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ORIGINAL RESEARCH

Using the Perceptual Experience Laboratory (PEL) to simulate tourism environments for hedonic wellbeing

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Abstract
Measuring the relationship between stress, mood and tourism in natural settings is problematic in terms of the ability to undertake detailed, systematic and accurate monitoring. This paper presents the results of a preliminary investigation into the use of an immersive simulated tourism environment to measure tourisms' potential to alleviate physiological and psychological stress and enhance mood. The objectives of the study were to record and analyse participants' heart-rate data before, during and after three experiences (workplace setting, TV-watching setting and simulated tourism setting) and to undertake completion of mood questionnaires before and after each of these three experiences, allowing comparative pre- and post-mood analysis. Qualitative data was also gathered from the participants about these three experiences, in particular the simulated tourism environment. The preliminary results demonstrate that PEL effectively creates a simulated tourism environment which can be used for measuring stress and mood as signifiers of hedonic wellbeing.

Keywords Tourism experiences · Stress · Mood · Physiological measurement · Simulation

1 Introduction

Tourism has long been associated with health and wellbeing, as rural and coastal environments provide space for emotional release and medicinal bathing (Bell et al. 2015; Connell 2006; Walton 2000). Proponents argue that tourism can be a force for

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change, with genuine benefits for individuals (Reisinger 2013), as holidays provide opportunities for rest and leisure, which may also enhance intercultural and social interaction, self-esteem, skills and personal development (Dolnicar et al. 2013; Mannell and Iso-Ahola 1987; Moscardo 2009; Willis 2015). Consequently, interest in tourism and wellbeing has increased; fuelled by work-leisure conflict (Bevan et al. 2018; Cooper 2009; Lin et al. 2013), materialistic and over-individualistic societies (Konu and Laukkanen 2010) and recognition that individual health and wellbeing can be a better measure of social progress than economic measures alone (Breslow et al. 2016; Higgins-Desboilles 2006; Uysal et al. 2016). However, whilst it is accepted that holidays are good, little is known about why they are good (McCabe et al. 2012) and measuring the relationship between stress, mood and tourism in natural settings is problematic in terms of the ability to undertake detailed, systematic and accurate monitoring. This is a consequence of the characteristics of real tourism experiences, as any monitoring attempts in a natural setting would create inconvenience to individuals and intrusion, as well as high costs in recording physiological and psychological responses. In addition, natural settings are susceptible to uncontrollable elements. Methodological complexities and the limitations of traditional methods, such as questionnaires issued at the end of a tourism experience are well-documented (Shoval and Isaacson 2007; Shoval et al. 2018a) and there are calls for a shift towards methodological tools with sensor technology to measure tourism experiences (Shoval and Birenboim 2019).

This paper presents the results of a preliminary investigation, using a simulated tourism environment within the Perceptual Experience Laboratory (PEL), compared to a workplace setting and a TV-watching setting. The PEL was used, for the first time, to simulate an immersive tourism environment with greater levels of realism than has previously been attempted (e.g. Heilig 1961). Hence, respondents were immersed in a tourism environment and interacted with the simulation from within the experience (Slater et al. 2009). It was not the intention of this investigation to demonstrate precisely *how* tourism can alleviate physiological and psychological stress and to enhance mood when compared to workplace and TV experiences, but *how* the Perceptual Experience Laboratory (PEL) can be used as a methodological tool to simulate tourism environments which can then be used to measure tourisms' potential to alleviate physiological and psychological stress and enhance mood. The preliminary results demonstrate that PEL successfully creates a simulated tourism scene which can be used for measuring stress and mood as signifiers of hedonic wellbeing.

2 Literature review

A wealth of evidence attests tourism's contribution to hedonic wellbeing (Bell et al. 2015; Chen and Petrick 2013; Connell 2006; Dolnicar et al. 2012; Kelly 2018; Lin et al. 2013; Mannell and Iso-Ahola 1987; Morgan et al. 2015; Neal et al. 2007; Page et al. 2017; Pesonen and Komppula 2010; Willis 2015); whilst, some studies have considered how tourism experiences contribute to employee stress recovery and life satisfaction (Chen et al. 2014; Smith and Diekmann 2017). Studies in occupational health (e.g. De Bloom et al. 2009; Kuhnel and Sonnentag 2011) have considered the impacts of tourism on health and wellbeing pre and post-trip and there is some work on stress in tourism and hospitality employment (e.g. Faulkner and Patiar 1997; MacKenzie and Kerr 2013; O'Neill and Davis 2011). However, Nawijn and Filep (2016) warn of overestimating the benefits of tourism experiences; as individual wellbeing can differ pre, during and post-tourism experience (Corvo 2011; Kirillova and Lehto 2015; Nawijn 2011; Nawijn et al. 2013; Smith and Diekmann 2017). Thus, although research has documented the psychological benefits of tourism and proposed a link between tourism, stress and mood, apart from some notable exceptions (Marchiori et al. 2018; Shoval et al. 2018a, b; Toda et al. 2004) it has not measured the physiological benefits of tourism. Indeed, the physiological impact of tourism has received limited consideration, partly due to the practical difficulties of measuring effects in situ.

