Attending to an artistic performance is more emotionally engaging than watching it on video

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Abstract : During the Covid-19 pandemic, the live entertainment industry in Europe, particularly in France, faced severe disruptions due to public health restrictions, with cultural activities deemed non-essential. This resulted in substantial economic and artistic losses, prompting many artists and institutions to seek alternative ways of engaging with their audiences. Digital platforms emerged as a crucial medium, with initiatives such as Culture Box broadcasting pre-recorded performances to the public. Yet, a critical question remained: can the emotional resonance of a live performance truly be replicated through a digital screen? To explore this, a study was conducted comparing audience responses to a live theatre performance versus a recorded screening of the same play. Thirty-six adult participants were evenly divided into two groups, attending either to the live session or the recorded version. All participants were equipped with electrodermal activity (EDA) sensors and provided with tablets to capture real-time emotional responses throughout the artistic event. The results revealed stronger emotional responses when considering the implicit emotional measure (EDA) in the live performance condition, but not when considering the explicit emotional measure. The analysis further identified several "remarkable moments" marked by heightened audience reaction (both implicit and explicit), many of which coincided with scenes the director had intentionally designed to be impactful. These findings suggest that physical co-presence of artists and spectators enhances emotional intensity, reinforcing the notion that live performance offers a uniquely immersive and impactful experience. Overall, the present study underscores the irreplaceable value of live interaction in the performing arts and its profond emotional resonance with audiences. Furthermore, it establishes the use biomarkers as a promising and innovative approach to assessing emotional responses to artistic performance.

Keywords : Performing arts; cognitive science; emotional response; audience engagement; digital humanities; artistic impact

1 Introduction

During the Covid-19 pandemic in Europe (2020-2021), the live entertainment sector suffered significantly due to global health restrictions, including lockdowns, stringent hygiene measures, and social distancing mandates. In France, for instance, the government imposed sanitary restrictions to halt the spread of the virus but also products, services, and activities were divided between essential and non-essential ones in order to limit, as much as possible, face-to-face human interactions (Storr *et al.*, 2021). In this context, the designation of cultural activities deemed non-essential has had profound repercussions on their accessibility and economic viability, deeply affecting the performing arts sector. In France, losses in sales for live entertainment amounted to 2.5 billion euros in 2020 compared with 2019 and to 2.1 billion euros in 2021 (Bourlès & Nicolas, 2022). The reduction of cultural activities had a significant impact on the production of live shows, not only financially (for companies and venues that make a living from ticket sales) but also artistically: artists faced challenges in collaborating and rehearsing together in person, while also lacking the opportunity to connect with audiences (for instance in the United States, the venues were not authorized to reopen until April 2021 and in France, until May of the same year). In order to overcome this long period of inaccessibility to live performances, several cultural institutions and artists made the decision to grant online access to their performances, thus catalyzing the proliferation of digitization and platformization within the cultural sphere. In France for instance, Culture Box, a public television channel dedicated entirely to recorded live performance, was launched in August 2021 and still working. Additionally, a considerable number of artists have reevaluated their approaches, opting to engage with their audiences through online performances and distribute their creation *via* streaming platforms or online TV channels. This strategic shift aimed to sustain their connection with their audiences despite physical limitations (Quillet, 2022).

However, the experience of witnessing a live show in person *versus* one performed remotely is likely to have distinct impacts on the audience's appreciation. Indeed, the essence of experiencing Performing Arts necessitates the physical co-presence of both the audience and the performing artists within the same venue, which the Argentinean theorist Jorge Dubatti (2014) calls "convivio", allowing immediate and ongoing interaction between the two groups and significantly influencing the audience's reception. The concept of "tecnovivio" (Dubatti, 2015), which involves experiencing Performing Arts through technology, such as live performances on online platforms, lacks the direct interaction between spectators and artists that is characteristic of traditional live performances. Hence, artists performing on these "téléscènes" (Bardiot, 2019) often resort to mediation tools like chatbots to capture audience reactions. However, these methods fall short of replicating the effects generated by physical co-presence. For this reason, it is reasonable to assume that a spectator attending a live show at a venue perceives a richer array of information intellectually, emotionally and sensorially, compared to someone watching it on a screen. This hypothesis forms the central focus of the present study, which aims to investigate whether the audience experience is heightened when spectators engage with Performing Arts in live conditions. To this end, we conducted a comparative experiment involving two groups: one attended a live theatrical performance, while the other watched a video recording of the same

