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► To cite this version:

Anastasiia Ternova, Georges Gagneré. The Wizard Without Shadow: Staging and Evolution of a Performance Involving Motion Capture. *International Journal of Art, Culture, Design, and Technology*, 2022, 11 (3), pp.1-13. 10.4018/IJACDT.314784 . hal-03959051

HAL Id: hal-03959051

<https://univ-paris8.hal.science/hal-03959051>

Submitted on 26 Jan 2023

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The Wizard Without Shadow: Staging and Evolution of a Performance Involving Motion Capture

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ABSTRACT

In this article, the authors share their experience of making a creation-as-research, The Wizard Without Shadow, in order to bring to light the different steps of staging, the difficulties, and methods that could be applied. This research is based on empirical and analytical methods and aims for a better understanding of the pipeline of a theatrical staging with motion capture, as well as exploration of the nature, limits, and potential of a pre-recorded live-controlled virtual performance. This paper is an extension of The Wizard Without Shadow paper previously published in the ARTECH21 conference.

KEYWORDS

Avatar Direction, Mixed Reality, Motion Capture, Performing Arts

INTRODUCTION

As Dixon depicted, the theatre always tended to include in its practice new technologies in order to “increase performance and visual art’s aesthetic effect and sense of spectacle, its emotional and sensorial impact, its play of meanings and symbolic associations, and its intellectual power” (Dixon, 2007). In this article, we are particularly interested in using motion capture in performance, which has progressively attracted directors all over the world. We could highlight such performances as *The Tempest* staged by Gregory Doran in 2017 in Royal Shakespeare Company in collaboration with Imaginarium Studios in Great Britain, *I.D.*, an opera based on Arnaud Petit’s music staged in France in 2017, *Orestia* of Theatre na Podoli Ukrainian company staged by Illya Moshitsky, *Anti-Gone* staged by Theo Triantafyllidis in 2019 in the United States, and *Mandala* staged by Thomas Villepoux in 2021 in France. All these performances have very different aesthetics and use different technologies and approaches. They are bright and attractive, but the process of creation stays unknown to the public, professional theatre-makers, and researchers.

DOI: 10.4018/IJACDT.314784

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In this article, we share our experience of making a creation-as-research, *The Wizard Without Shadow*, in order to bring to light the different steps of our staging, the difficulties, and different methods that could be applied for their solving. In our approach, we take into consideration all the steps of production, beginning from the digital creation of the avatars. We try to balance between the gaming approach (Ward, 2005) that combines technical 3D modeling and rigging with the creation of the story of the character and the theatrical approach based on Stanislavsky's system, which means to "develop a set of behaviours that give the avatar the semblance of responding convincingly and with emotional authenticity to any situation an audience could perceive it finds itself in" (Weinbren, 2016).

In our creation-as-research, an actor who narrates a story performs in front of a screen, where a virtual universe is projected. The story is played by numerous digital shadow-avatars: flat silhouettes, virtual marionettes (as defined by Plessiet et al., 2019) animated with pre-recorded movements. We apply a hypothesis that depending on the physical actor's point of focus, the audience will be more attracted to the screen or the actor or will divide attention between both (Ternova & Gorisse, 2022). This research is based on empirical and analytical methods and aims for a better understanding of the pipeline of a theatrical staging with motion capture, as well as exploration of the nature, limits, and potential of a pre-recorded live-controlled virtual performance. This paper is an extension of *The Wizard Without Shadow* (Ternova & Gagneré, 2021) presented in the ARTECH21 conference.

TECHNICAL AND ARTISTIC CONCEPTS

Shadow Avatars Talking to Children

The entry point of the creation-as-research of *The Wizard Without Shadow* (Ternova, 2021) was a decision to explore different aspects of the aesthetic of CAVOAV, a Castelet in Virtual reality for shadow AVATAR (Gagneré & Ternova, 2020). This concept is inspired by classical shadow theatre and combines live performing with a live-controlled 3D environment inhabited by shadow-shaped avatars animated in real time or pre-recorded. It fosters the circulation between different states of realities, featuring physical actors interacting with 2D/3D shadow avatars in a mixed reality stage. It was first explored in 2019 within the performance *The Shadow* staged by Georges Gagneré and based on the homonym fairy tale of Christian Andersen (Gagneré, 2020). In *The Shadow*, there was one physical actor playing with five avatars. Sitting in the left corner of the stage behind a table next to the screen, he was reading the text and driving the evolution of the shadow avatars and modulations of his voice in a real-time musical environment with a MIDI controller. His body acting was minimalistic.

