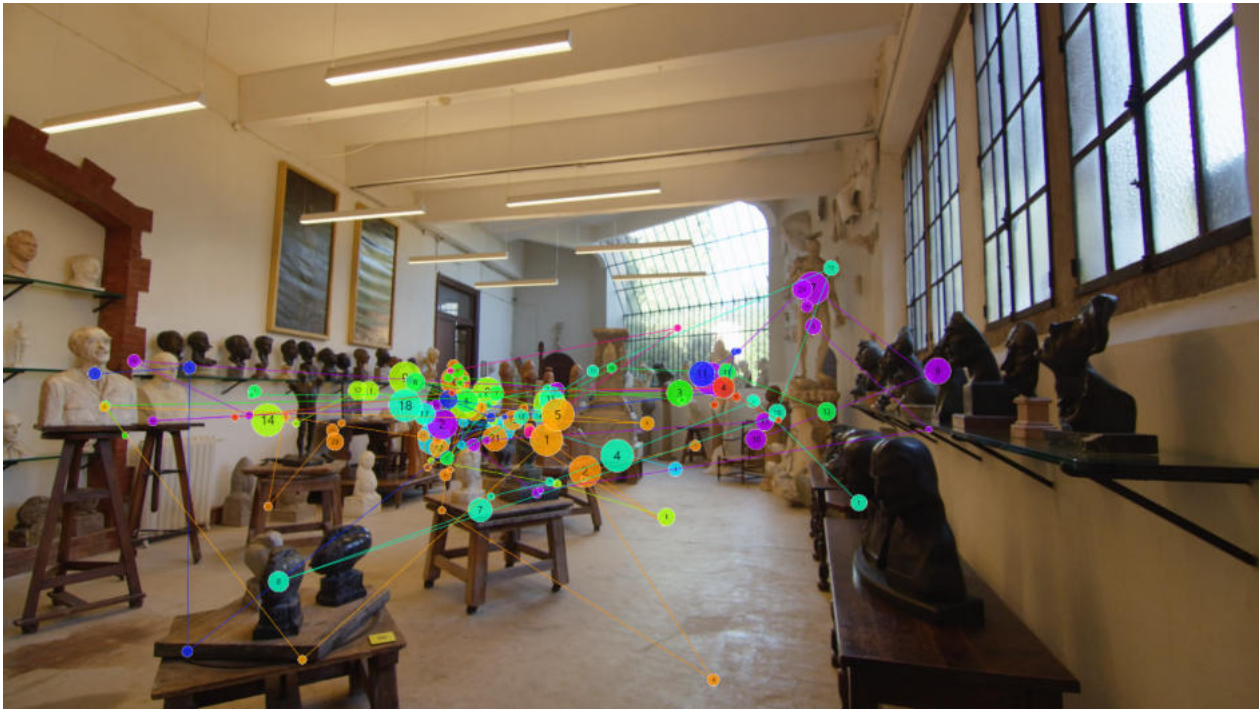
In summary, the data suggest that participants, upon entering the atelier, predominantly oriented their attention towards its central features. Their visual exploration was marked by selective attention and a relatively constrained scanning strategy, rather than by an extensive or systematic examination of the spatial environment.



Attention Scan Path

Analysis of the scan path (see following image) indicates that the statues placed on the central tables of the atelier elicited the highest levels of visual engagement. This is evidenced by the dense aggregation of fixation points and the convergence of saccadic trajectories within the central zone. Participants' initial gaze behaviour was primarily oriented towards areas labelled 1, 2, and 3, suggesting that their attention was immediately anchored by the central sculptural installation upon entry.

Figure 24: Attention Scan Path of the workshop scene – Group CC



Only a limited number of scan paths exhibited a left-to-right directional movement. In contrast, a consistent progression of gaze from the foreground towards the background was observed, indicative of participants' visual exploration into the depth of the space. Each participant displayed a distinct scan path, reflected in the variability of fixation points and differentiated saccadic pathways, as illustrated by the coloured mapping. In conclusion, the scan path analysis reveals an inherent tendency to prioritise statues positioned in highly salient, symmetrically arranged locations, with lighting conditions likely amplifying their perceptual prominence.

Opacity Map

The final visual representation displays the fixation-derived opacity map, delineating darker zones indicative of minimal or absent visual engagement and lighter zones reflective of intensive gaze fixation. The most luminous regions correspond to the artworks exhibited on the back wall, the



centrally located sculptures, and the tall statue adjacent to the window, all of which consistently elicited repeated visual fixations. These findings imply that the spatial configuration — including vertical and horizontal positioning — combined with specific lighting conditions, substantially influenced participants' attentional deployment within the environment.