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performance projected in a theatre setting. We collected and compared data on their feelings, including both implicit and explicit emotional evaluations, to assess how the latter differed according to the condition in which the play was presented. Implicit emotional responses to the performance were measured using electrodermal activity (EDA), whereas explicit emotional responses to the performance were measured using a touchscreen tablet presenting positive and negative emojis. Our hypothesis posited that implicit and explicit emotional responses should be higher among spectators engaging in live performances compared to those experiencing the same performance *via* video projection. Furthermore, we anticipated that fluctuations in emotional responses should coincide with pivotal moments as established by the stage director.

2 Method

2.1 Participants

Thirty-six adults were volunteers to take part in the study: Five participants were in the [18-29 years] age category, seventeen participants in the [30-49 years] age category, and fourteen participants in the [+50 years] category (average: 43.9, SD: 11.2). They were selected from an online advertisement circulated within the University of La Rochelle. After having declared being volunteers to participate in the experiment, they were randomly assigned to one of the experimental groups: Heighten participants (11 women) were assigned to the Live group (live theatre session) and heighten participants (11 women) were assigned to the Video group (video theatre session). Before the experiment, each participant received a letter of information concerning the location and the overall objectives of the experiment. They were advised that their presence on the experimental site would imply consent to participate in the study.

2.2 Apparatus and stimuli

The theatre play presented was *La vie devant soi* created in 2018 by the French director Simon Delattre based on the famous Romain Gary's novel (1975) and presented during the 2021-2022 season in different theatres among which the Ernée theatre at Montenay. The play was either presented live, or during a video projection (6m x 4m), and lasted 94 mn. Once seated in the theatre hall (top of the bleachers), participants were requested to watch the play (live or projected) wearing an E4 Empatica sensor, which recorded the electro dermal activity (4Hz) during the whole performance. They were also equipped with a touch sensitive tablet. We developed a custom application for Android Studio (Java, xml, v.4.2. & higher), to ensure compatibility between all tablets purchased since 2014. The application installed on the tablets allowed the users to select one of the presented emojis (Annoyance, Boredom, Sadness, Surprise, Questioning, Smile, Laughter, Hilarity). The emojis elected provided an estimate of the participants' explicit emotional state and its variation across time.

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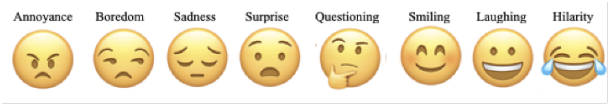


Figure 1: Emojis used during the explicit evaluation of the participants' emotional state while being exposed to the (live or video) theatre play.

The set of emoticons was defined from the domain ontology inspired by Plutchik wheel (1980) and adapted for this experiment on the basis of the work performed by the ESNA[1] research group in the context of the Visual Staging project.

2.3 Procedure and design

Both groups of participants were tested in a theatre hall during a public performance: one group (N=18) attended the live show while the other group (N=18) watched in a different session a recorded version of the play projected on a screen within the theatre. After having received the instructions concerning the experiment, the participants were provided with a digital tablet, and an EDA sensor was attached to the wrist of their non-dominant hand. The reference of the tablet was associated with the sensor number but without including the participant's name, so that the data recorded remained anonymous. The tablet program and the EDA device were triggered before the show started and the computer timestamp was used to synchronize the two devices.

Following the beginning of the live or video broadcast of the play, the participants could use the tablet with their dominant hand to indicate explicitly their feelings at any time they wanted to express an emotion (there was no constraint on how many or when these expressions were expected). To this end, participants had to select one emoticon according to the emotion felt (boredom, annoyance, sadness, surprise, interrogation, smile, laughter, hilarity) as shown in Figure 1. The stage director Simon Delattre was then interviewed in order to get information about the impactful moments that, as a director, he wished to produce on the audience during the play.

