

EXPERIENCING ART IN SOCIAL SETTINGS

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Whether in galleries, theatres, concert halls or out on the street, art is often experienced together, not alone. The performing arts, including dance, theatre and music have likely evolved in social settings (Brown et al., 2005; Merker, Morley, & Zuidema, 2015) and practicing them facilitates social bonding (Dunbar, 2012; Savage, Brown, Sakai, & Currie, 2015; Von Zimmermann et al., 2018). However, while research in aesthetics has thrived in the last two decades (Chatterjee & Vartanian, 2014; Kawabata & Zeki, 2004), the sociality of aesthetic experience remains under-investigated. Most existing studies (and theories) exclusively focus on aesthetic experiences of individual people in isolation. Only in recent years has the social context of art experience come into focus, when people collectively watch a film in the cinema, attend a live concert, a dance performance or a play in the theatre (Hanich, 2014). In this chapter we will review behavioral and neuroimaging studies that explore art experiences in these social settings.

This social gap in the empirical aesthetics literature may be due to the methodological constraints of neuroimaging methods and laboratory settings, which typically can only record measurements from one person at a time. Aptly, Schilbach et al. (2013) labelled measuring the collective experience as the “*dark matter*” of social neuroscience. Recently, hyperscanning, that is, simultaneously recording the brain activities from more than one subjects interacting (for review, see Babiloni & Astolfi, 2014; Hasson et al., 2012) and mobile neuroimaging approaches such as functional near-infrared spectroscopy (fNIRS, e.g., Pinti et al., 2020) and mobile electroencephalography (EEG, e.g., Mustile et al., 2021) have allowed researchers to conduct studies outside of the conventional laboratory environment, moving into socially dynamic, real-world settings. These technologies can thus be applied to the collective aesthetic experience and

record the brain activity of multiple audience members in live or virtual performance contexts (Hamilton et al., 2018).

Existing research on the collective aesthetic experience often manipulates the number of people experiencing art together (e.g., attending to artwork alone or in a group, Kaltwasser et al., 2019) or the social context in which art appreciation occurs, for example the degree of shared experience (Dunand et al., 1984) or the layout of a gallery space (Pelowski et al., 2014).

Measurement of the collective experience often takes the form of quantifying interpersonal synchrony, that is the temporal and spatial coordination of behavioral, cognitive, or neurophysiological processes between two or more people (Czeszumski et al., 2020; Delaherche et al., 2012; Mayo & Gordon, 2020). Interpersonal synchrony can emerge automatically in social situations, as when large crowds clap in synchrony (Neda, Ravasz, Brechet, Vicsek, & Barabasi, 2000). Notably, coordinating actions with others is rewarding in itself (Kokal et al., 2011), an experience that has been termed '*collective effervescence*', or the joy of belonging (Durkheim, 1912; Rennung & Göritz, 2016).

In this chapter, we will review social aesthetic appreciation across different art domains. We will discuss social influences on the aesthetics of dance and theatre, live and recorded music and watching film. We will focus specifically on studies that have either: i) investigated co-presence between a performer and a spectator; ii) directly compared individual and social settings of aesthetic appreciation, iii) investigated interpersonal synchrony between people attending to the same artwork, recorded separately; or iv) investigated interpersonal synchrony among audience members experiencing art together.

Social influences on the aesthetics of the live performing arts (dance and theatre)

Before the arrival of recording technologies, the performing arts could only be experienced 'live' (Auslander, 1999), in a defined space and time where and when performers and spectators share their experience (Orgs et al., 2016). In live performances, performers and the audience are typically co-present (Fischer-Lichte, 2008). Indeed, one study suggests that co-presence of performer and spectator can produce greater cortical excitability than the experience of a

recorded performance which does not involve co-presence (Jola & Grosbras, 2013). In recent years, there has been a growing number of studies conducted during live performances, in which physiological and behavioral responses of the audience and performers are recorded. Live performance research has studied the role of audience size (Lemasson et al., 2018; Rennung & Göritz, 2016); the spatial layout of the audience sittings (Lemasson et al., 2019); the social closeness between the performer and the spectator; active engagement of the participant (Konvalinka et al., 2011), or attentional focus (Bachrach et al., 2015; Himberg et al., 2018).