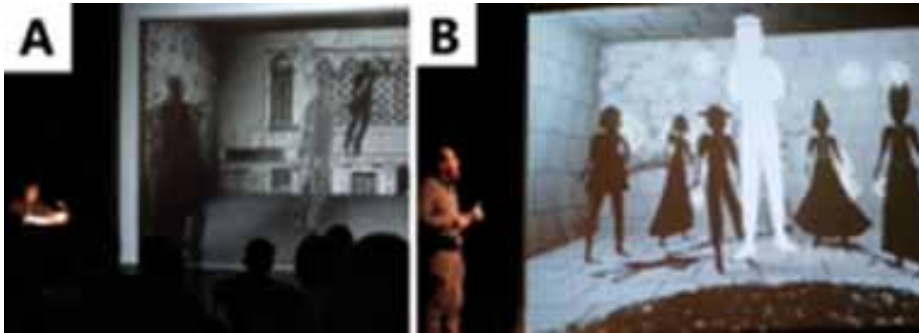
The Wizard Without Shadow aimed to put in the center the gesture interactions between the physical actor and the avatars. The actor is placed in front of the screen in order to underline his physical presence for the audience. In that way, he gets the liberty of movement and facilely reacts to the actions of the avatars keeping eye contact with the audience.

The performance had to fulfill three conditions: the plot might be related to the shadow theme, it should be a story for children, and it has to give playful situations in order to enhance potential gesture interactions between the virtual and physical worlds. The Scottish fairy tale "The Black Airts" matched these conditions. It talks about a boy named Jaimie who is going to a school of magic run by a wizard Orraque. In the end of the courses, one of the pupils must stay forever with the schoolmaster as his slave. Jaimie proposes his shadow instead and saves everyone as the master accepts the trick. Collecting variations of this story from different folklores, the director wrote her own adaptation as an original play.

AvatarStaging Framework

Avatar animation in the performance is based on AvatarStaging, a low-cost framework dedicated to theatrical experimentations with digital characters and physical performers in a mixed-reality setup (see Figure 2; Gagneré & Plessiet, 2018). An actor equipped with a motion capture costume (a *mocaptor*)

Figure 1. The shadow (1A) and the wizard without shadow (1B)

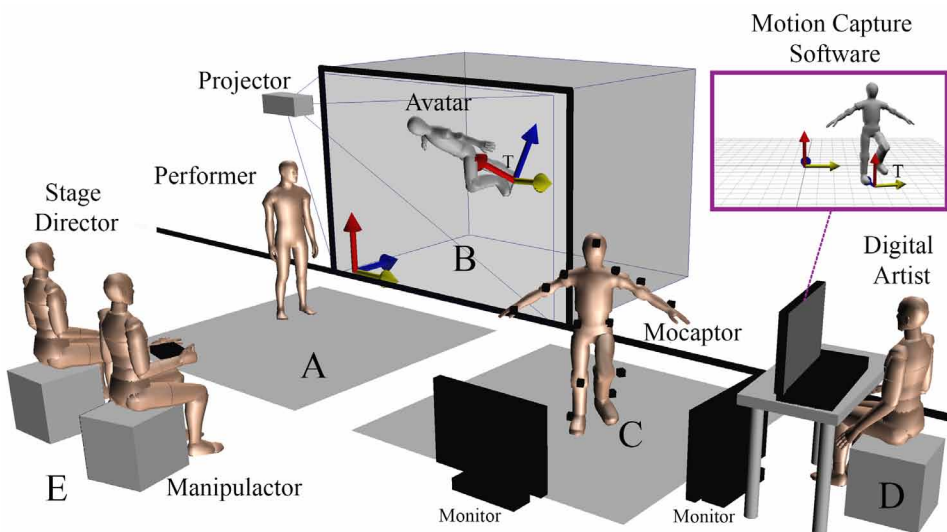


plays in a space encircled with screens that show the virtual world. The mocaptor properly sees the result of his acting, adapts his movements for the specificity of the digital scene, and interacts with a physical actor and other virtual characters.

The main feature of AvatarStaging is AKN_Regie (Gagneré, 2022), a universal, adaptable, evolving plugin programmed by Georges Gagneré in Unreal Engine that is constructed to easily organize the presence and appearance of avatars, virtual scenography, VFX effects in the virtual space. The plugin has various applications, but it was created for theatrical use, and its main target is keeping the virtual part of the performance controlled in real time. It is also elaborated in a way that a person without significant programming experience could handle it. The programming of a virtual performance is limited to a linear narration. A digital operator has to launch a new cue in order to move to the next phase of the virtual performance.

The avatars could be animated in real time or with pre-recorded animations. To simulate live interaction between the physical actor and avatars' pre-recorded animations (Gagneré et al., 2020), we used a feature based on a system of idle and salient actions that makes avatars alternate between active and passive actions, passing to the waiting idle mode once a salient movement is accomplished. It

Figure 2. AvatarStaging setup



permits adapting the speed of the digital performance to the speed and intensity of the physical acting, in some cases, recombining the recorded sequences, creating new behaviors of an avatar, for example.