Figure 25: Opacity Map of the workshop scene – Group CC



The regions along the right wall — particularly the busts positioned on the shelving — together with substantial portions of the ceiling and floor, remained dark on the opacity map, suggesting minimal visual engagement. These findings further substantiate the hypothesis that both lighting dynamics and spatial depth critically influence the allocation of visual attention, supporting the broader theoretical framework whereby centrality and illumination function as key determinants of visual salience in three-dimensional environments (Wang et al., 2020).

Comparison

The Tobii eye-tracking data highlight marked distinctions in audience engagement patterns between the VR and CC groups. Participants assigned to the VR condition demonstrated a more exploratory and dispersed visual exploration of the atelier. Multiple Areas of Interest (AOIs) received moderate to high attentional engagement, as evidenced by the duration interval plots and the fixation-based heat maps, suggesting a broader spatial distribution of gaze. The Oculus Quest 3 headsets appear to have facilitated freer navigational behaviours, closely resembling real-world exploratory dynamics. Moreover, the scan path analysis reveals a multiplicity of entry points and fluid saccadic



movements, indicative of heightened environmental curiosity. Finally, fixation metrics show that while participants surveyed a wider spatial extent, they spent less time per object, reflecting the inherently dynamic and transient perceptual processes characteristic of virtual environments.

Participants assigned to the CC condition displayed a notably selective and targeted visual engagement pattern. The attention and fixation heat maps demonstrate that peripheral elements received minimal visual attention, whereas central and right-sided Areas of Interest (AOIs) exhibited prominent clustering. Analysis of the opacity map and scan paths reveals a constrained exploration style, akin to a visual tunnel, indicating that under physical observation conditions, participants tended to orient predominantly towards salient spatial features rather than engaging in broad environmental scanning. This behavioural pattern suggests heightened visual anchoring within the CC group, with attentional resources concentrated in fewer regions, accompanied by denser fixation distributions and extended dwell times within selected zones.

The findings of the REBOOT project indicate that the sustained global competitiveness of the EU film industry hinges not only on continued investment in traditional filmmaking practices, but equally on the proactive adoption of technological innovations and hybrid formats including Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR). The analysis underscores that emerging technologies are reshaping attentional dynamics, youth engagement, social interaction patterns, and immersive cognitive experiences, making the ability to shape interactive media consumption a critical determinant of competitiveness. Investing in XR capacities thus constitutes an imperative strategic priority for the European Union, essential to preserving cultural sovereignty, enhancing international audiovisual influence, and maintaining generational relevance in an evolving global landscape.

5.6.11. Partial Conclusion Based on VR Eye-tracking Results

Introduction: The Eye in the Labyrinth

Building upon a comparative protocol, three groups of students were exposed to the heritage site of the Château de Mandelieu La Napoule via different modalities: a physical, in-person visit; a standard screen-based video (monitored with Tobii eye-tracking); and a fully immersive VR experience using the VARJO system. None of the participants had any prior exposure to the site or the experimental procedure, thereby ensuring the authenticity of the spatial memory formation process. Following the exercise, participants were asked to sketch a floor plan of the site and to locate six designated areas, the courtyard, conference room, lounge, dining hall, seafront, and workshop, while the time taken for spatial recognition was recorded.



The analysis centred on the patterns of visual attention and cognitive mapping that emerged from these experiences, with particular emphasis on the immersive VR group. Eye-tracking data, encompassing fixation patterns, gaze trajectories, and attention heatmaps, were interpreted through the lens of recent cognitive science theories concerning perception, attention, and embodied cognition.

Recall of the Theoretical Framework: Cartography of Attention

The present analysis draws on contemporary models of attentional control that emphasise the dynamic interplay between sustained focal attention and transient, exploratory attention in complex environments (Carrasco, 2020; Eimer, 2015; Nakayama et Mackeben, 2018). These phenomena, originally conceptualised by early cognitive theories (e.g., Posner, 1980), now benefit from refined neurocognitive frameworks particularly suited to interpreting gaze behaviours in immersive virtual reality contexts. Particular attention is given to the phenomena of peripheral visual processing, ambient perception, saccadic transitions, and the challenges associated with allocentric spatial encoding in virtual environments (Chrastil et Warren, 2012).

Further theoretical grounding is provided by Shimamura's (2013) framework on experiential engagement, which highlights how attention, memory, and aesthetic experience are dynamically intertwined during media consumption. Shimamura's insights into cognitive-affective processes offer a pertinent lens through which to view participants' navigation of immersive environments. Additionally, Bandura's (1986) social cognitive theory underscores the importance of self-efficacy and observational learning, concepts that are particularly relevant when considering how novice VR users adaptively regulate their behaviours and expectations in unfamiliar sensory landscapes.

