<table>
<thead>
<tr>
<th>Title</th>
<th>Viewer versus Film: Exploring Interaction Effects of Immersion and Cognitive Stance on the Heart Rate and Self-Reported Engagement of Viewers of Short Films</th>
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<tr>
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**Background**

An immersive viewing environment compels the viewer to attend more to the film (Slater, 1999). Such immersion is associated with increased emotional experience in the viewer (e.g. Visch et al., 2010; Reeves et al., 1999). Thus, for an emotional film, an immersive experience should arouse more intense emotional engagement than a less immersive environment. Viewers can actively regulate their cognitive engagement with the film (Koriat et al., 1972; Tan, 1995, 2008). For example, viewers can remind themselves it’s not real, or conversely, they can make extra efforts to empathize with the character.

**The Current Study**

**The Aim** was to explore participants’ cognitive engagement with film and how this interacts with the immersiveness of the viewing environment.

**The hypotheses** predicted that:

- A more immersive environment (Lights OFF) will facilitate viewer involvement in a film and hinder detachment.
- A less immersive environment (Lights ON) will have the opposite effect.
- Emotional arousal, appreciation and engagement will be higher when the lights are off, and for the involved group.

It is also unclear how participants might differ in terms of the strategies they employ to achieve the instructed stance under the different conditions.

**Method**

**The Viewers** were 106 participants (41 male, 65 female, age range 18 - 55 years) tested in groups of 3 - 10.

**The Films** were short films selected based on pilot data (viewing sequence was randomised). See Figure 1.

**The Environment**

Low immersion condition (Lights ON) – seating area was illuminated (screen was in darkness).

High immersion condition (Lights OFF) – entire room was in darkness.

**The Instructions**

Participants were given specific verbal instructions to adopt either an involved or detached stance. (Reminders were presented before each film).

**The Measures**

**Physiological Measures**

- HR: Tonic heart-rate change score (bpm) was recorded using a polar Team 2 Pro wireless heart-rate monitor system.
- HRV: Heart-rate variability change score (RMSSD) was used as an index of parasympathetic influences on HR.

**Self-report Measures**

- Emotional Arousal (SAM; P. Lang, 1980).
- Emotional Valence (SAM; P. Lang, 1980).
- Appreciation (Rooney, 2011).
- Engagement (RTC-SCOP; Lessiter, et al., 2001).

**Results**

**Table 1: Summary ANOVA results**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Interaction Effect</th>
<th>HR Change</th>
<th>Emotional Arousal</th>
<th>Emotional Valence</th>
<th>Appreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M (SE)</td>
<td>M (SE)</td>
<td>M (SE)</td>
<td>M (SE)</td>
</tr>
<tr>
<td>Action</td>
<td></td>
<td>4.1 (0.4)</td>
<td>4.6 (0.7)</td>
<td>5.1 (1.2)</td>
<td>4.7 (1.2)</td>
</tr>
<tr>
<td>Drama (Tragedy)</td>
<td></td>
<td>3.7 (0.7)</td>
<td>3.3 (1.0)</td>
<td>2.6 (1.0)</td>
<td>4.0 (1.0)</td>
</tr>
<tr>
<td>Horror (Shades)</td>
<td></td>
<td>2.0 (0.4)</td>
<td>2.0 (1.0)</td>
<td>1.6 (1.0)</td>
<td>2.8 (1.0)</td>
</tr>
<tr>
<td>Drama (Comedy)</td>
<td></td>
<td>3.1 (0.7)</td>
<td>3.1 (1.0)</td>
<td>2.6 (1.0)</td>
<td>5.6 (1.0)</td>
</tr>
</tbody>
</table>

Note: HR change reported in bpm. Emotional arousal, emotional valence, and appreciation reported on a scale from 1 to 7.

Participants demonstrated a significantly bigger drop in HR (from baseline) when viewing the films with the Lights OFF (-3.77) than when viewing with the Lights ON (-2.10). Lights OFF participants also reported significantly higher engagement and appreciation.

The involved groups were significantly higher than the detached groups for self-reported emotional arousal and engagement. But HR was not in appreciation.

**The Interaction Effects**

No significant 3-way interaction effects were observed for any dependent variables.

A significant interaction effect between Instructions and Environment was observed on participants’ HRV. This analysis revealed no significant simple effects. However, the disordinal interaction can be explored by looking to the means in Figure 2.

**Figure 2: Plotted means for interaction effect between Instructions and Environment on HRV**

**Discussion**

Self-report measures of emotional arousal and engagement were higher for participants...

...who viewed the films in a more immersive environment...

...who were instructed to take an involved stance

HR dropped (from baseline) for all conditions. This was previously identified as the allocation of cognitive resources towards the viewed film (A. Lang, 1990, 1994).

Drop in HR was significantly higher for participants viewing films with the Lights OFF, suggesting that the more immersive environment facilitates increased attention to the films.

HRV (RMSSD) represents the parasympathetic influence on HR (Task Force, 1996; Ravaja, 2004), which has previously been associated with emotion regulation (Appelhans & Luecken, 2006; Thayer & Lane, 2000) and executive function (Wood et al., 2002; Pagani, et al., 1991). In light of previous research (Luff, et al., 2009; Porges & Raskin, 1969; Redondo, & Del Valle-Inclán, 2009), findings from the current study suggest that HRV is negatively associated with cognitive effort in media viewing.

**HRV Cog. Stance Environment Cog. Effort**

<table>
<thead>
<tr>
<th>Lowest</th>
<th>Detached</th>
<th>High Immersion</th>
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</thead>
<tbody>
<tr>
<td>Lower</td>
<td>Involved</td>
<td>Low Immersion</td>
</tr>
<tr>
<td>Higher</td>
<td>Involved</td>
<td>High Immersion</td>
</tr>
<tr>
<td>Deter</td>
<td>Low Immersion</td>
<td></td>
</tr>
</tbody>
</table>

The findings from this study demonstrate that the film environment can facilitate engagement with film.

Yet, importantly, viewers cognitively adjust their mental resources to the environment so as to maximise engagement.

Future research will explore the impact of such cognitive resource allocation on other film-viewing cognitive functions such as mind-reading or spatial imagination. Finally, the current study provides evidence that HRV and RMSSD in particular, can serve as a measure of such cognitive engagement while viewing film.