Another social aspect of the performing arts is watching a group of performers act or dance together. Vicary et al. (2017) studied the influence of synchronous movement among a group of dancers on physiological and continuous behavioral responses of spectators, in a contemporary dance choreography which continuously manipulated synchrony. Rather than a fixed series of steps, dancers in this study worked with a defined movement vocabulary that emerged from a set of task instructions that relied on the social interactions and decisions made among the performers. Across four live dance performances, 101 participants were equipped with wrist sensors that recorded cardiac activity while they attended to the performance, as an implicit index of engagement and arousal. A subset of participants also evaluated synchrony and enjoyment during the performance, using a tablet. For the dancers, their movement acceleration in three-dimensional space was recorded during the performances. Performed group synchrony was computed from the dancers' acceleration data with cross recurrence quantification analysis (CRQA, Fusaroli, Konvalinka & Wallot, 2014). It was found that, although audience members gave homogenous subjective ratings within their groups (65-70%), four performances elicited different levels of subjective enjoyment, as one performance was most favored (3rd), and another was least favored (1st) by the audiences. Granger causality analysis (an analysis identifying directional correlation between two time series data, Dean & Bailes, 2010) revealed that synchrony among dancers predicted the spectators' heart rate and enjoyment, but only for the most and the least favored performances, whereas for performances with intermediate levels of enjoyment, the relationships were absent or even reversed, suggesting that forming a strong and stable evaluation of a live performance is associated with sustained temporal coupling of the spectators' reactions to the performers' actions. In sum, the findings show that the aesthetic appreciation of live dance indeed depends on the co-presence of performers and spectators in a

defined here and now, and that movement synchrony is an important feature of the aesthetics of group dancing.

The communicative effect between the performer and the audience in live performing arts settings is not necessarily a one-way interaction from the performer to the spectator. The performers can also be influenced, e.g., by the size or composition of the audience and their reactions. Lemasson and researchers (2019) focused on studying spatial positioning of live audiences, and its impact on both the actors and spectators' implicit and explicit reactions. In theatres, proscenium arch or end-on stage seating arrangements are common, where the audience faces the stage only frontally. Alternative traverse (bi-frontal), in-the-round (quadri-frontal), or other configurations that blur the distinction between stage and the audience are often associated with a more immersive experience or audience participation. Lemasson et al. investigated three different types of staging on emotional responses of the actors and spectators. 15 acting school students performed a combination of monologues and dialogues in a fixed order, repeated in three performances, each time in a different staging condition. Different audience members were recruited for each day (for frontal = 35, bi-frontal = 28, quadri-frontal = 43 participants). For both actors and spectators, galvanic skin responses (GSR, Bodie 2010) were recorded during the performance as a measure of arousal. At the end of the performances, spectators and actors were asked to rate their aesthetic experience.

The results showed that the actors preferred to perform while being surrounded by the audience. In this condition, performers felt that they interacted the most with the audience and that the audience emotions were most heightened, although they also reported that they were more anxious in the bi-frontal and quadri-frontal layout. Reciprocally, actors' GSRs were highest in the quadri-frontal layout. Similarly, spectators reported highest attention in the quadri-frontal staging and the lowest attention in the bi-frontal staging. However, spectators reported to have interacted the most with other spectators in the bi-frontal staging, and their GSRs were significantly higher in this configuration compared to the other two. Overall, the findings indicate that there is a disparity of felt and speculated affect, interaction and attention between the actors and the spectators. However, the sample size in this study was small; more research is

needed to investigate the effect of spatial layout of the performance space on the sociality of aesthetic experience.

Ardizzi et al. (2020) investigated cardiac synchrony between spectators during the live performance of a monologue, in groups of four people, and studied how implicit physiological synchronization could be related to subjective reports of emotional intensity. The Electrocardiogram (ECG) was recorded from 12 professional actors and 12 quartets of spectators, before and during the monologue performances. After the monologue, ratings for emotional intensity and quality of the monologues were collected. Cardiac synchrony was significantly higher for groups of spectators who saw the performance together (in-group) than for those who were in different quartets (out-group), both during the performance and rest periods. Contrary to their hypothesis, the authors did not find a positive correlation between cardiac synchrony and emotional intensity ratings. However, further analysis revealed that the convergence score, that is how much emotional ratings between each participant and the other in-group spectators, correlated with in-group heart rate synchrony. Thus, the more similarly people had rated their experience, the more synchronous was their heart rate. These findings suggest that the mere presence of others in attending to theatrical performance does synchronise behavioural and psychophysiological elusive, but this synchronization does not necessarily lead to the experience of more intense emotions.

