

## MEASURING AUDIENCE RESPONSE ON-LINE: AN EVALUATION OF THE PORTABLE AUDIENCE RESPONSE FACILITY (pARF)

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### ABSTRACT

If it is the case that artists and art explore organization of the brain (Zeki & Lamb, 1994), then the investigation of response to artistic performance holds promise as a window to perceptual and cognitive processes. The portable Audience Response Facility (pARF) is an instrument for recording real-time audience response (Stevens et al. in press). Twenty, hand-held, Personal Digital Assistants (PDAs) collect responses on customizable skin interfaces. The pARF server transmits the customizable options, synchronizes devices and collects data for export. In this paper we report ratings of the usability of the pARF that were collected after 37 participants had used it to continuously rate engagement along a single dimension while a female dance artist gave two performances of a short solo contemporary dance work. The motion of the dancer was also captured as she performed the piece but only usability rating data are reported here. Ratings indicate that the cognitive load imposed by continuously rating engagement while watching a dance performance was manageable and the pARF was easy to use.

### 1. INTRODUCTION

Music and dance provide rich settings for the investigation of psychological processes. Perceiving a work of art involves attention, multimodal perception, memory and may elicit emotional responses. These temporal arts challenge those researchers interested in rapid and hidden processes to develop methods that: i) are portable so as to be used in situ in a gallery, theatre or auditorium; ii) are flexible, modifiable and non-intrusive; and iii) capture responses as a live, multimodal performance unfolds in time. In this spirit, and in the context of recording continuous psychological responses from audience members, we developed the portable Audience Response Facility or pARF (pronounced as in singer Edith Piaf). The pARF is a set of hand-held computers commonly known as personal data assistants (PDAs) that have been programmed to record and synchronize one- or two-dimensional ratings from up to 20 audience members as a live or recorded dance, music, theatre, multimedia performance or installation takes place.

#### 1.1 Measuring Audience Response

During the past 20 years, there has been intense research interest in the perception and cognition of music (e.g., Deutsch, 1999; Dowling & Harwood, 1986; Sloboda, 2005) and, more recently, dance (Brown, Martinez & Parsons, 2006; Calvo-Merino et al. 2005). Most often, perception, cognition and emotional responses have been

recorded in a laboratory setting, with individual participants responding to pre-recorded music or dance stimuli. While this approach ensures rigor, it is achieved at the expense of capturing reactions to live performance of a multimodal (i.e., auditory, visual, kinesthetic) artform in the presence of other perceivers or audience members. Now, hand-held computers and wireless technology enable the recording of audience reactions to live performance in naturalistic, group settings. Such techniques provide the means to investigate the validity of results from earlier laboratory-based, unimodal studies where participants were tested individually.

One question regarding audience response concerns the extent to which, for a single performance, audience reactions diverge and converge. As in other perceptual domains, it is of psychological relevance to quantify agreement among respondents, identify the underlying mechanisms, and eventually investigate factors that influence agreement such as observer expertise and stimulus familiarity. It is also beneficial for artists to have the means available, when desired, to compare artistic intention and audience reception (e.g., Weale, 2006).

Another reason for measuring audience reactions is motivated by long-standing discussions of art, perception, and aesthetics. According to Zeki and Lamb (1994), artists in their explorations are unknowingly exploring the organization of the visual brain. In a similar vein, Ramachandran and Hirstein (1999) search for artistic universals and propose eight laws of artistic experience – a set of heuristics that artists are said to consciously or unconsciously use to optimally titillate the visual areas of the brain. Such assumptions about production and perception of art, especially the temporal arts, require methods that can accommodate both change in the stimulus and cumulative responses through time.

Continuous data collection tools (e.g., Ariely, 1998; McAdams, Vines, Viellard, Smith & Reynolds, 2004; Madsen & Frederickson, 1993; Schubert, 1999; West & Biocca, 1996) may supplement more qualitative questionnaire or survey methods that summarize responses and ratings across an entire work. Pen and paper survey and open-ended methods are easy to administer and yield much information, but they are retrospective, rely on observer memory, and do not allow an understanding of moment to moment fluctuations in response that may occur as a performance unfolds. Continuous data can be compared directly with other time series such as an accompanying musical score or soundscape, structural analysis of an artwork, or motion data captured from a dancer (e.g., Stevens et al. 2009). However, continuous response devices used for recording responses to art works are rarely evaluated with respect to participant usability. In the present paper, we describe a

method for measurement of continuous response and report the results of a usability study and focus, in particular, on an evaluation study that was conducted to assess self-reported usability issues.