PREPARATION

The Team and the Conditions of Creation

The creation was initiated by Georges Gagneré and Anastasiia Ternova. The whole team of the project consisted of five persons. Anastasiia Ternova took the role of a staging director, playwright, motion capture technician, programmer, character designer, and organizer of the working process. Justine Waller became a layout designer, VFX creator, programmer, and digital operator. Remy Gorski worked as a mocaptor and animated all eight avatars. Naël Bernard incorporated the narrator of the story. Georges Gagneré was the curator of the project and developer of the digital tools.

The whole team initially comes from the theatre domain with no special background in programming or 3D art. Although Georges had started to explore in practice the use of motion capture in theatre in 2014 and became a developer of digital tools, Anastasiia joined his experimentations at the end of 2017 and, in about a year, managed to develop the required skills to independently use the motion capture tools and AvatarStaging framework and freely program the AKN_Regie plugin. The whole team had worked together previously in 2019 on the creation-as-research of *Patrick and Venus* (Ternova, 2019), managed by Anastasiia. Justine, Remy, and Naël were initiated into the workflow and, in six months of rehearsing, achieved autonomy in their branches. Hereby *The Wizard Without Shadow* was entirely created by theatre-makers with no support from professional 3D artists. The independence of the team was an important advantage, as the staging happened during the lockdowns and displacement restrictions of 2020. We were able to easily manage all the aspects of the rehearsals and make punctual, efficient face-to-face sessions that gave the matter for further post-production work at home.

Impacted by COVID pandemic challenges, the performance was initially created and performed in January 2021 in two forms: live and remote. Due to the complicated period, it was suspended in 2021 and rebooted twice in autumn 2021 for the ARTECH conference in Aveiro and in summer 2022 in Paris.

Storyboard

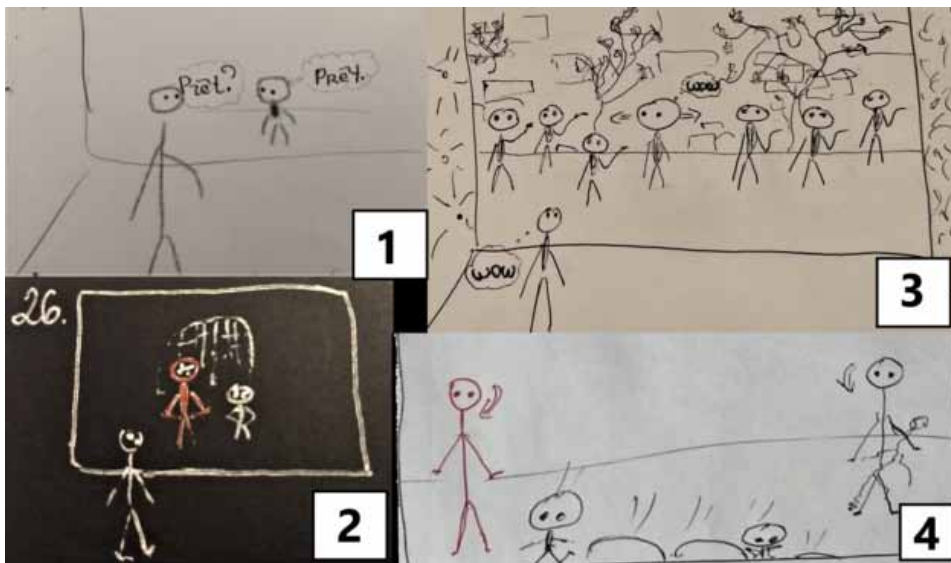
After gathering a team, deciding the form of the performance, and writing a play, the next step was to create a storyboard. In the beginning, we decided that the shadows are deprived of words but move actively, while the narrator could speak but is more constrained in his actions.

Writing an original play gave the freedom to draft relationships between all the actors in the performance, but the storyboard helped to enter the details of interactions (see Figure 3): define the number of avatars in each scene, the focus point of the physical actor and the avatars and make the first draft of interactions between all of them. Consequently, the storyboard helped to decide the strategy of the recordings—in other words, how to split the whole action into five sequences—and we decided to separate the five spaces of action (instead of changing the virtual decorations on the same spot like on a theatrical stage).

The first one is a dialog between the actor and Jaimie's avatar. The actor enters the stage, where he meets Jaimie playing with his shadow in a neutral space (see Figure 3-1). The actor begins to tell the story while the space gradually fulfills with decorations of Jaimie's home. The second part happens in the dark. Jaimie arrives at the school and meets the schoolmaster, who explains the rules of the school (see Figure 3-2). In the third part, he studies magic with six other pupils in the schoolyard (see Figure 3-3). The fourth part is the last day when the seven children get out of school (see Figure 3-4). The last part in the darkness is the farewell between Jaimie and the actor.