Other studies have directly compared art appreciation between individuals and groups. Nomura and colleagues (2015) investigated unconscious eyeblink synchronization among spectators as an index of cognitive entrainment while watching traditional Japanese *Rakugo* theatre. In *Rakugo*, a story is narrated by a single actor, with a specific focus on the performer's voice and facial expressions. In a first study, Nomura et al. (2015a) found that expert viewers of *Rakugo* showed significantly higher eyeblink synchrony at the beginning of the performance, compared to novice spectators. Both groups watched a 50-minute recorded performance in the lab. However, novice participants' eyeblinks became synchronized over the course of the performance, and the difference between the two groups disappeared in the last 15 minutes. In a follow-up study, Nomura et al. (2015b) compared eye motion synchrony during a live and a recorded *Rakugo* performance. Eyeblink synchronization was significantly stronger in the live social condition

than the alone lab condition, for both expert and novice spectators. For expert spectators, eye blink synchronization was moderately stronger in the live social condition compared to the alone recorded condition. For novice spectators, eye blink synchrony during in the live social condition was significantly stronger from the beginning and throughout the entire performance, compared to the alone, recorded condition. Such results suggest that a live and social performance context facilitates eye blink synchronization, especially if spectators have little or no prior experience with a specific art form or style. Perhaps, other spectators' reactions to a performance (e.g., laughter) provide a cue to engaging with art forms that are more difficult to understand if experienced alone.

Together, these studies show a clear influence of liveness and social context on the appreciation of dance and theatre. Future studies should aim to further disentangle interpersonal synchrony between the performers and the audience at neural, physiological and behavioral levels.

Social influences on the aesthetics of live and recorded music

In contrast to dance and theatre, listening to recorded music in personal devices has become the dominant format of music consumption (Bull, 2006; Wald-Fuhrmann et al., 2021). But live music events remain popular, particularly among people who seek novel experiences and social connectedness (Brown & Knox, 2017). Accordingly, many music listeners rate live concerts as their favorite way of engaging with music (Krause et al., 2020).

In one of the first studies on social influences on music listening, Egermann et al. (2011) compared listening to music in solitary versus group conditions. The study investigated whether the social setting would change subjective or physiological measures of emotion. 14 participants from an amateur orchestra listened to 10 sets of one-minute classical music excerpts which were previously found to induce aesthetic chills (Grewe et al., 2007). Participants listened to these excerpts once alone and once again in a group. Subjective reports of emotional reaction were taken at the end of each musical excerpt, using felt intensity questionnaires (Krumhansl, 1997). Aesthetic chills, described to the participants as 'strong emotions accompanied by shivers down the spine or goosebumps', were recorded both explicitly – participants pressing a button with one

hand whenever they experienced a chill – and implicitly by measuring skin conductance response (SCR). Interestingly, Egermann et al. (2011) found that there was no significant social influence on subjective emotional ratings. However, participants exhibited greater skin conductance in the solitary listening condition, across all 10 musical pieces, and the difference between the alone and the social conditions peaked when listeners reported that they experienced aesthetic chills. In fact, 11 out of 14 participants reported that they enjoyed music listening more when they were alone.

This finding is important, as it indicates that social settings may not necessarily *heighten* audience engagement, but instead can have negative effects on aesthetic appreciation (Sutherland et al., 2009). Perhaps, the presence of other people can be distracting if the musical work requires more sustained and focused attention to be appreciated. However, this experimental paradigm involved a button-pressing task to be carried out individually even in the group listening condition, which is only partially comparable to real-life social music listening in a concert. Moreover, recorded classical music in particular may be typically experienced alone rather than in groups.