A key theoretical dimension concerns the distinction between allocentric and egocentric spatial encoding. Allocentric encoding involves constructing a mental map based on external landmarks and spatial relations, whereas egocentric encoding relies on one's own body-centered perspective (e.g., 'turn left at the archway'). Chrastil and Warren (2012) demonstrated that virtual navigation, when decoupled from proprioceptive and vestibular feedback, tends to impair allocentric map-building and fosters a reliance on egocentric strategies. This observation is crucial in interpreting the participants' behaviours within VR.

General Observation on VR Gaze Patterns

During the immersive sessions, participants displayed frequent moments where visual attention became dispersed, fragmented, or non-focalised. Rather than indicating simple distraction, these patterns reflect the natural oscillation between ambient exploration and focal search within complex



spatial environments. Such dynamics are exacerbated in VR, where cognitive overload and sensory novelty may intensify exploratory behaviours.

It is particularly noteworthy that despite their general unfamiliarity with immersive head-mounted displays, participants demonstrated remarkable adaptability in navigating and encoding the virtual space. Their ability to manage attention within these novel sensory environments, even amidst initial cognitive load, speaks to a latent plasticity of perceptual strategies when engaged in immersive narratives.

The absence of dense fixation clusters in heatmaps, far from being insignificant, signals a state of cognitive navigation that prioritises broader environmental scanning over targeted attention. This phenomenon aligns with Trevarthen's (1968) concept of ambient perception and Rensink's (2000) theories of the 'attentional blink', underlining the fluid interplay between different attentional modes in immersive settings.

Technical Considerations: Eye-tracking Metrics and Cognitive Load

The use of Tobii and VARJO integrated eye-tracking technologies allowed for a precise capture of participants' visual behaviours. Key metrics such as fixation duration, saccade paths, and heatmap density offer critical insights. Research has shown that longer fixation durations are typically associated with deeper cognitive processing (Holmqvist et al., 2011), whereas erratic saccadic paths may indicate search strategies or cognitive uncertainty. Heatmaps and opacity maps reveal zones of attentional concentration or neglect, with sparse regions suggesting either attentional overload or a lack of salient cues.

As demonstrated by Makransky and Petersen (2021), VR can overload working memory, particularly for novice users, owing to the overwhelming quantity of sensory stimuli demanded by the device. This overload often results in fragmented gaze behaviours, with scanning without anchoring. Nonetheless, the ability of the participants in this study to adapt and stabilise their attentional strategies over time is encouraging for the application of VR in cultural and educational contexts.

Understanding Spatial Encoding

In this context, 'spatial encoding' is defined as the cognitive process through which participants perceive, process and memorise the spatial layout of the environment. The process entails the translation of the visual and navigational information encountered during exploration into a coherent internal representation, termed a 'mental map'. This map serves as a guide for subsequent recall, recognition, and navigation. Effective spatial encoding typically manifests through sustained fixations on salient landmarks, coherent scanning strategies, and the ability to integrate visual information into an organised memory system. Conversely, erratic gaze behaviour, fragmented



attention, and absent or sparse fixation patterns may indicate challenges in building a stable spatial memory. Thus, the quality of spatial encoding is a critical factor in determining into the depth and efficacy of participants' immersive experiences.

The participants' successful identification of key zones, despite the sensory novelty of VR and the absence of prior site knowledge, suggests an encouraging potential for immersive media to foster spatial learning even in inexperienced users. This further underscores the idea that narrative-driven VR can serve as a powerful vector for cognitive engagement and memory consolidation.

Participant Case Studies: P1 to P10 Analysis

Participant P1

Table 13: Participant 1 Case Studies

1.1	
1.2	
1.3	

In the Courtyard, Participant P1 exhibited relatively concentrated fixations near the central axis of the courtyard structure, suggesting an initial phase of spatial anchoring. Upon entering the Archway area, however, gaze paths fragmented considerably, indicating exploratory scanning without immediate focal targets. The Lecture Theatre phase showed renewed focalisation, particularly around the main visual cues such as entrances and large furniture pieces. In the Living Room and Dining Hall, P1's attention dispersed again, with scan paths forming wide arcs, perhaps revealing cognitive fatigue or environmental overload. Finally, in the Studio/Workshop and Seafront, a return

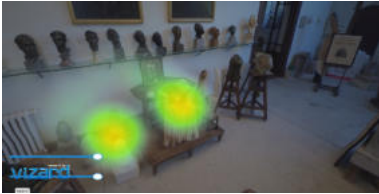


to more linear gaze patterns suggested task-oriented attention, likely driven by the explicit instruction to locate specific areas.