The cardiovascular system is understood to be one of the most vulnerable systems to stress, with an amplified resting heart rate recognised as an indicator of increased stress (De Vente et al. 2003; Pieper et al. 2007; Steptoe 2000). An increased heart rate during stress is due to processes in two distinct areas of the autonomic nervous system (ANS) being altered, creating a hormone imbalance. This comprises of epinephrine and norepinephrine being secreted into the cardiovascular system due to the stimulation of the sympathetic nervous system (SNS) whilst the parasympathetic nervous system (PSN) remains inactive (Akselrod et al. 1981). As a consequence, the cardiovascular system experiences increased blood pressure due to vasoconstriction and changes in heart rate (HR) and heart rate variability (HRV). During less stressful periods, such as sleep, the PSN is increasingly stimulated which stops the production of the hormone cortisol, creating a balance with the SNS and reducing HR (De Vente et al. 2003). The examination of resting HR and HRV data has shown correlations between both types (Hart 2013), with HRV data widely used in contemporary mental stress research as the interaction between the SNS and PSN on the rhythm of the heart during normal regulatory impulses provides a complete measurement towards acute and chronic stress (Schubert et al., 2009; Xhyheri et al. 2012). Some previous tourism studies have used heart rate data in order to gather data on objective physiological measures of emotional arousal amongst tourists (Shoval et al. 2018b) and to assess reactions to a tourism-related virtual reality setting (Marchiori et al. 2018). However, accompanying tourists to undertake such research could cause significant intrusion and incur significant financial costs. Herein lies the research problem, as exploring the relationship between stress and tourism experiences in natural settings is problematic, as the circumstances do not allow for measuring the physiological benefits and the relationship between stress, mood and tourism.

Gray (2002) and Patton (2014) discuss the use of simulated task environments as a way that researchers can study participant behaviour appropriate to their research question without the costs and complexities of the natural world. These simulations range from high-fidelity real environment substitutes to simple laboratory environments, allowing exploration of task performance with greater experimental control. Robbins et al. (2019) also consider how simulated environments can be repeated in a trial by trial format, as an efficient way of measuring behaviour. Furthermore, Patton

(2014) refers to presence within immersive simulated environments, in terms of how an individual responds to the environment and the extent to which they feel part of that environment. Ultimately, 'greater realism produces a greater sense of presence' (Patton 2014, p. 245). Authors such as Guttentag (2010) and Tussyadiah et al. (2018) assert the importance of technological developments such as Virtual Reality (VR) for both tourism demand and supply. Likewise, the concept of presence is of importance with VR environments as the user receives a realistic representation of a particular environment. However, VR technologies require tethered or untethered headsets to be worn and whilst these are simpler to use and more mobile than previous simulators, e.g.: Sensorama (Heilig 1961), for some people, headsets might be invasive and may impinge on their level of multisensory immersion (Martins et al. 2017).

This paper, attempts to address the methodological difficulties of measuring the physiological benefits of tourism environments and the relationship between stress, mood and tourism by using three settings: workplace experience (as a datum), TV-watching experience and simulated tourism experience to investigate how the Perceptual Experience Laboratory (PEL) can be used as a methodological tool to simulate tourism environments which can then be used to measure tourisms' potential to alleviate physiological and psychological stress and enhance mood. Participant heart-rates (HR) established stress levels between the three experiences and the Incredibly Short Profile of Mood States (ISPOMS) (Dean et al. 1990) was used to assess mood within and between each experience. A qualitative approach after each of the three experiences enabled participants to provide an account of their sensory experiences (Iarocci and McDonald 2006). Therefore, the physiological responses of participants were analysed as well as their subjective sense of presence.