Shoda and researchers (2016) investigated cardiovascular responses of audiences attending to live vs. recorded piano performance, both times as a group. Out of 118 audience members, 37 participants' continuous ECG was measured, first during a pianist playing six solos, then once again 10 weeks later, while participants listened again to the recorded version. The six musical pieces were presented in blocks of two tempi (fast and slow) by three composers (Bach, Schumann, Debussy). The audience's average HR changed in line with the tempo of the music, but only in the live condition. During live concerts, participants' heartbeat became faster in fast tempo music, and slower in slow tempo music. Moreover, the vagal nerve activities indicating stress reduction (the amount of high-frequency ECG components relative to total-frequency components, Eckberg, 1997) were found to be significantly higher in the live condition, while sympathovagal balance indicating mental stress (calculated as the amount of low-frequency components relative to high-frequency components, Nakahara et al., 2009) was moderately lower in the live condition. Overall, this study supports the idea that a pianist's live performance may not only lead to stronger entrainment of heart rate in a group of audiences, inducing

audience attention, but also has a greater calming effect on the listener than listening to a recorded performance.

Bernardi et al., 2017 assessed interpersonal synchrony among group of 14 participants with, and 13 participants without musical training. Over four days, both groups of participants listened to seven religious musical pieces repeated twice, played live by a professional organist in a cathedral. All participants gave subjective ratings on pleasure, familiarity, and loudness variability, after the first performance. During both baseline and live performance conditions, participants' ECG, breathing rate, finger vasomotion and blood pressure were recorded simultaneously. Interpersonal physiological synchrony was computed as Generalized Partial Directed Coherence (Bacclá et al., 2007), for each of the four physiological measures, in low and high frequency bands. The effect of live organ performance on group synchrony depended on the specific music compositions: For simple harmonic progressions, all physiological signals showed stronger synchronization in the live performance compared to the baseline condition, while during a hymn, no differences on physiological group synchrony were found between live performance and baseline. Music training background had a significant effect on promoting stronger group synchronization in breathing and blood flow distribution, but not in cardiovascular and blood pressure coherence. While subjective ratings of pleasantness and familiarity were found not to be good predictors of group synchrony, loudness variability alone accounted up to 80% of variance in all measures of physiological group synchrony. Specifically, audiences listening to music with more simple patterns showed greater physiological than when they listened to loud music with a complex structure. This study shows that live performed music can lead to greater synchronization of various autonomic signals, but this effect strongly depends on musical structure, with simpler structure generating stronger group synchrony.

The study by Bernardi et al. (2017) involved co-presence of the musician and the listener, but it did not actually manipulate it. More recently, Belfi and researchers (2021) studied music appreciation while one group of participants attended to a live concert in a social setting, and another group of participants attended to recordings of the concert in a laboratory setting. 20 participants who were allocated for live condition watched a joint concert of a military band and a university symphony orchestra together. Separately, 12 participants were invited to watch the

video recording of the concert, alone in a laboratory setting. For both live and lab conditions, overall ratings were measured once before, once in the intermission and once after the performance, while participants provided continuous aesthetic ratings on their smartphones (Briemann et al., 2017) as they attended to four pieces of music: two songs played by the military band, two by the university orchestra. One of the compositions had a patriotic theme, the other piece was non-patriotic.

The overall ratings did not significantly differ between live social vs. recorded alone conditions, except for liking for the pieces played by the military band. Positive feelings for listening to the military band increased between the intermission and after the concert, but only in the live social condition. With continuous measures, researchers found that both the average and highest peak of continuous pleasure depended on the congruency of musicians with their repertoire. People reported higher pleasure for listening to the military band playing patriotic music, and the university orchestra playing non-patriotic music. There was no overall difference between the live and the recorded conditions. Additionally, in a follow-up study where participants listened to recorded music only, without visual information to acknowledge which musical piece was played by which band, there was no effect of congruency between musicians and their repertoire. This study suggests that continuous pleasure of music depends more on *who's playing what*, rather than the performance context. However, in this study physical liveness (live vs. recorded) is confounded with social liveness (listening alone or in a group). Future studies should aim to disentangle these two distinct influences on music appreciation.

Apart from physiological recordings and subjective measures, body movement of the audience has also been explored in music appreciation in live vs. recorded events (Swarbrick et al., 2019; Jensenius, Zelechowska, and Gonzalez Sanches, 2017). Swarbrick et al. (2019) captured the head movements of audience members during a live rock concert and in a control condition in which the audience collectively listened to recordings of the same songs. After the performance, researchers not only collected linking ratings for the songs but also for the band. Audience members were both either unfamiliar with the band or already fans of the band prior to the experiment. All participants were randomly allocated to either attend the live event or an album release event in which only recorded songs were played. Participant's head movement data were

collected with motion capture during live and recorded concerts which were held in the same venue. All songs except the last one were unfamiliar to the audience.