2.4 Data recording and analysis

Throughout the play (live and video session), the data related to electrodermal activities (EDA) were registered from the sensors (implicit measure). The data related to the emotional perception (explicit measure) were collected from the touch-sensitive tablets. Finally, the information about the impactful moments according to the stage director was collected during the post-experiment interview. The onset of the recording was time-locked to the onset of the live or video session of the play. The three different sets of data were first analyzed separately and then compared to each other.

[1] ESNA (Ecole du Spectateur de Nouvelle Aquitaine, 2021-2024) is a research project in Digital Humanities. It aims to digitise research in Performing Arts from case studies linked with live performance artists. Among the digital tools created to reach this goal, the team has been working on the creation of a domain ontology dedicated to Performing Arts which integrates a list of the feelings and judgements possibly felt by the audience during a live show.

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2.4.1 Implicit emotional evaluation

Implicit emotional evaluation was analyzed from the time variation of the electrodermal activity (EDA). For each participant, the phasic component was extracted from the EDA signal using Ledalab (v3.4.7), that provided the temporal sequence of Skin Conductance Responses (SCR). After having checked for normality of data distributions (Shapiro-Wilk test[2]), we compared the average SCR in the video and live exposure conditions across the participants using the U Mann-Whitney[3] test or Student t[4] test for hypothesis testing.

We then calculated the frequency of SCR per minute over the whole play performance to obtain an estimate of the temporal distribution of SCR derived from EDA-phasic activity over time. In order to identify remarkable moments in the phasic component of EDA, we compared the frequency of SCR obtained every minute of the play to the average SCR computed over the whole play duration (i.e., the total of SCR / 94 mn). Remarkable moments corresponded to when the frequency of SCR obtained every minute was higher than the average SCR computed over the whole play duration. We thus selected the periods of time where remarkable moments were congruent in the live and video exposure conditions. These common remarkable moments were used to compare participants' emotional reactions to the intention of the stage director (see below).

2.4.2 Explicit emotional evaluation

Explicit emotional evaluation was performed using the data recorded on the digital tablets. Data were collected from the participants' responses (i.e., the selected emojis) by the experimenter. In order to standardize the set of data, we considered in every block of one minute only the emojis that were of different categories, i.e., not considering emojis that were already selected in the same block of 1 minute. We then computed the average number of emojis selected by the participants in each block of one minute, separately in the video and live experimental conditions. We then identified remarkable moments as moments in time where the average number of emojis in each block of one minute was higher than the average number of emojis selected over the whole duration of the play. We finally analyzed the type of emojis selected across the whole play.

[2]The Shapiro-Wilk test is a statistical test used to assess whether a sample comes from a normally distributed population. At a 5% significance level, if the p-value is greater than 5%, we consider that the data follow a normal distribution. Otherwise, if the p-value is 5% or lower, it indicates that the data significantly deviate from normality.

[3]The Mann-Whitney test is a non-parametric test that compares two independent samples without assuming a normal distribution. At a 5% significance level, if the p-value is greater than 5%, we consider that the two groups have equal values. Otherwise, if the p-value is 5% or lower, it indicates a significant difference between the distributions of the two groups.

[4]The Student t test is a statistical test used to compare two independent groups assuming normal distribution. At a 5% significance level, if the p-value is greater than 5%, we consider that the two groups have equal values. Otherwise, if the p-value is 5% or lower, it indicates a significant difference between the distributions of the two groups.

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2.4.3 Interview with the stage director

During the post-experiment interview, the director Simon Delattre was asked to indicate the key-moments in his staging where he expected a reaction from the audience during the play (both positive and negative). Those key-moments identified according to the blocks of one minute of the play were then compared to the remarkable moments identified from the implicit and explicit emotional responses as provided by the participants.

3 Results

3.1 Emotional responses

3.1.1 Implicit emotional responses

Concerning the phasic component of EDA, mean SCR during the play was 213 (SD: 235) in the live condition, which corresponded to 2.27 SCR per min. Mean SCR during the play was 68 (SD: 67) in the video condition, which corresponded to 0.71 SCR per min, the difference between the two conditions being significant (U = 92, p = 0.027).