3 Research methods

3.1 Perceptual Experience Lab (PEL)

The Perceptual Experience Lab (PEL) is a low-cost, state-of-the-art synthetic reality space that replicates the way humans perceive and experience the physical world by immersing users in directional sound, smell, airflow, temperature and full field of view vision. Two School of Art and Design research groups at Cardiff Metropolitan University (Wales, UK), FovoLab and User Centred Design Research developed the PEL facility, a unique mixed-reality user-testing environment that can be configured to accurately represent virtually any space in terms of sight, sound, smell, temperature and air movement. The in-house facility can be set-up in 30 min with bespoke content and comprises a 2.5 m-tall, high-resolution cylindrical rear projection screen wrapped 200° around participants. Cylindrical media is back-projected onto the screen technology using six mapped projectors utilising Epson 3LCD technology for exceptional sharpness, clarity and detail in this high fidelity environment. Smell, environment temperature, three-dimensional sound, air movement, digital projection, physical objects and actors emulate environments realistically at a multi-sensory level, while body movements, eye movements, heartbeat variability and galvanic skin responses are monitored via state-of-the-art user observation systems. PEL can simulate virtually any environment in laboratory conditions, which extends previous systems (Agapito et al. 2013; Heilig 1961). Unlike VR technologies, participants do not have to 'learn' how to use the PEL and are not required to use headsets, so there are methodological advantages of using the PEL. The PEL facility allowed the projection of high-resolution media onto a 200° wrap-around screen, supplemented by multisensory props, e.g.: 3D sound, smell, temperature and air movement, to provide an immersive simulation (Fig. 1). Such multisensory cues facilitate high presence levels in simulated environments (Martins et al. 2017).

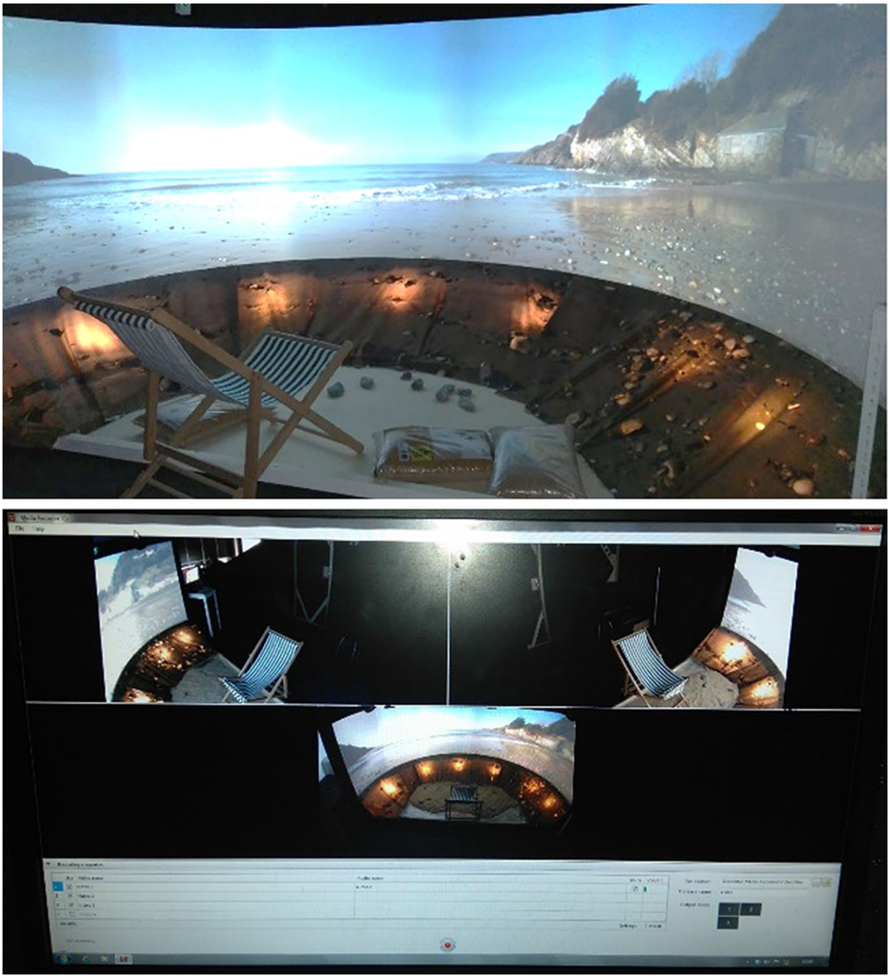


Fig. 1 The images show the 200° PEL screen which displays media through back projection. The participant area is also staged in relation to the media