Participants showed more vigorous head movements during the live concert, compared to the recorded concert, and this effect was greater if listeners were fans of the band. Notably, liveness did not influence head movements during the performance of unfamiliar songs. However, during the well-known song, fans nodded their heads more vigorously to the beat in the live than the recorded condition. In both conditions, fans showed more vigorous head movements than listeners who did know the band in advance. Together, these findings suggest that social influences on music appreciation are more pronounced if the audience has a collective positive attitude towards the musicians and their music. However, in this study, the recorded condition did not provide any visual information, i.e. a recorded video of the concert. Accordingly, it is not fully clear whether more vigorous and synchronous head movements in the live condition were driven by co-presence of audience and band, or by the availability of visual information, that is watching the movements of the performers on stage.

The studies summarized above suggest that the co-presence of musicians and listeners physiological and behavioral synchrony among audience members. However, does synchrony also occur at the neural level? Yingying Hou et al. (2020) have investigated the neural synchrony between the musician and the listener, and its relationship with listener's subjective appreciation. Researchers used dual fNIRS to record cerebral blood flow of a violinist playing 12 musical pieces. 16 listeners watched a video recording of this performance. After each piece, participants rated their subjective fondness towards the music. Inter-brain coherence (IBC) was computed for each violinist-participant dyad. IBCs between the violinist and the listeners were consistently higher than at resting state, across the left temporal cortex, the right postcentral and the inferior frontal cortices. Aesthetic ratings significantly correlated with the IBCs from all four brain regions, and this correlation was most pronounced at the performance.

Such results imply that brain-to-brain synchrony between the musician and the listener is stronger when the listener enjoys the experience more and that this synchronization occurs in brain areas associated with interpersonal communication and musical structural comprehension

(Dai et al., 2018; Abrams et al., 2010). Arguably, music can function as a social signal, and stronger neural synchrony may be related to passing intentions or emotions from the performer to the listener via music. In line with this idea, Leong et al. (2017) had conducted a brain imaging study with infants listening to pre-recorded and lively performed nursery rhymes, while manipulating social gaze. The researchers found that direct gaze between the singer (adult) and the listener (infant) significantly increased the inter-brain coupling between the singer-listener dyads. When infants were watching a pre-recorded video of the adult singing, this effect was unidirectional, that is the singer's EEG signal preceded the infant's EEG signal. However, in the co-present hyperscanning setting, that is when infants were in the same room as the adult, inter-brain connectivity was bidirectional. This suggests that social gaze and the co-presence of the listener also impacts on the singer's brain activity. Together, Hou et al. (2020) and Leong et al. (2017) show that synchronized neural activity between a musician and a listener correlates with (a) enjoyment of the audience and involves brain areas associated with communication social interaction.

While the two previous research studied inter-brain coupling between the musician and the listener, numerous other studies have investigated inter-brain synchrony among participants listening to music on their own. In these studies, inter-brain synchrony typically increases in brain areas related to auditory perception, verbal communication, body movement and emotion processing (Troost et al., 2015; Abrams et al., 2013; Alluri et al., 2012). For example, Troost et al. (2015) identified musical sections that elicited the highest inter-subjective correlations (ISCs) among 17 participants, while they listened to three classical music pieces. These segments were then characterized along nine musical features, including rhythmic variations, timber, spectral entropy. In a follow-up session 14 new participants and provided continuous ratings of arousal and valence, all while listening to the same musical pieces. Greater ISCs were observed in key brain regions associated with reward and affect states such as the insula and the ventral striatum. The amygdala was also found to be significantly activated during inter-brain synchrony, but only in the pieces which elicited the strongest emotional reactions. ISCs in the left insula, the amygdala, and the right caudate nucleus were positively correlated with arousal, while the activity in the same brain areas was negatively correlated with valence. Additionally, authors discovered that BOLD activation during inter-personal synchrony correlated with objective musical features, and

the direction of the relationships varied depending on the regions – e.g., increase in synchronized amygdala activations were found to be accompanied by increase in energy-related music features such as event density or entropy. More research linking brain synchrony to both subjective experience and objective musical features in this way is needed in order to better understand to what extent brain synchrony is driven by external, stimulus-related or internal, listener-related factors.