This behaviour suggests that while P1 managed partial encoding of key locations, the fluctuating attentional focus may have resulted in fragmented spatial memory, potentially impacting the participant's ability to recreate an accurate mental map post-visit.

Participant 2

Table 14: Participant 2 Case Studies

2.1			
2.2			
2.3			

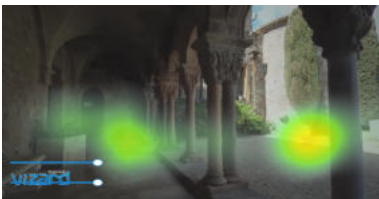
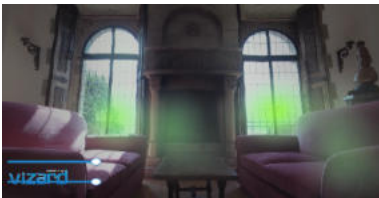
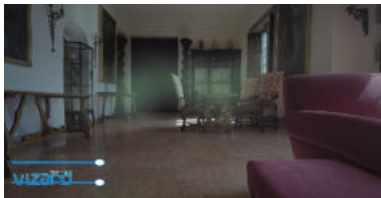
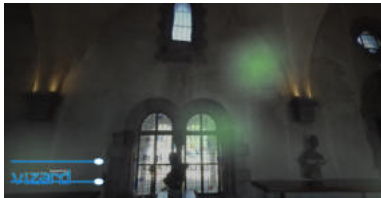
A marked difference was observed in the gaze behaviour exhibited by P2 in the Courtyard when compared to that of P1. Instead of centring attention early, P2 displayed a roaming gaze with brief, scattered fixations. In the Lecture Theatre, attention focused more narrowly on dominant architectural features such as windows and podium structures. In the Living Room and Dining Hall, P2 showed very few dense fixation clusters, suggesting a lower level of spatial encoding. The absence of fixation on certain salient details, particularly in the Dining Hall, may correspond to cognitive disengagement, as suggested by recent findings in VR-induced attentional shifts (Makransky et Petersen, 2021).

This pattern indicates that P2's spatial memory construction may have remained superficial, capturing isolated features without integrating them into a cohesive whole.



Participant P3

Table 15: Participant 3 Case Studies

3.1			
3.2			
3.3			
			
3.4			

P3 demonstrated relatively strong initial focus in the Courtyard, with several overlapping fixations near key structural pillars. In the Archway, however, gaze trajectories revealed frequent saccadic movements without sustained fixations, a hallmark of exploratory attention. It is worth noting that, during the Lecture Theatre phase, P3's attention stabilised, concentrating on central objects and

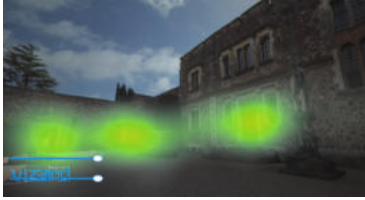
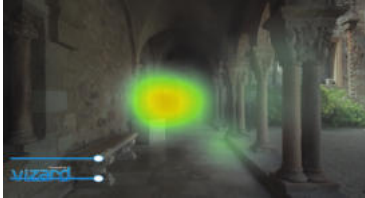
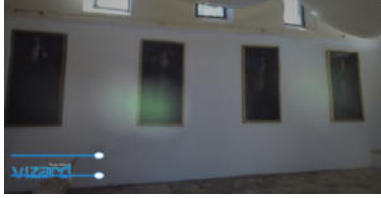


exits. The Living Room and Dining Hall elicited highly fragmented gaze behaviours, possibly indicating navigational uncertainty. By contrast, the Studio/Workshop and Seafront areas saw longer fixations and diminished scan path entropy, suggesting heightened spatial familiarity.

Overall, P3 seemed to progressively improve spatial encoding over time, gradually refining their mental representation of the environment despite initial challenges.

Participant P4

Table 16: Participant 4 Case Studies

4.1			
4.2			
4.3			
4.4			

P4 exhibited a unique pattern in the Courtyard: frequent short fixations combined with small saccadic jumps. This micro-scanning behaviour persisted across the Archway and Lecture Theatre, indicating heightened vigilance or a cautious exploration strategy. In the Living



Room and Dining Hall, P4's fixations appeared more stable, though still relatively dispersed. In the Studio/Workshop and Seafront areas, attention patterns narrowed considerably, suggesting task focus as participants became more goal driven.

Such a scanning strategy may have favoured a detailed but compartmentalised encoding of spatial features, potentially leading to a segmented rather than holistic spatial memory.