An analysis of the storyboard shows three types of interactions:

Figure 3. Four excerpts of the storyboard



- the physical actor and the avatars are in a vivid dialogue (e.g., they look at each other, actively react to the words and physical actions, support each other, and argue)
- the physical actor is focusing on the audience, while the virtual action is still
- the avatars or the virtual action (e.g., VFX effects and light effects) are active while the physical actor is physically still

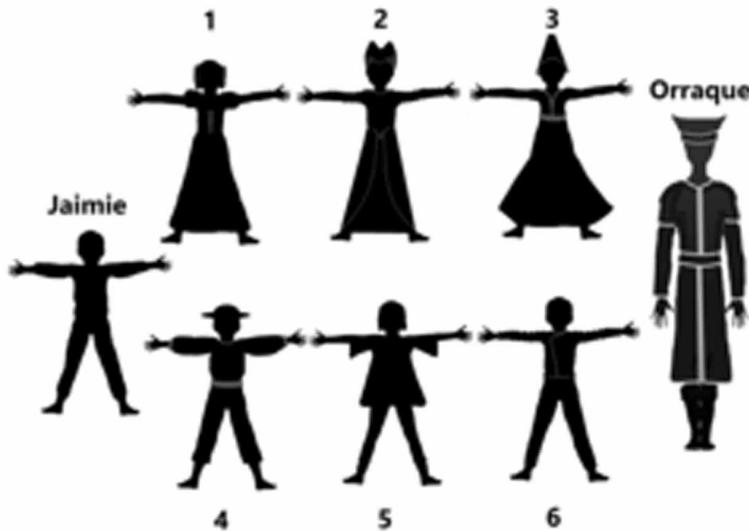
We suppose that in the first case, the audience divides its attention between two worlds, considering them as plausible shared environments. In the second case, the spectators might focus more on the physical actor, and finally, in the third case, on the virtual world. Of course, the three types of interactions are related to each other and change fluently during a performance.

Creation of the Avatars

The next phase was the creation of the digital part of the performance. The director decided to create an avatar for each character. That was necessary to underline the nature of the main characters (Jaimie and the magician Orraque) and to develop the specificities of the secondary characters that have almost no words in the play. The design was inspired by the medieval style.

Jaimie (on the left in Figure 4) appears to be the most neutral compared to other students in the beginning of the play and changes his form by the final scenes, getting a small crown like Orraque's and slightly growing bigger than the other pupils. That visually describes his evolution as a magician. Orraque has a mildly disproportional body with longer members than usual. That highlights his supernatural powers and gives an unconscious idea that he is different from normal people and is scary in a way. Other characters have different appearances that give an opportunity to create a legend for each of them about their origins, the reason why they study magic and gesture style. That consequently served the mocap to search for the movement characteristics for each of them. The characters are black and grey. Only Jaimie and Orraque become in several scenes glowing and share supplementary the yellow color that appears in their crowns and on the embroidery of Orraque's costume. That shows their likeness and partly explains why the master accepts the trick of his student in the end. The optimal workflow that we found was to make a basic model in Blender and use the automating rigging in Mixamo.

Figure 4. Shadow avatars in The Wizard Without Shadow



Digital Spaces

For the virtual scenography, the director decided to choose the style of children's drawings. Justine Waller drew all the details manually and then transposed them into the virtual world. The storyboard briefly described the minimalistic spaces while the final results envelop the avatars, providing them plenty of opportunities to play with the scenography. For example, in the initial version of Jaimie's home, everything was meant to be drawn on a plane behind him. While in the performance, the virtual stage is filled with multiple objects like trees, a house, sheep, and geese, so the avatar could hide behind, look through the house's window and play with the animals.

Another example is the second scene, in which Jamie secretly leaves his home and joins the school. It is meant to be an empty black space illuminated with balls of light in the beginning and an empty space with a luminous door once Jaimie gets to the Orraque's castle. Instead, the first part of the scene was charged with a dense forest and a castle that appears in the distance and approaches progressively. That helped to immerse the mocaptor in the situation and naturally inspired him to be more expressive in his movements, playing Jaimie frightened by the storm and lost in the woods. So, the virtual scenography impacted a lot the final behavior of the avatars that, in turn, stimulated more engaged and bright reactions by the physical actor who had a reason to look for the avatar behind the virtual objects, encourage the character or express displeasure of his or her actions. The digital spaces matched the measures of the physical rehearsal stage. In that way, the mocaptor could freely move on the physical stage, easily covering the virtual one as well.