3.2 Media production and PEL staging

Whilst much research on natural tourism environments and wellbeing has focused on 'green' spaces; less attention has been given to 'blue spaces', i.e.: coastal environments (Bell et al. 2015; Kelly 2018), despite the historical association between tourism, wellbeing and the coast (Connell 2006; Smith and Diekmann 2017; Walton 2000). The research team selected one simulated tourism environment of a coastal destination for this preliminary study into how the PEL could be used as a methodological tool to simulate a tourism environment. Consequently, the media film created for the PEL and TV experiences was of a Blue Flag beach (Caswell Bay) in Southwest Wales, UK, using a wide-angle lens, so that media would match the lateral field of view of the PEL screen. A five-minute film with audio was used as the PEL and TV media. The viewing area in the PEL was staged to promote a convincing immersive environment for participants. This involved props, which comprised a printed beach skirting, sand pit, beach stones and a deck chair. The research team acknowledges Zillmann's (1988) work on mood management in that selecting specific messages for consumption will regulate mood and that only one simulated environment was used, but given the exploratory nature of the research, it was felt to be justified. Fans produced a wind effect and seaweed was located out of vision to give an associated beach smell (Fig. 2), as Martins et al. (2017) identified that the inclusion of realistic smells increased the sense of presence in simulated environments.

Fig. 2 The image shows the development of the beach simulation in PEL. A back-lit printed fabric is used to extend the beach from the screen to the sand pit. Play sand and beach stones are added along with a deck chair for participants

3.3 Participants and experimental protocol

In total, 30 participants (25 female and 5 male) were drawn from the University using convenience sampling. Eligibility for inclusion was 18 years or over and an employee of the University. The participants comprised student support staff, administration and academic staff from the School of Art and Design and School of Management. None of the University employees had any prior contact or involvement with the PEL facility. The research team acknowledges the limitations of convenience sampling, specifically the gender imbalance and the use of University staff. However, given the nature of the research design, using on-campus staff who had agreed to participate was a pragmatic way of ensuring the research was completed within the project timeframe, as whilst the sample was convenient, it was the most appropriate sample to use for two reasons. Firstly, University staff were familiar with the University campus and surrounding environment; using non-University staff could have introduced other variables, e.g. travelling, parking and unfamiliar environments, which may have had an effect on stress and mood measurements. Secondly, the research design required each participant to complete three different settings over three separate workday sessions. This was a considerable time commitment which needed the convenience of participants on campus, rather than expecting non-campus based participants to make three separate journeys. Hence, there were logistical and acclimatization reasons for drawing a convenience sample from University staff.

The School of Art and Design's Research Ethics Committee granted ethics approval. All participants gave their informed consent prior to their inclusion in the study and received a £5 Amazon voucher as a token of appreciation. Participants were assigned a number, so that their identities were anonymised. The experimental protocol of this study involved each participant being introduced and welcomed to the three different settings (experiences). Each participant was required to complete each of the three experiences, so all 30 participants were individually exposed to all three experiences, workplace, TV watching and PEL. Participants were informed of their right to cease participation at any time and given the opportunity to ask questions.

This research used a repeated-measures design, in which the participants are not split up into groups but are kept as 'one' group and are tested repeatedly in all of the conditions. Each participants' score in one setting was then compared with their own score in the other settings and these differences within the group were analysed for statistical significance (Richardson et al. 2011). Repeated-measures designs involve fewer participants, in the region of 10–20 participants per group and are more likely to detect any differences between conditions (Field and Hole 2003). Therefore, our sample of 30 participants was deemed a sufficient number.

3.4 Procedure

Data collection was conducted one participant at a time. Participants' involvement in the study consisted of making themselves available for three separate weekday sessions between 12 and 4 pm with all participants seated during each session to reduce the effect of variation in respiration rates (Allen et al. 2007). The sessions took place in three different locations each with a different experience. These three experiences (Fig. 3) comprised of: (a) the participant's normal workplace environment, (b) a meeting room with a flat screen TV and (c) the simulated beach experience in the PEL. To ensure a robust and unbiased experimental design, although the sequence of the three experiences was different for each participant, there was a measured and controlled setting for each experience, e.g., all participants sat in the same chair to watch TV and in the same deckchair