## 1.2 Continuous Response Measurement and the portable Audience Response Facility (pARF)

To capture reactions from audience members as a performance unfolds and to avoid the unwieldiness of a desktop PC-based system such as EMuJoy (Nagel, Kopiez, Grewe & Altenmüller, 2007), the PDA-based pARF has been designed to record 1- or 2-dimensional data sampled twice per second. PDAs were selected as the data collection device because they are small, programmable, readily available and affordable (Figure 1).



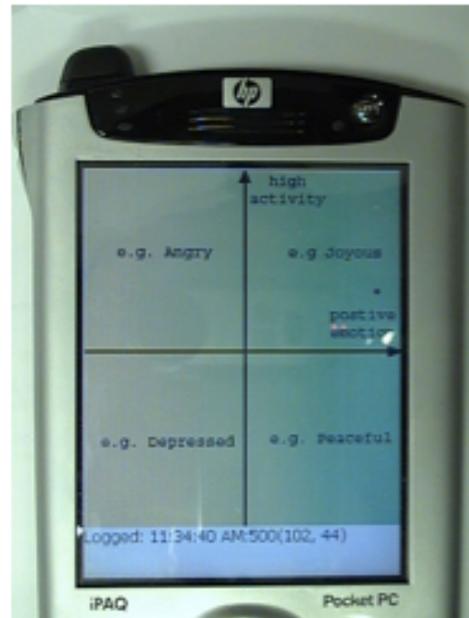
**Figure 1.** An illustration of more than 20 input devices of the PDA-based portable Audience Response Facility (pARF).

We had considered using laptop computers located under each audience member's seat but opted for a system that was more portable, less conspicuous, and where the data could be collated and time-stamped for synchronization purposes. The participant uses a hand held pen-like stylus as input to the PDA (Figure 2) but other devices can be connected in an effort to match the input medium to the variable being measured (e.g., a device with some graded, haptic resistance to measure tension, or the use of a joystick where the return to a central reference position is useful).



**Figure 2.** Participants rate a performance along one- or two-dimensions continuously by moving a stylus along the screen of the pARF.

One-dimensional continuous response measures that can be recorded individually using the pARF include engagement, tension, aesthetic quality, pleasingness, and complexity. In the measurement of emotional response, Nagel, Kopiez, Grewe and Altenmüller (2007) argue for the two-dimensional arousal-valence descriptions of both felt and perceived emotion which has been implemented in their EMuJoy system. This popular two-dimensional description, dating back to Wundt (1874/1905), is the basis of a dimensional model of emotion discussed by many researchers (e.g., Russell, 1980, 2003; Schubert, 2001). The 2D emotion-space ('2DES' Schubert, 1999), for example, represents emotion labels in a two-dimensional, four-quadrant space constructed from the dimensions arousal/activity (low to high) and valence (negative to positive). Such a two-dimensional representation of emotion may be programmed on the pARF (Figure 3).



**Figure 3.** Skin on the pARF displaying arousal and valence dimensions for recording emotional response along two dimensions.

Customisable 'skins' of the pARF allow it to be programmed to record ratings along one- or two-dimensions. Technical specifications of the pARF and results from two studies using the devices can be found in Stevens et al. (in press).

While the pARF has now been used to collect audience response data in a handful of live performance contexts – predominantly while watching contemporary dance – there has been no systematic evaluation of its usability. For example, it is important to ask: is the pARF user-friendly? Is training in its use helpful for the user? How many attentional resources are imposed by using the PDA during a performance? Would audience members prefer to complete a pen and paper questionnaire *after* a performance or use a continuous recording device *during* the performance? These types of questions motivated the design and administration of a simple questionnaire regarding ease of use of the pARF.

## 2. METHOD

### 2.1 Participants

The sample consisted of two groups of observers who formed the audience in two separate experiment sessions. The total sample consisted of 37 observers (36 females, 1 male) with a mean age of 25.38 years ( $SD=8.83$ ). All but two of the observers were trained in and performers of dance with a mean of 13.22 years of training ( $SD=6.31$ ). Twenty-two participants noted contemporary dance as their main form of dance training, seven had a background in classical ballet, while six others noted jazz (2), tap (1), calisthenics (1) and hip hop (2) as the basis of their training. All participants reported normal or corrected-to-normal vision. They each received AU\$20 as reimbursement for their participation time and costs associated with traveling to the studio.

### 2.2 Stimuli

A solo dancer twice performed a ten-minute contemporary dance piece. The dancer wore a black lycra bodysuit onto which were attached a series of small reflective markers. The markers enabled her movement to be captured digitally for subsequent analysis (not reported here).