Animation Recording

To preserve the quality of avatar movement in the animations, the director chose to record long sequences of actions that would be cut afterward to produce the numerous salient and idle animation pieces necessary for programming with AKN_Regie (Gagneré, 2020). The main principle is to decompose any avatar animated acting in a succession of a salient action, followed by an idle one which loops as long as necessary until the next salient action. Salient actions are cued by an operator or the actor himself, according to the acting, and the actor keeps his freedom to move along while idle actions are waiting for him.

Exploration of the Avatars

The preparatory phase of the animation recordings was a session with the mocaptor, who “tried on” different avatars, examining their specific characteristics, tempers, and specific body language. For each avatar, the work started with a free improvisation that gradually was guided by the director, who indicated the specific details about each avatar and subsequently explored and enriched by the mocaptor.

As the main aspect of Jaimie (see Figure 4) was curiosity, he became very active, sometimes chaotic but always nimble movements, and when he turns into a powerful wizard, he becomes more deliberate, focused, and slow. Orraque (see Figure 4) is marked with confidence and mystery. His movements are slow, defined, and somewhat snake-like.

The secondary characters have very little stage time, and their stories are not exposed in the play or the original tales, so the challenge was to transform them from a uniform background into an interesting surrounding that Jaimie logically wants to protect. For that, we imagined stories of each character based on their appearance.

There are three girls:

- a daughter of a peasant (see Figure 4-1) who is as curious as Jaimie. Her gestures are vivid and funny, and she exaggerates her emotions, so she loves clapping hands and making big gestures with her arms;
- a daughter of a knight (see Figure 4-2) who is raised as a lady but wants to be like her father, so she tries to be rough and heavy in her movements;
- a daughter of a duke (see Figure 4-3) who behaves like a small queen, being always very courtly.

Three boys are:

- a son of a peasant (see Figure 4-4) who tries to look like a noble knight, so his movements are very sharp, but he does his best not to forget to keep straight,
- a son of a duke (see Figure 4-5) who loves singing and has very graceful and exquisite movements
- a mysterious boy (see Figure 4-6) who is keeping mostly still and a little bit superior to others but who admires doing large and impressive movements while performing magic.

These characteristics might not be consciously noticed by the spectators as the avatars appear all together and do not present themselves, but it creates a rich atmosphere.

Improvisation Strategy

As the driving idea of the performance was the interactivity between the actor and the avatars, the director decided that an optimal methodology would be to record movements working together with a mocaptor and the physical actor, as shown in Figure 5, which presents a rehearsal of the very first scene of the performance. Rehearsals started with a common global analysis of the play, which applied a method derived from Stanislavsky's system. The director and the actors decided together on the main topic, style of the future performance, idea, and emotion that we wanted to transmit to the audience. All these points had further an impact on the nature of gesture interactions.

Afterward, we discussed the first scene, the main points, intentions and relationships between the characters, and the director proposed her blockings. As this routine showed up to be efficient, we kept it for all the scenes. Subsequently, the actors came on the stage. The narrator read the text that allowed the mocaptor to keep the correct timing while discovering the virtual space and trying the blockings for the first time. Once the mocaptor felt free with the virtual decorations, we started an improvisation part when the narrator gave lines to the avatar, inspiring it for the interactions. We were surprised to discover that when the mocaptor replied vocally to the physical actor and commented on

his own actions, though Jaimie was not supposed to speak, the gesture expressiveness of the avatar became brighter. So, the director asked the mocaptor to keep talking during the rehearsing process.

The team chose the best moments of the improvisations and wrote a movement score that the mocaptor learned attentively. The last step consisted in recording the movement score, taking into account that salient actions must be a bit shorter than the reading duration of the respective text and pauses must be longer. It is important because if the salient actions are too short in comparison with the text, the avatar might quickly become boring. On the other hand, if the movement is too long, the physical actor will be forced to wait until the end of it, and that might restrain the intensity of his acting. The movements could be accelerated or slowed down, but a violent change in speed is easily perceived as implausible by the spectators. As we do not clean the recorded movements during the post-production, the mocaptor had to be very precise so his movements would fit the virtual space and timing of the text perfectly. The avatar's body adopts the correct position while addressing the narrator and being as expressive as possible.