Participant P5

P5's Courtyard phase was marked by long fixation durations on the peripheries rather than central features, implying a scanning strategy focused on environmental borders. In the Archway and Lecture Theatre, gaze behaviour became more focalised, with sustained attention on key spatial transitions such as doorways. The Living Room and Dining Hall triggered extensive exploratory behaviour, marked by erratic saccades and minimal fixation clustering. This pattern points to either cognitive overload or lack of salient guidance cues. In the final stages (Studio/Workshop and Seafront), P5's gaze paths indicated improved spatial understanding, with smoother, more directed trajectories.

This evolution suggests that although P5 initially struggled with spatial encoding, exposure and repetition eventually fostered a more coherent mental mapping of the environment.

Participant P6

Participant P6 presented an initial exploratory strategy in the Courtyard, with short, dispersed fixations suggesting a broad ambient processing of the space. In the Lecture Theatre, fixation density increased markedly around architectural thresholds such as doors and windows. In the Living Room and Dining Hall, P6 exhibited intermittent focal engagement, alternating between brief explorations and periods of visual stagnation. The absence of Studio/Workshop exploration in P6's data hints at either navigational disorientation or early cognitive fatigue during the immersive experience.

Consequently, P6's spatial encoding process appears incomplete, likely resulting in a fragmented internal representation with significant omissions.

Participant P8

In the Courtyard, P8 showed a structured scanning pattern with periodic returns to previously fixated zones, indicating an attempt to build a coherent spatial map. The Archway sequence



revealed more linear gaze trajectories, contrasting with highly fragmented attention during the Living Room and Seafront phases. Notably, P8 devoted considerable attention to the conference room, suggesting selective encoding of salient architectural elements over general spatial coverage.

This selective approach may have resulted in a spatial memory rich in landmarks but sparse in global spatial coherence.

Participant P10

Participant P10 demonstrated highly focused visual exploration from the outset, with a strong emphasis on central features in the Courtyard. In the Archway and Lecture Theatre, fixations clustered intensively on transition points between spaces, reflecting effective anticipatory attention. The Living Room and Dining Hall phases revealed less structured gaze behaviour, with frequent saccadic transitions and a reduced number of prolonged fixations. In contrast, the Studio/Workshop and Seafront stages showed a return to more task-driven gaze paths, indicating an adaptive adjustment of exploration strategy over the course of the session.

Overall, P10 exhibited a dynamic encoding process, balancing between initial precision and later-stage adaptation to task demands.

Preliminary Discussion

The variability observed among P1 to P10 highlights the non-uniform nature of spatial encoding and attentional strategies within immersive environments. It underscores that VR experiences do not impose a singular perceptual mode; instead, they invite a dance between exploration and focus, engagement and withdrawal. The fluidity of attention in VR, far from being a flaw, reflects the unfolding of a new cinematic consciousness, one in which narrative agency is partly ceded to the embodied perception of the viewer.

Considering that the majority of participants were first-time users of head-mounted displays, their ability to quickly adapt, explore, and begin forming coherent spatial representations is particularly remarkable. Rather than being overwhelmed, participants often demonstrated intuitive navigation strategies and attentional shifts appropriate to the complexity of the environment. These findings suggest a fertile ground for the deployment of immersive technologies in cultural and cinematic contexts, where even neophytes can be transformed into active explorers of narrative spaces.

The preliminary findings support the hypothesis that immersive technologies, when appropriately designed, have the potential to cultivate richer, more participatory forms of spatial and narrative engagement. This, in turn, could herald a renaissance for European cinema, expanding its creative and cognitive horizons beyond the traditional frame. Moreover, these results open pathways for



future hybrid Cinema-XR experiences. By integrating embodied cues such as virtual locomotion or haptic feedback, future VR narratives could scaffold deeper allocentric spatial memory, turning simple observation into true experiential knowing. This transition could dramatically enhance the narrative richness and emotional resonance of immersive cultural experiences.

Implications and Future Directions

Immersive technologies, when thoughtfully designed, expand the grammar of storytelling. They move beyond framing the spectator's eye within a limited viewport to transforming the entire perceptual world into a stage. Inheritances such as *La Napoule* are re-animated, no longer static relics but dynamic, emotionally inhabitable spaces.

The competitiveness of European cinema may depend on this paradigm shift: from passive spectatorship to active spatial co-creation, balancing guided narrative with autonomous exploration. Attention itself becomes an art form, one that must be meticulously crafted.

Recommended next steps include the comparative quantification of gaze metrics across the physical, screen-based, and VR groups; the estimation of cognitive load indices based on fixation dispersion (Krejtz et al., 2016); and the exploration of embodied interaction strategies to reinforce spatial memory and narrative immersion.