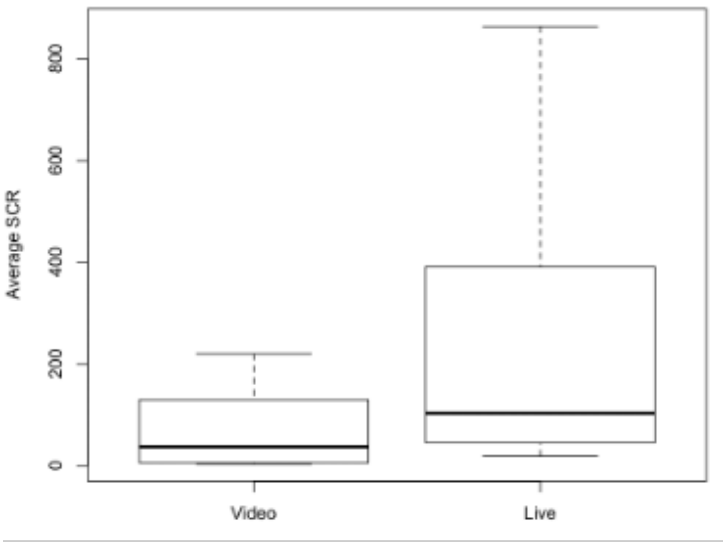


Figure 2: SCR obtained from the phasic component of EDA in the video and live experimental condition respectively.

3.1.2 Explicit emotional response

With respect to the explicit emotional response (emojis selected on the tablets), the average participants' responses (i.e., the number of selected emojis) in the live condition (on average 49.3, SD: 23, which corresponded to 0.52 per minute), was not different than in the video condition (on average 43.1, SD: 26); which corresponded 0.46 per minute (t = 0.76, p = 0.46).

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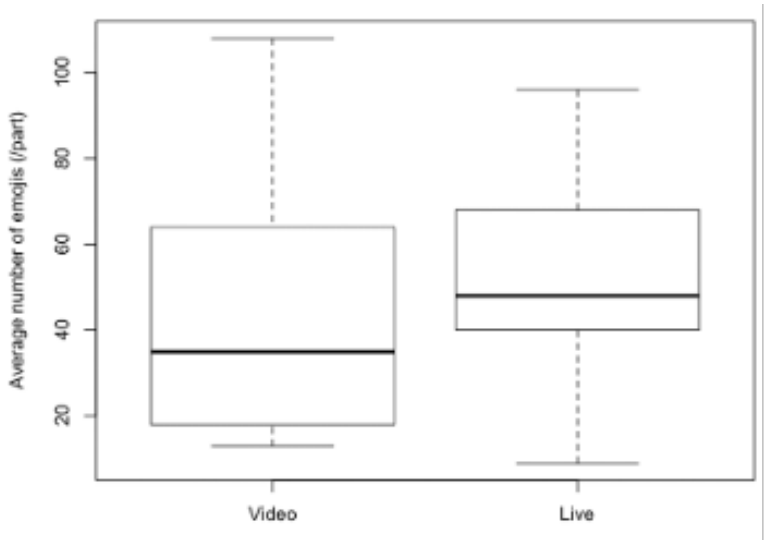


Figure 3: Average number of selected emojis on the tablet in the Video and Live experimental condition respectively.

3.2 Remarkable moments

3.2.1 Remarkable moments from EDA

Common remarkable moments computed from EDA (i.e., SCR frequency on every minute > average SCR frequency over the play) in the live and video exposure conditions are represented in Figure 4. We found 8 common remarkable moments where SCR frequency was higher than the average performance concomitantly in the live and video conditions.