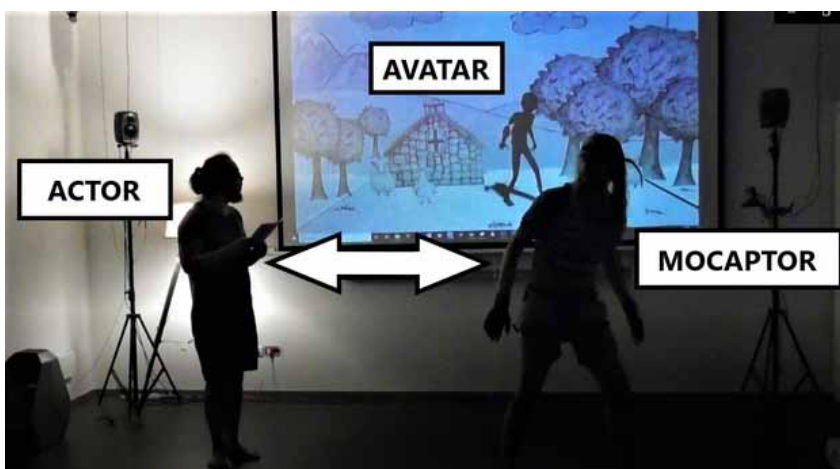
The first part lasts four minutes and took five hours of rehearsal. Though time consuming, improvisation gives fruitful results, helping to create vivid avatar actions that respond to the text. The first version of the storyboard proposed 9 salient actions as the final movement score has 12 salient actions: the avatar actively inhabits the virtual stage, looks at the actor, or reacts to his words. This method is satisfactory when the mocaptor controls only one avatar. It does not work in the scenes with group interactions, as the mocaptor must interact with other avatars that are not yet animated.

Golem-Puppeteer Strategy

With a single mocaptor, the only solution to record the group scenes is to do it character by character. In an ideal case, we should progressively add each recorded character in the virtual scene. But the operation is time-consuming, and as we were restricted in time, we were not able to do it properly. Additionally, one of the scenes supposed numerous VFX and visual effects that were not ready or not integrated at the moment of recording. It results in the fact that most of the time, the mocaptor had no virtual partners and no visual references though he had to perform precise interactions and gestures to launch the magic tricks. In these conditions, the improvisation strategy was not possible to apply. The director decided to guide him vocally, telling him what happens on the stage, where to look and what to do.

For example, in the third part of the storyboard, Jaimie comes to the class, discovers the powers of his classmates, and learns magic. After the analysis of the scene, we recorded rough blockings of Jaimie, who was a visual reference for all the characters in the scene. This animation was integrated into the digital space. The second step was the recording of the secondary characters one by one. The

Figure 5. Actor and mocaptor rehearse the story beginning



director described the VFX effects, launched by a character, before the recording and then pronounced out the actions and counted down the idles, which the mocaptor accomplished precisely. We also integrated one of the animations of the secondary characters in the virtual space as a timing reference for the following recordings. Finally, during another session, when all the secondary characters were integrated into the scene, the mocaptor recorded Jaimie's action properly, reacting to his virtual partners and still listening to the director's indications.

According to Plessiet et al. (2019), the avatar animated in real time or pre-recorded is a virtual puppet, as the origins of the movements and decisions come from an external actor or a digital operator. In his virtual actor classification, the golem involves another type of behavior; the origin of movements belongs to the golem, but the decision to move comes from outside. In this paradigm, the mocaptor finds himself in a situation in which he is the puppeteer of the avatar and, at the same time, the golem of the director. This approach is limited as the bounds of actions are very constrained compared to the improvisation method, when the actor has more freedom to explore and discover unexpected moves and gestures. However, it is efficient as it permits recording different characters rapidly with only one mocaptor.

Integration of Pre-Recorded Movements

The integration of the pre-recorded movements in the virtual scene is the less artistic and the most repetitious and time-consuming part. We adopted the method elaborated during the staging of *The Shadow*, which proved efficient. It consists of the next steps:

- organization of the text according to operator cues that trigger salient actions (see Figure 7A).
- description of the recorded animation in a table with a title, starting and ending action frames, and a short action description (see Figures 7–B), which helps not only during the staging but also for proper documentation of the work.
- cutting the long sequence into shorter animations following table indications.
- programming the cues: each cue contains the programming instructions, addressed to avatars to accomplish a chosen salient action and to pass to a chosen idle action afterward (see Figure 7C).
- adjustments to the programming.

The adjustments mean corrections of the errors of programming, speed change of certain salient actions, making some cues launched automatically and not by the operator, and cutting excessive actions if necessary. For example, in the magic trick-training scene, the pupils disappeared and reappeared one by one and then disappeared altogether for several instants, surprising Jaimie. Although during final rehearsals, it turned out that the one-by-one part was too long and slowed down the action pacing; thus, this part was cut. This last programming step is extended in time and could last till the opening night or even after, as the adjustments depend as well on the physical actor and new demands if the performance is reprised.