In sum, the findings of the REBOOT project offer a compelling vision for the future of immersive storytelling, where technology and cognition converge to reshape the experience of cultural heritage and cinematic expression.

5.7. Perspectives of Experimental Research in the 'Cinema / XR'

5.7.1. Emergence of the New Hybrid Cinematographic Culture since 2023-25

At a time when the first academic training programmes have been introduced in France since 2023-24, and when the first sustainable jobs are emerging in this sector, with an increasing number of audiences being exposed to this type of content - particularly in fields such as sport, medicine, advertising, events, professional training, live streaming, immersive videoconferencing, and signage - the society of the targeted spectacle is transitioning into the era of ecological spectacle: environmental, immersive, and interactive. This new form blends realities, sometimes artificial and other times integrated into the consciousness and memory of individuals through natural perception.

A promising avenue for future research could involve conducting studies that bridge eye-tracking methodology and semiotic analysis of the environment. Such studies would allow for an exploration of the social reception of audiovisual products from the 'cinema / XR' hybridisation, which are now entering a phase of widespread social acceptance. As these products begin to integrate into the



circuit of social biofeedback, they have the potential to shape the evolving culture of the 'hearing gaze', influencing both the way audiences perceive and engage with these immersive experiences.

Neither the Canadian and American precursors of this type of research (eye-tracking in cinema and XR) undertaken in the early 2000s, nor researchers in 2019, have had the opportunity to investigate the new patterns of spectatorial and creative cognition among audiences exposed to the image and sound culture of XR, coupled with the conventions of classic cinema. This gap in research presents a unique opportunity to explore how these emerging hybrid forms of media are reshaping the cognitive and perceptual experiences of contemporary audiences.

The extension of the REBOOT research project in this direction can address the question of how, from the perspective of spectatorial and creative cognition, the new visual and auditory culture is being adjusted. This culture is being influenced not only by cinema hybridised with XR but also by other forms of immersive media, such as the search for geographical information through 360° imagery services like Google Street View. Both contribute equally to the evolving ways in which audiences engage with and process spatial, visual, and auditory information.

5.7.2. Foreshadowing of the 'Master Cinema-CR' Training

This proposal outlines a new two-year Master's degree program, 'Cinema / XR - **Bridging Realities**', a joint initiative between Université Côte d'Azur (France) and the University of Cape Town (South Africa). It aims to train 'imaginative creators and technical innovators' fluent in both traditional cinema and emerging XR technologies.

The program is motivated by the growing convergence of cinema and XR, supported by studies and initiatives like the AAP Specific call and the REBOOT project, and recognizing the innovative use of XR in African cinema, particularly in South Africa.

The curriculum includes foundational knowledge in the first year split between Europe and South Africa. The second year offers two specialization tracks. The program culminates in a Master's project and thesis.

Program Structure (2 Years / 120 ECTS)

The program would be structured around core modules providing foundational knowledge and specialized tracks allowing for deeper exploration.

Year 1: Foundations & immersion

Semester 1 (Europe): Core principles

Classical audiovisual storytelling (6 ECTS), Hybrid video production I (6 ECTS), Fundamentals of XR technologies (6 ECTS), Digital media theory & aesthetics (6 ECTS), Introduction to



REBOOT (www.thereboot-project.eu) has received funding from European Union's Horizon Europe Research and Innovation programme under Grant Agreement No. 101094769.



photogrammetry & 3D Scanning (6 ECTS), Media ergonomics & user experience (3 ECTS), Language & intercultural Europe / Africa communication (3 ECTS)

Semester 2 (South Africa): Expanding Horizons

Hybrid video production II (6 ECTS), Immersive 360° storytelling (6 ECTS), Aerial audiovisual production (6 ECTS), Introduction to Metaverse concepts & platforms (6 ECTS), Cognitive & aesthetic approach in digital media (6 ECTS), Sound design for immersive media (3 ECTS)

Year 2: Specialization & Innovation

Students will choose one of two specialization tracks, allowing for focused skill development:

Track 1: Immersive narrative & experience design

Semester 3 (Europe or South Africa - Student Choice): deepening

Advanced Metaverse creation & worldbuilding (6 ECTS), VR / AR / MR development & prototyping (6 ECTS), Immersive live streaming (6 ECTS), XR for immersive professional e-learning (6 ECTS), Research methods in XR & Media (6 ECTS), Optional module (3 ECTS)

Semester 4 (Europe or South Africa - Student Choice): Project & Thesis

Master's project (24 ECTS), Master's thesis (6 ECTS)