The aforementioned studies found synchronized brain activity among audience members or between the musician and the listener, and the strength of these shared neural activities at auditory, sensorimotor, attention, emotion, aesthetic appreciation and communication brain areas were indeed associated with music appreciation. Overall, studies show positive and negative influences on the effect of social settings on music appreciation. Notably, none of the studies described here recorded brain activity from multiple audience members simultaneously, ISC measures are always based on recordings from individual listening to music alone, and thus do not account for the effects of collective listening on music appreciation and brain synchrony.

Social influences on the aesthetics of film watching

There are only very few studies on social influences on watching film, yet in real-life, collective spectatorship is the norm in cinemas and may even involve spectator participation, for example during screenings of films like “The Rocky Horror Picture Show” (Hanich, 2014) or Bollywood movies (Srinivas, 2002). Arguably, a collective cinematic experience can elicit stronger emotional engagement and enjoyment than watching a film alone at home (Fröber & Thomaschke, 2021).

Kaltwasser et al., (2019) studied the joint cinematic experience by measuring the spectators’ physiological responses as well as behavioral self-report.. 39 healthy participants watched emotional movie clips in a cinema, once alone and once again in a gender-balanced group with three confederates. Ten two-minute movie clips used were previously validated to be evoking five different emotions (amusement, anger, fear, tenderness and neutral, Schaefer et al., 2010). While film clips were shown in a randomized order, the participants’ breathing (respiratory sinus arrhythmia, RSA), HR and GSR were recorded. After each clip, participants rated their

emotional experience of the film clips. In both conditions, participant's resting state tonic RSA was recorded for two minutes as baseline. RSA, i.e., the rhythmical variation of HR in synchrony with respiration, quantifies the vagal mediation on cardiac output (Porges, 2007). Low RSA is associated with feeling safe and positive mood states. More importantly, resting state tonic RSA is known to reflect individual differences in self-regulation abilities and prosocial traits (Muhtadie et al., 2015).

The findings indeed indicated that there were individual differences in one's vagal mediation (baseline tonic RSA) to the mere presence of others. However, the manipulation of collectiveness did not elicit significant differences, neither in HR, GSR nor in behavioral responses. Instead, emotional content of the clips impacted physiological responses: Fearful films elicited higher HR, while angry films elicited higher GSR. For behavioral self-reports, only empathy ratings showed a main effect of baseline tonic RSA difference. People who showed lower RSA in the social setting empathized more with the protagonists on screen. All behavioral measures, apart from memory clip content, varied significantly according to the type of emotion conveyed by the films. Such results suggest that the physiological and behavioral responses to film watching primarily reflect responses to the content of the film clips, rather than the social context. However, individual differences in self-regulating abilities reflected in one's physiological reaction to sharing a space with other people may influence the way one empathizes with film characters. Further manipulation on group behavior such as active responding (Dunand et al., 1984) and increased interaction between participants (Dikker et al., 2017) could be explored in the future to understand the physiological correlates of the social appreciation of emotional films (Rennung & Göritz, 2016).

Continuing their research on affective processes of film watching (Kostoulas et al., 2015), Muszynski and colleagues (2018) investigated social influences on film watching by testing whether strong aesthetic reactions coincide with higher levels of viewer movement and skin conductance synchrony. Th 13 participants watched 30 films with scenes pre-classified by a group of film experts. The authors compared several group and pairwise indices of synchrony computed from the EDA and motion acceleration data. Using a data-driven approach, the study showed that EDA and motion can classify key moments in the film clipss, but skin conductance

synchrony was found to be a better predictor than movement synchrony among the viewers. In addition, pairwise measures performed more robustly than group measures, irrespective of film genre.

Watching film is known to elicit reliably similar brain activations not only within an individual in repeated trials, but also across people (Hasson et al., 2004; Hasson et al., 2008). Such covarying brain activations (ISCs) are typically computed as pairwise correlations of the individual viewers' BOLD signals, and then averaging the results for the entire group. ISCs increase with stronger arousal, negative emotions, and familiarity with the film stimulus (Hasson et al., 2009; Dmochowski et al., 2012). Hasson et al. (2008) proposed that such shared brain responses among viewers should form the basis of a cognitive neuroscience of film or "neurocinematics". Yet, despite using activity from multiple subjects to study the brain mechanisms of film watching, these studies do not inform about the influence of social context, because participants are always tested individually and not in groups.