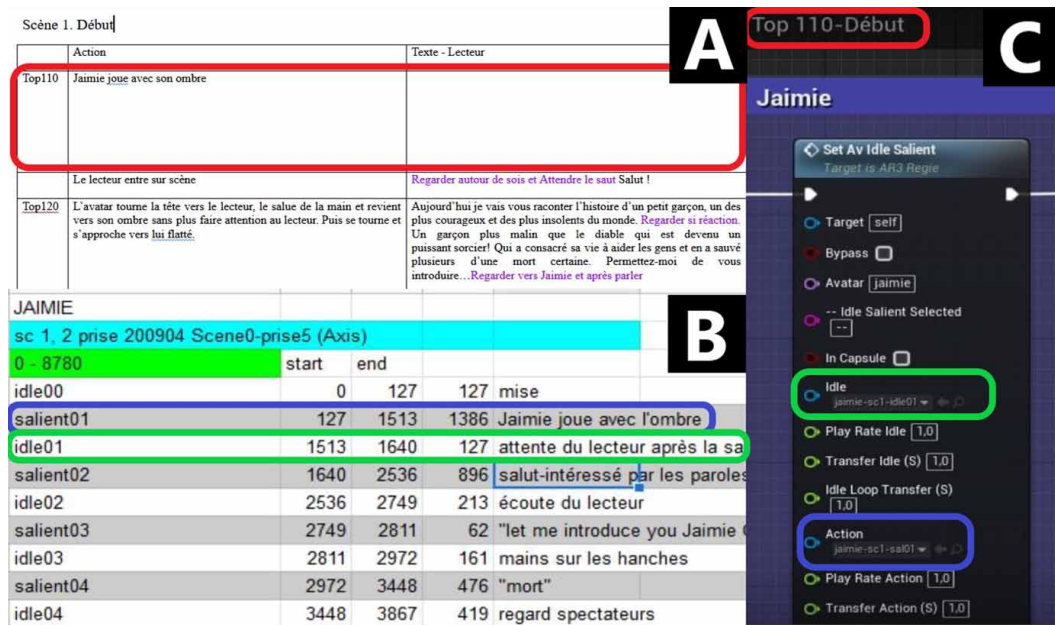
As *The Wizard Without Shadow* was initially created for face-to-face and remote presentations, the programming contains a piece of code that activates or deactivates video planes in the scenes as well as the camera live stream. For later releases, options of cue remote control and complementary blackouts were added. The operator finally triggers 70 cues during the 16 minutes performance, which makes a new salient action every 14 seconds. This result corresponds to the initial intention to create an active gesture interaction.

CONSTRUCTING AND ACTING WITH AVATARS

Acting With Animations

The last step of staging consists in directing the actor. There are two main challenges: the first is to bring the actor to play with the avatars as if they were animated in real time and if they shared the

Figure 6. Organization of operator cues driving avatars



same imaginary world. The second issue is to organize the focus point to conduct the attention of the audience. To accomplish the first one, the actor and the director need to spend some rehearsals, carefully observing the nuances of the virtual performance and discussing which parts should be underlined and in which way. Initially, the director justified the difference between the virtual and the physical space by an explanation that the projected digital world is a realm of shadows that passed away centuries ago. That was not enough for the audience to empathize with the virtual characters and neglect the significant difference in forms. So, we worked with the actor improving tiny nuances of his relationships with the avatars, discussing how his own character as the narrator feels about each avatar and their actions. In some scenes, the narrator empathizes with the characters so much that he adopts the position of Jaimie or Orraque and speaks for them, so we searched as well for the voices of these characters that would be different from the narrator's one. Jaimie has a child's voice; he always tries to sound adventurous even when he is scared. Orraque's voice is lower, and we used hypnosis techniques to add mysterious, unusual, and uncomfortable shades.

As for the second challenge, controlling the audience focus, we found three main attitudes during the rehearsals:

- the actor is addressing the avatars physically or intentionally, waiting for their response, corresponding to the dialogue or shared focus mode.
- the actor is actively watching the virtual action in silence or performing the text without any expectation of reaction from the virtual characters, corresponding to avatar-focus mode.
- the actor forgets about the screen, focusing on the audience and speaking to the spectators trying to evoke an emotional response, corresponding to the physical actor focus mode.

The director proposed to the actor a precise score of these attitudes associated with particular phrases and virtual actions and asked him to learn them. The shifting attention of the actor helps to make the audience believe that he is telling this story and discovers the actions of the avatars for the first time.

Initial Focus Schema of the Performance

The director proposed that in the first scene, Naël, the actor, starts by observing Jaimie, who does not pay attention to him, then goes on by addressing the audience and boasting Jaimie's qualities, which finally results in attracting the shadow-boy attention. Subsequently, the decor appears, and Naël continues his speech addressing the audience but keeping an eye on Jaimie, who does some actions in contradiction with the text that makes the actor address Jaimie, turning to him. During this part, the audience should be in a shared focus mode, circulating between the physical and the virtual stages as if both spaces were in dialogue.

In the second scene, when Jaimie is running out from home, the audience might watch his active movement and pay less attention to the actor, who is attentively watching the screen and creating a sound ambiance through words. In the following scene, when Orraque describes to Jaimie all the preciousness of magic, both avatars are still. Naël imitates Orraque and takes all the attention to hypnotise the audience. In the end of the second part, Naël asks the avatars to bring on stage some items that are not planned. That frustrates the avatars, making them abandon their roles for a while and argue with the physical actor. At this moment, the physical performer and the avatars are in an active dialogue, so the audience might adopt a shared focus.