Track 2: Innovative Media & Communication

Semester 3 (Europe or South Africa - Student Choice): Deep Dive

Mobility media experiences (6 ECTS), Digital signage & experiential environments (6 ECTS), DAB+ radio & hybrid audio / video experiences (6 ECTS), AI fundamentals for communication & artistic creation (6 ECTS), Research methods in media & communication (6 ECTS), Optional module (3 ECTS)

Semester 4 (Europe or South Africa - Student Choice): Project & Thesis

Master's project (24 ECTS), Master's thesis (6 ECTS)

New Teaching Options to Consider:

Environmental eye-tracking for Immersive Design, Volumetric capture & point cloud processing, Generative AI for media creation, Cross-cultural storytelling in XR, Accessibility in immersive media, Real-time motion capture & Integration, Interactive installation design, Legal and ethical frameworks for XR and Metaverse.

5.7.3. Research on the New Industrial Offer for Hybrid Cinema

Hybrid cinema is currently benefiting from a renewed industrial offering, particularly through complex, miniaturised devices that incorporate the latest advances in spatial sound and immersive / interactive image technologies. These capture devices now engage with the captured environment through evolving artificial perception, organised by AI modules. They interact with both the visual display and sound diffusion systems, dynamically mediating between the sound and visual sources



and the active behaviour of the listener-spectator. This technological integration enhances the immersive experience, allowing for a more responsive and interactive relationship between the audience and the audiovisual content.

This new complex device facilitates the emergence of novel perceptual ergonomics, thereby giving rise to new cognitive patterns in audiovisual culture. By integrating advanced technologies in sound, image, and artificial perception, it reshapes how audiences interact with and process immersive content, fostering a more dynamic and engaging perceptual experience.

In this current and future context, by combining eye-tracking methodology with hearing posture detection (Luberadzka et al., 2024), we can envisage research on:

- new creative devices, such as those for images resulting from the automation of the transition between 360° video and autostereoscopic 3D, or sound resulting from the coupling of ambisonics and binaural sound. and reception,
- new visualization and sonification devices aimed at miniaturizing and simplifying the ergonomics of equipment, leading to the replacement of movie theatres with 'naturalized' installations with variable decor and geometry and the replacement of VR / AR headsets with active glasses,
- other innovations that are currently being patented and that contain AI modules enabling scalable human / machine interaction through artificial learning and accelerated adaptation of user cognition.

5.8. General Conclusion and Recommendations

This study has investigated the current relationships that the professional cinema sphere has with XR technologies through the lens of social cognition. The practice of each media shapes vast swaths of perceptual and mental structures in creators and the audiences concerned. The emergence of new media is conditioned by cognitive skills and competencies, and the exercise of media in turn influences the emergence of new patterns. The classic example is given by writing/reading (+5300 BU) where the required skills have been prepared beforehand: at the perceptual level by the skills to understand visual symbols, and at the mental level by symbolic thought and spatial awareness. Once the use of writing became widespread, writing structured memory and reorganized learning to ultimately prepare the social coordination that was never possible before and which required the emergence of other media again (Watkins, 2005).



The practice of cinema for 130 years has imprinted new patterns on both high-level perceptive and mental structures that have become widespread. Taking into consideration that other emerging media, and in particular media with XR technologies, are reconfiguring cognitive skills at the social level and that this reorganization on several points competes with cinematographic structures, we have noted a worrying gap that is widening between the patterns of social cognition induced by cinema, and the corresponding patterns induced by XR technologies. This is the difference between the organization of the visual scene into central and targeted areas, for cinema, and the organization of the spherically distributed visual field with a structural multitude of perspectives, for XR. It is also a question of comparing the perceptive passivity of classical cinema with the enactive dynamic, the absence of interaction with the interactivity, the linear narrative paths with the spatial and alternating editing of XR (Manovich, 2001).

At the same time, we have observed the existence of Hybridisation between classic cinema and the XR sphere. It is a persistent phenomenon, but it has long remained at the stage of avant-garde experiments. However, since the early 2000s, it has encouraged the emergence of new industrial formats. Several non-European cinematography then makes it an expansion strategy imagined with large resources: financial aid, architecture of viewing spaces, implementation of dedicated creative training.

We wanted to know if European countries are considering the same measures? Indeed, there is a European policy, primarily at the member state level, to encourage digital creation, particularly in the field of media that blends narrative elements and the photorealistic approach of cinema with the treatment of XR space. We launched a large-scale study to understand the details, structure, and volume of European support for the 'cinema / XR' Hybridisation. The results show that these policies are disparate, unharmonized, and often very weak. The notable absence from this spectrum of support is the training of young creators in the 'cinema / XR' Hybridisation.

Some countries are exemplary, others remain cautious, and all European countries are being overtaken in this area by certain non-European countries that we have studied.