Dmochowski et al. (2014) adopted the ISC approach recording EEG from a small group of participants attending to a narrative TV series and TV commercials. Interestingly, neural reliability measures from only 12 participants were more predictive of the results of an online survey from 7000 people than the sample's own ratings. This suggests that shared temporal dynamics at cortical level among a small group of participants may be a better predictor of large population behavior than of their own behavior. This study suggests that collective brain activity among a small group of spectators, can be used to predict popularity of films or commercials in large samples.

Poulsen et al (2017) recorded simultaneous EEG activity from two groups of nine participants watching excerpts from acclaimed short films, while sitting together in a classroom. ISCs during group viewing were compared to the ISCs from a previous study where 12 individuals had watched the same stimuli in isolated, controlled laboratory setting with high-density EEG (Dmochowski et al., 2012). The study reports similar relationships between ISCs and attentional engagement with the short films for both social and non-social data collection. The experiment included an additional control condition where the narrative of the short film was disrupted with

scrambled scenes, which resulted in significantly lower ISCs both within and between viewing groups. Lastly, researchers computed average luminance difference (ALD) of the films and found significant relationships between ISCs and ALD, which were reduced for the scrambled video. Accordingly, similarity of neural responses among viewers can be partially explained by a combination of low-level and engagement with a coherent narrative structure.

Another factor found to impact collective experience reflected in brain-to-brain synchrony is self-reported social dynamics (e.g., rapport, Bevilacqua et al., 2019; Dikker et al., 2017). In real-life, people often visit cinema with their friends, romantic partners or family, and the degree of social closeness can impact the level of collective attention of spectatorship in film watching (Hanich, 2014). Recently, Parkinson and colleagues (2018) studied whether social closeness is associated with how people attend and respond to films using fMRI. The study investigated whether friendship could be predicted by BOLD signal similarities when watching video clips. Brain synchrony was clearly related to social closeness, and was most pronounced in brain areas associated with motivation, emotional processing and learning (e.g., nucleus accumbens, caudate nucleus, putamen and amygdala, Ben-Yakov & Dudai, 2011) as well as language processing, attention, narrative and meaning-making (Mar, 2011) in the parietal lobe. Finally, with a subsection of the collected data, researchers trained a machine learning algorithm to classify social distance based on a dyad's fMRI time series similarity. This classifier reliably predicted friendship status. These findings suggest that social closeness between spectators is an important predictor of the neural correlates of collective film viewing.

As is the case for the role of social influences on dance, theatre and music appreciation, existing studies on film viewing raise more questions than they answer. Yet, measures of brain synchrony emerge as a robust measure of narrative engagement and appear to be modulated by a number social and individual factors such as social facilitation, individual difference in physiological response to the mere presence of others and friendship.

Conclusion

To this date, there are only a handful of studies which have investigated collective aesthetic experiences. The studies reviewed in this chapter reveal a heterogeneous picture of how social settings impact the experience of various forms of art. Importantly, experiencing art together can both enhance and diminish the aesthetic experience of the individual. Pelowski and others (2014) have proposed that encountering other people during art appreciation may be detrimental to one's aesthetic experience, because one's attention enters a competition between self-focused enjoyment and social awareness. On the other hand, merely being involved in a live social especially when in synchrony, can be rewarding (Kokal et al., 2011).

Moreover, many studies of aesthetic appreciation of live performance do not separate social influences from the location in which the artwork is experienced. Films can be watched in the cinema or at home, together or alone. In order to understand the role of social influences on aesthetic appreciation, future studies should aim to carefully disentangle these social and physical components of the live experience.

Recently, Shamay-Tsoory et al. (2019) proposed that interpersonal movement synchrony, emotional contagion and social conformity may be interlinked processes relying on shared brain networks. Hyperscanning paradigms investigating brain patterns among multiple spectators simultaneously in the museum or the theatre provide an exciting new avenue opportunity for research in empirical aesthetics. Other relevant technologies like Virtual Reality can further help overcome the difficulties of studying social dynamics outside the lab (Kourtesis et al., 2020). At the same time theories of aesthetic appreciation have largely focused on the individual and ignored social influences. New theoretical approaches to understanding aesthetic experiences will need to incorporate the inherently social and situated nature of aesthetic experience and art appreciation.

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