The next scenes, in which Jaimie is learning magic and use a trick to quit the school, are mostly avatar-focused as avatars are more active than the actor, except for several short moments of interaction between Jaimie and Naël when the audience may achieve the shared focus mode again. The final scene is a farewell dialogue between the avatar and the actor, so the focus is shared. This is a global review of the initial director's ideas, but the practical application changed a lot from version to version.

Different Modalities of the Performance

The creation-as-research was initially supposed to be presented by two persons: a physical actor and a digital operator, invisible to the spectators who would launch the virtual actions. In January 2021, three versions appeared: face-to-face and remote performances in French and a remote performance in the director's mother tongue, in which the actress performed the operator's role as well. In October 2021, the performance was presented in a face-to-face version at the ARTECH21 conference in English, and, for technical reasons, the actress, Anastasiia Ternova, performed the role of operator as well.

In June 2022, the performance was re-staged by Naël and presented in French in an acting school featuring Anastasiia Ternova, the director, in the narrator's character. The digital operator's space was put on the stage in front of the spectators and took part in dramatic collisions when Anastasiia and Naël alternately launched the cues. This version of the performance was much more physical and actor oriented. The timings of these versions varied between 15 and 25 minutes due to the lengths of the phrases in different languages and playful situations that changed from one version to another. Still, the pre-recorded animations were exactly the same for all the versions.

Remote Versus Face-to-Face Performances

In the remote and face-to-face versions of January 2021, we tried to keep close to the initial focus schema, though the interpretation of the actor was very different in each version. Performing on a stage, the actor feels naturally, projecting his voice, turning to the screen to interact with the avatars, being free with his body language, addressing the public, and directly receiving their answer. Playing in front of the camera for the remote version revealed multiple issues.

First of all, the actor was completely cut from the audience and worked blindly, so to speak. As the shadow is deprived of the mimics, his big face on the screen becomes visually very attractive for watching. So Naël needed to continuously keep attention on his own mimics and be more precise with the focus point than during a face-to-face performance when he could improvise according to the reactions of the spectators.

Secondly, the hand gestures might also look more vivid than the avatars and consequently attract too much attention. Besides this, the proximity of the camera could easily produce strange angles of

view. That restricts a lot of body movements of the actor, letting him mostly just look at the camera or turn his head to the avatars. However, the interesting advantage of the remote version is that we can instantly erase the picture of the actor, leaving only his voice if we want to bring more intimacy to the virtual character's interaction and be sure that the audience is focused only on it.

Thirdly, it is hard for the actor to keep the correct addresses, because, unlike the face-to-face version, he has no screen behind him. The virtual action is actually happening in front of him on the computer screen. The only way that we found to deal with this problem was to put a second screen on the left of the actor. As he was supposed to look on the left to see the avatars, he was able to adjust his head, checking on the second screen his live-streamed image position.

Finally, the voice gains an important role as the actor works with a microphone that catches all the nuances. On the one hand, that demands a high level of awareness as well during performing. On the other hand, it opens a range of intimate colors that theatrical actor is often deprived of on the stage.

CONCLUSION

In this article, we exposed our methodology to present the challenges of creating a performance with avatars. During the staging, we could discover the precise impacts of all the decisions made during the preparation stage on the final performance. We also elaborated on several unexpected methods of creating physical–virtual interactions, such as vocal communication between the actors and the puppeteer–golem strategy. The director had the intention to create a virtual pre-recorded, live-controlled performance that could be interpreted remotely or face-to-face, but through new interpretations, we discovered that this performance appears to be something different. It seems to be a sort of visual silent story-telling that could be developed and interpreted in many different unexpected ways by changing the physical action.

The creation-as-research was positively accepted by different types of public. Though it was criticized for the absence of sound, that could be improved in a future version. Besides this, due to the actual technical state of the AKN_Regie plugin, the animations have very low limits of further adaptation to the physical actor. The adjusting of speed should be used carefully in order to keep the action plausible. The movements that are not recorded successively could rarely be blended in one sequence as the difference between the poses of the body or the position in the 3D world of two animations could be that much important that their combining would provoke visible, implausible glitches. New features are in development, for example, the possibility to control the avatar head in real time independently from the recorded animation. It could allow some playful situations or enhance adjustment of the acting addresses.

ACKNOWLEDGMENT

We thank didascalie.net, which supports the development of the AvatarStaging framework and produces *The Wizard Without Shadow* (<http://didascalie.net>), and the team of Villiers-Le-Bel for welcoming the rehearsals and performances.

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