In order to accelerate the decision-making process in this area, we have undertaken a comparative study of cognitive abilities that emerged through contact with cinema content and XR content. It is obviously difficult to work on the evolution of cognitive patterns over long periods, especially since the media landscape permeates our senses and brains as a complex network of interdependent elements. However, it is possible to verify how two groups of participants in the experiment behave in relation to the parameter recognized as rudimentary in the construction of the representation of the world, by all media without exception: spatial orientation. This simple test shows unequivocally what type and quantity of information a viewer/listener receives depending on the type of media used. The results argue in favour of better spatial orientation in the group that viewed a heritage site



in the VR headset compared to the group attending a classic film screening on the same site. The performance in terms of task completion time of the former is better.

We wanted to support the explanation of this result by the eye-tracking method long used in film studies. Now, the industrial offer allows research with eye-tracking for XR products. Although requiring computer support, which we provided, the Varjo experimental station, one of the leaders in the field, offers remarkable measurement precision, in duration plot, fixation heat map, attention heat map, attention, scan path and opacity, allowing advanced interpretations, some of which we are considering for the extension of the Reboot project.

The way in which the spectator becomes aware of a site that is previously unknown to him is completely different from the cognitive ergonomics offered by classic cinema. In cinema, the cognitive subject receives a targeted vision of the space and its layout, which means that not only is the visual field offered to him structured according to the central targeting, but also the fragment that is offered to him comes from a choice previously made by the creator of the moving image. The viewer is thus linked with the creator by a pact of trust which is beneficial and can vary depending on the evolution of the creator throughout his career.

In the XR experience, this last element is replaced by personal guidance, trusting one's own gestures, neck and eye positions and interactive controls. As a result, the session must sometimes be longer when interactivity is programmed for controllers (Varjo) or denser when the viewer exercises their own movements to orient themselves (Oculus). The better temporal performances of XR already confirm the classic results in cognitive science on the cognitive reinforcement of learning and memorization in subjects who participate in topokinetic tasks with their own body movements, which is explained by the observation that the more the perception of a representation of an environment involves proprioceptive stimuli, the more the subject increases the motor anticipation of their own movements in this environment (Berthoz, 2008).

We are not advocating for one of the spectatorial, cinematographic or XR attitudes, but we note that the combination of the advantages of both, of the confidence in the creative approach of recognized artists and the personal involvement in the search for visual and auditory information, can significantly increase the attractiveness of the cinematographic spectacle. Europe therefore has everything to gain by favouring the Hybridisation of two genres and by promoting creative training based on both vectors of technologies and two types of storytelling that they offer.

The foreshadowing of such training is our latest contribution to the discussion on Europe's incentive policy to increase the attractiveness of European cinema. During our experiments with two distinct groups, the creative group in XR technologies and the novice group (D5.3.1), it appeared that young creators appropriate more quickly than others the spectator behaviours aimed at taking advantage of all the narrative benefits offered by this type of experience. Our hypothesis is then that investment



in the creative sector of the 'cinema / XR' Hybridisation can accelerate the democratization of equipment as well as their evolution towards more ergonomic design (***evolution of the VR / AR headset to VR / AR glasses***), can also be more beneficial for the technological adaptability of young creators and thereby increase the quality of the extended cinematographic spectacle and give it its role as an instigator in the evolution of the entire media landscape, as was the case with cinematography at the height of its development in the 1970s. Thus, 'cinema / XR' type education can lead to a faster arrival of the new creative and spectatorial culture, the one that, safeguarding the spectacular narrative means of classic cinema, offers the immersive, interactive spectacle that mixes realities, whose glory days are still to come.

In summary, the findings of this study indicate that the global competitiveness of the European film industry can be enhanced only through the implementation of a coordinated strategy embracing XR and immersive technologies. The REBOOT project demonstrates that emerging media practices not only redefine cognitive modalities, audience behaviours, and expectations, but also precipitate the reconfiguration of traditional cinematic paradigms. Current European initiatives aimed at promoting the hybridisation of cinema and XR remain fragmented, limited in scope, and insufficiently oriented towards the development of young people's creative competencies. In this context, the adoption of comprehensive policies to support hybrid creative processes, to invest in XR-based education, and to facilitate technological advancement within the sector appears essential to sustaining Europe's leadership in cultural innovation and ensuring the long-term viability of its audiovisual industry. By fostering the convergence of narrative excellence, interactivity, and immersivity, the European audiovisual sector may simultaneously preserve its cultural heritage and assert a leading position within an evolving global media landscape. ***A firm and strategic commitment to this hybrid future is likely to prove central to reinforcing Europe's cultural sovereignty, technological leadership, and international influence.***



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