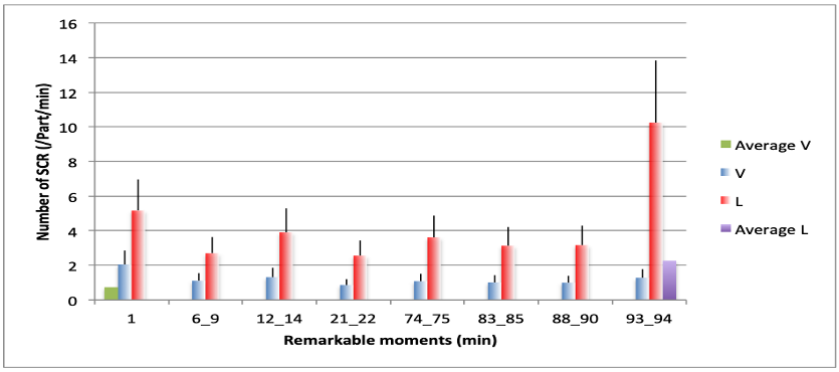


Figure 4: Common remarkable moments computed from SCR frequencies in the live and video conditions respectively.

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3.2.2 Remarkable moments from tablet

Common remarkable moments computed from the tablet (i.e., the number of selected emojis on every minute > average number of selected emojis over the play) in the live and video exposure conditions are represented in Figure 5. We found 12 common remarkable moments where the number of selected emojis was higher than the average performance concomitantly in the live and video conditions.

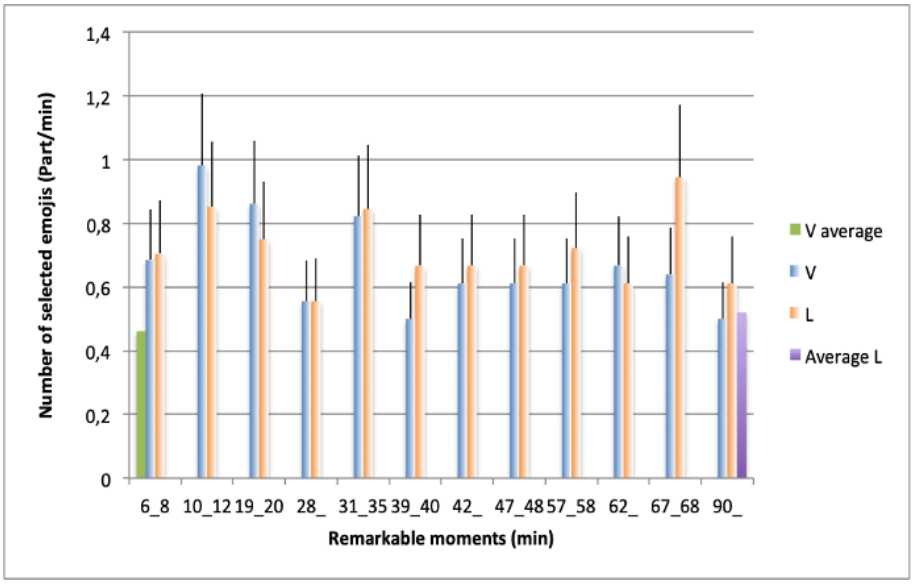


Figure 5: Number of selected emojis in common remarkable moments in the live and video conditions respectively.

3.2.3 Interview with the stage director

During the interview, the stage director defined 7 moments of the play that according to him may have an impact on the spectators. These remarkable moments were considered as "rendez-vous avec le public" ("appointments with the audience") and thought to be impactful due to the staging and direction of the actors. Among those 7 moments, there were three that were, according to him, the expected most impactful remarkable moments, as shown in Table 3. He also mentioned that according to him, emotional intensity is thought to increase during the last twenty minutes of the play.

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Minutes of the play	Intensity of impactful moments according to the stage director
3-6	+
43-45	++
56-57	+
62-70	+
74-79	++
83-84	+
88-90	++

Figure 6: impactful moments and their intensity (+ or ++) across the different minutes of the play.