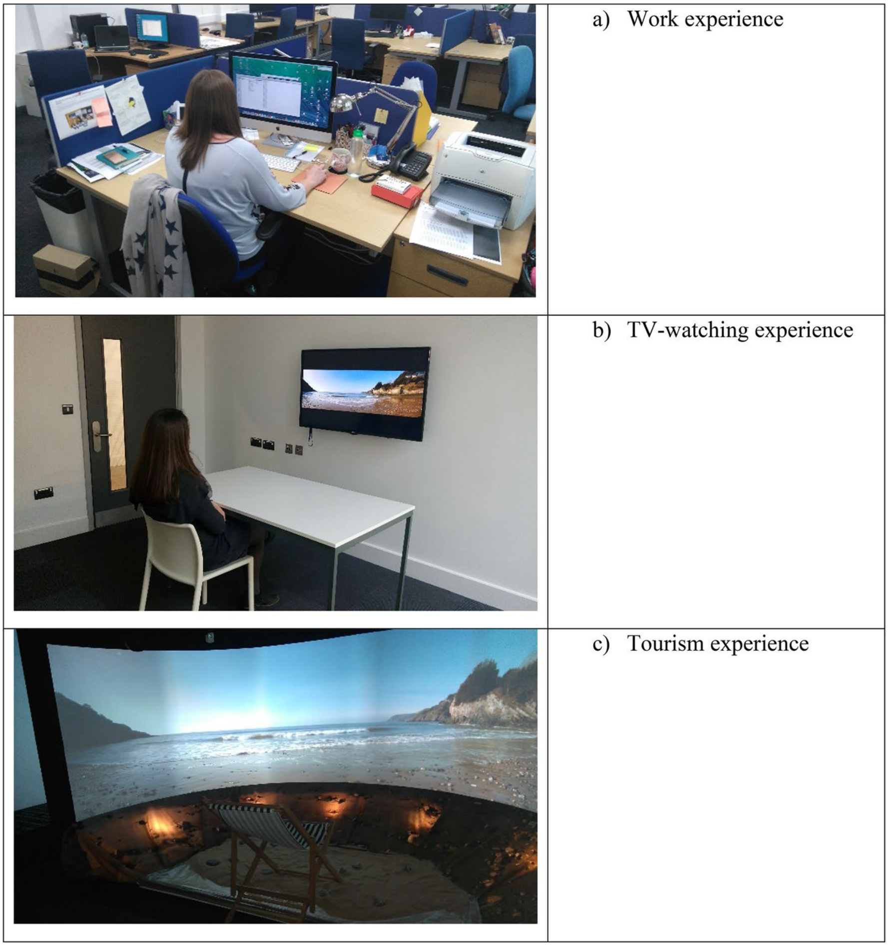


Fig. 3 Shows the three different experiences that participants encounter during the study

for the PEL experience. Only the workplace setting varied between participants, as each participant was located in a different office space. However, participants were measured in their normal working space, so they were all familiar with the setting. The team acknowledge that in any psychophysical experiment, respondents may respond differently on different days; however, this is often due to external factors; thus, the settings for the three experiences were controlled as much as possible. The first two experiences (workplace and TV-watching) were field experiments, designed to contribute to understanding the value of PEL as a lab experiment to measure the physiological benefits of tourism environments, given the inherent difficulties of measuring these in the field.

The study also examined individual's measured changes in mood, within and between each experience, using the Incredibly Short POMS (ISP) established by Dean et al. (1990), due to its quick completion time of less than one minute. The ISP comprises of one question for each of the six original mood factors and the ratings are summed to yield a total mood disturbance score before and after each experience, allowing comparative pre and post-mood analysis. In relation to the risk of respondents responding differently on different days, again, the team acknowledges this, as although different message types affect diverse moods in diverse ways, 'the effect of a particular message type on a particular mood is consistent' (Zillmann 1988, p. 240). One-way repeated measure ANOVAs were employed to determine the effectiveness of these design elements and their mood capabilities during user interaction.