### 2.3 Equipment and Questionnaire

The pARF consists of 20 hand-held palm pilot (personal digital assistant - PDA) computers. The PDAs record along a horizontal axis the path of a stylus made by the observer. This axis was labelled "Engagement" and defined prior to the experiment. Stylus position measurements from each participant are transmitted to a central computer server twice a second. The central computer stores the data for later analysis.

After each continuous data recording of a performance ended, participants completed a pARF usability questionnaire. This questionnaire consisted of six five-point rating scales regarding: enjoyment using the PDA, PDA ease of use, finding the PDA was a distraction from the performance, ease of rating engagement continuously using the PDA, preference for assigning pen and paper ratings after a performance rather than using the PDA to give ratings continuously during a performance, and the clarity of instructions for using the PDA. For each item, a rating of 1 referred to *Totally Disagree* and a rating of 5 referred to *Totally Agree*.

### 2.4 Procedure

Both sessions were held in the Motion.Lab at Deakin University, Victoria, Australia, September 2, 2008. Participants were provided with an information sheet and then signed a consent form in accordance with the Human Research Ethics Committee at Deakin University. They were given practice in using the pARF to continuously rate engagement by moving the stylus around the screen of the PDA (Figure 2). Engagement was formally defined. Participants then watched the live performance. At the conclusion of the performance and dancer motion recording, participants were asked to rate the usability of the pARF using a set of rating scales. The session

concluded with a general debrief and discussion of the pARF. The session lasted 40 minutes.

## 3. RESULTS

Mean usability ratings for the pARF are shown in Table 1. Ratings indicate that participant evaluation of the pARF was generally favorable. On a five-point scale with 5 referring to *Totally Agree*, the mean ratings concerning ease of use and clarity of instructions were both greater than 4. Ratings of enjoyment tended toward the *Agree* range of the scale. Participants indicated that they would not prefer to use a pen and paper questionnaire to rate engagement *after* a performance compared with using the pARF *during* a performance. Perceived cognitive load imposed by using the pARF during a live performance is reflected in items regarding distraction and ease of use. A mean rating of 3.41 ( $SD=0.86$ ) for the former refers to a mid-range rating of the statement "I found the PDA distracted me from the performance" with a rating of 3 referring to neither disagreeing nor agreeing with the statement. Ease of use received a mean rating of 4.16 ( $SD=0.55$ ) suggesting that, on the whole, audience members found the pARF user-friendly.

**Table 1.** Mean usability ratings for the pARF where the maximum rating of 5 refers to "totally agree", 3 to "neither disagree nor agree" and 1 to "totally disagree". Where  $t=obt$  is greater than  $|1.688|$  then the ratings are significantly different from the midpoint 3, "neither disagree nor agree", [based on  $t-crit(36)=1.688$  at  $p=0.05$ ]. All  $t$ -tests were significant at  $p=0.05$ . Only the question 'I would prefer to use pen and paper to rate engagement after the performance than use the PDA to rate engagement continuously during the performance' was rated as significantly lower than the midpoint of the scale, 3 (hence negative  $t$ -value).

Item	Mean	SD	$t=obt$
I enjoyed using the PDA.	3.65	0.63	6.28
I found the PDA easy to use.	4.16	0.55	12.83
I found using the PDA distracted me from the performance.	3.41	0.87	2.87
It was easy to rate my "engagement" continuously using the PDA.	3.43	0.90	2.91
I would prefer to use pen and paper to rate engagement <i>after</i> the performance than use the PDA to rate engagement continuously <i>during</i> the performance.	2.16	0.93	-5.49
The instructions about using the PDA were clear.	4.49	0.51	17.77

## 4. CONCLUSION

Continuous self-report response to temporally dependent works of art such as music and dance have been gaining

the attention of researchers over the last 15 years or so, with the appearance of several computer controlled interfaces that collect data from an interface that is sampled as the responses to the work unfold. While data collection and analytic techniques have been developed over that time (e.g. Schubert, 2001), little has been done to evaluate the efficacy of the devices from the perspective of the participant making the ratings. This is an important matter because there exists some warranted criticism of the method due to its apparent requirement for high cognitive load. The present study addressed this issue by collecting data on usability of the hand held pARF immediately after it was used to record 'engagement' responses to a dance work. An overall positive evaluation of the device was found. The only negative evaluation reported was the device's interference from the performance. While this result was significantly above the scale midpoint, it was nevertheless the 'least' statistically significant result of the six scales measured. Given the repeated application of *t*-tests for the analytic technique, it is likely that this result might not have been significant if *p* values were adjusted correspondingly. We therefore conclude that the advantages of the new perspective presented by the continuous response device outweigh an inherent problem caused by what appears to be a relatively small effect of cognitive load or attentional resources demanded by the device.

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