3.2.4 The comparison of remarkable moments

Regarding the three sets of data (sensors, tablets and director), we observed that all the remarkable moments defined by the director, as impactful scenes in the live show, coincided almost all with the audience reactions either through an EDA activity or the report of the emotional state. With respect to EDA activity, four remarkable moments corresponded to the impactful moments as provided by the director (i.e., at 6, 74-75, 83-84, and 88-90 mn). With respect to the tablet responses five remarkable moments corresponded to the impactful moments as provided by the director (i.e., at 6, 57, 62, 67-68, and 90 mn). Regarding the common remarkable moments between the tablet responses and the EDA activity, we observed that there are very few overlaps: only three moments at 6, 12 and 90 min. When comparing the common remarkable moments among the tablet responses, the EDA activity and the impactful moments defined by the stage director, only two moments coincided: at 6 and 90 min. Nevertheless, six out of the seven impactful moments identified by the stage director aligned with either the EDA activity or the tablet responses.

4 Discussion

The Covid-19 pandemic has accelerated the phenomenon of digitization and platformization in the cultural world, in particular in the performing arts' sector. By this way, many artists of the domain have implemented new ways of reaching their audience despite imposed social distancing, but also to attract new spectators by bringing performance art to them. This raises the question of the efficiency of these new practices and to which extent the technology can contribute to reaching the audience.

In the present study we investigated whether experiencing a performing art remotely through video projection elicits emotional responses comparable to those evoked by attending a live performance, where both the artists and audience share the same physical space. First and foremost, the data partially support what performing artists and theorists have long claimed: for spectators, the experience of a live performance is perceived as more intense than that of a recorded one. This assertion was confirmed through sensorial analysis (based on EDA), but not through cognitive analysis (based on self-reported experience). This suggests that emotional states do not always align with the conscious awareness of emotions, as highlighted by Damasio (1999), and that the analysis of implicit responses represents a particular fruitful approach.

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The educational, cultural, social, and existential context also influences the expression of emotions. Depending on the education we receive, the social group to which we belong, and the life events we experience, the way and extent to which we express our feelings can vary significantly (Arnold, 1950; Averill, 1980; Lazarus, 1991; Le Breton, 1998). As Lazarus emphasizes,'we can't understand emotional life solely from the standpoint of the person or the environment as separate units' (1991: 89). Similarly, certain emotions may be felt but not outwardly expressed, or their expression may be modulated—intensified, diminished, or transformed—through self-regulation shaped by internalized social norms (Scherer, 1989). For example, during the puppet show, it could be hypothesized that a young spectator might be more captivated by the appearance of the puppets on stage than an adult. However, further experimentation would be required to confirm this assumption.

In the present study, we also wanted to investigate to what extent the director's intentions corresponded to the audience's reactions in terms of shared emotional moments. As we have shown, the director planned, in the genesis of his staging, impactful moments that are expected, according to him, to trigger an emotional effect on the spectators. Remarkably, the data revealed – more clearly in the implicit than in the explicit measures of emotional responses – that nearly all the moments (86%) the director intended to be highly impactful aligned with the spectators' reactions. Interestingly, this alignment was observed sometimes in the implicit emotional measures and at other times in the explicit ones. The work of contemporary directors notably consists in producing effects on the audience with a range of stimuli in order to generate a "participation événementielle", i.e. the 'spectator's involvement in the energetic charge of the work' (Pavis, 2021: 240-241). The results clearly demonstrate that the director's objectives can be assessed, thereby validating that he has succeeded in emotionally engaging the spectators through the stimuli conveyed by his work. They also show that these stimuli have been designed (both implicitly and explicitly) for an "embodied" spectator who will be present in the venue, and not an abstract spectator. Indeed, in order to give their instructions to the actors, many directors not only place themselves "on stage" during the rehearsals but also "off stage" (Proust, 2006 ; p. 270), i.e where the spectators will be seated, and even in several possible seats where the perception of the show will be necessarily different. Thus, it's not just a question of seeing the stage from different angles and getting a "panoptical view", but also of physically experiencing the live work in the place where the spectator's bodies will be located. In conclusion, this study demonstrates for the first time that the intersection of performing arts and cognitive science can be profoundly beneficial, not only for understanding the performative effects of live performances, but also for exploring how art and emotional experience can meaningfully converge.

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Data Availability Statement

All relevant data are available at https://doi.org/10.34847/NKL.2D4ER67F

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