For this study a Mio Alpha 2 watch was used to collect heart-rate (HR) data. There were a number of motives behind using a watch with a HR senor to collect data instead of traditional physiological apparatus, such as: familiarity with wearing a watch, the removal of setup invasiveness and the speed at which participants could be prepared to take part in each condition. However, one acknowledged limitation with current HR watches is that software applications only provide mean HR data and not HRV measurements. Thus, at the start of each experience, participants wore a heart-rate watch, connected to a smartphone to record heart-rate data before, during and after the session. Participants refrained from consuming caffeine prior to heart-rate measurements for each of the three experiences. The HR data recorded before and after each experience was collected whilst participants completed the before and after ISP questionnaire. The research team decided to collect pre and post-HR data whilst participants were completing the pre and post-ISP questionnaires consistently across all participants and all sessions. Pragmatically, this was the best way to gather both sets of data in a limited timeframe with participants. The team accepts that completing the pre and post-mood questionnaires might have had an impact on HR variability but to have separated out these procedures would have extended the time required of participants. HR data was collected during each of the three experiences, which involved participants either: (a) continuing in their workplace, (b) watching the beach scene on a TV or (c) experiencing the beach simulation within the PEL. The experience for each participant was fixed at five minutes, after which the experience ended. The team acknowledge that five minutes exposure is shorter than the time participants would normally work, watch TV or be in a tourism setting, however, the team was aware of the overall time commitment from the participants across all three experiences and the implications of staff non-availability on the research design, so five minutes exposure was agreed as a suitable timeframe in accordance with other similar experimental studies (e.g.: Cantoni et al. 2017). The research team also accept that there is no theoretical reason why the University staff's heart-rate should react differently to these stimuli and that people who do more physical work would have an even greater effect, so this was a conservative sample, for which more subtle effects were expected.

For the workplace experience, all participants carried out their normal workplace activities without the researcher present. Workplace activities comprised of reading and replying to emails, preparing academic topics, administration tasks and discussing matters on the phone or directly with people present in the participants' office. Participant offices were the only variant in terms of the settings, but it was a familiar space. After five minutes, the researcher re-entered the workplace environment and saved the HR data using a participant/session code. This data provided a datum against which to measure the other studies.

For the TV experience, all participants were individually seated in front of a wall-mounted flat-screen TV in a meeting room. Participants watched a recording of a beach scene with the sound of waves rolling into shore for five minutes. The rationale for exposing participants to a recording of a beach scene, rather than selecting a TV programme (or indeed an alternative activity, e.g. reading a book/magazine), was because it provided a control for PEL, given that TV is a conventional way to view images and sounds. Participants watched the same beach scene (content) on the TV as they did in the PEL; thus, it was a fairer test of the PEL as an immersive, simulated environment within which to measure tourisms' potential to alleviate physiological and psychological stress and enhance mood. The researcher left the room once viewing had started and after five minutes, re-entered the room and saved the HR data using a participant/session code.

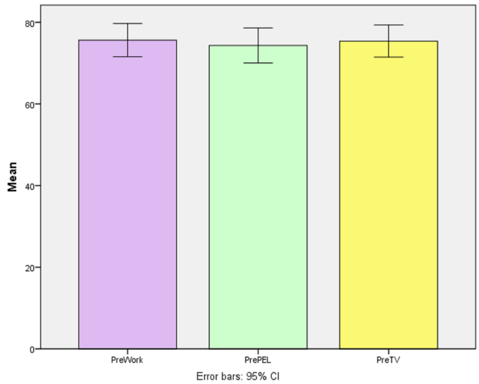
For the PEL experience, participants were individually seated on a deckchair positioned in the sand, in the simulated environment space. Participants watched a recording of a beach scene with the sound of waves rolling into shore, together with the smell of seaweed and wind blowing for five minutes. They were invited to remove their footwear to experience the sand underneath the deckchair. After five minutes, the researcher re-entered the room and saved the HR data using a participant/session code. At the end of each of the three experiences, participants provided qualitative feedback on each experience providing additional insight into the use of the PEL to simulate a tourism environment for measuring stress and mood as signifiers of hedonic wellbeing.

4 Results

4.1 Stress measurement results for the workplace, TV and tourism experiences

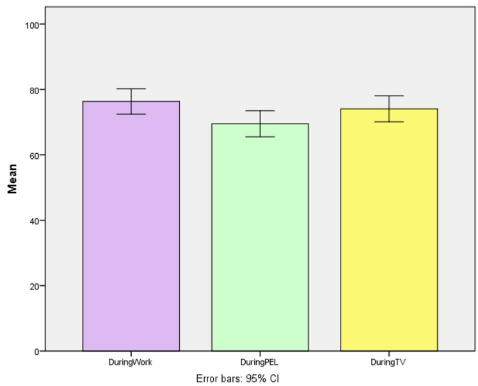
The analysis employed for HR data was a one-way within-subjects ANOVA design with Bonferroni post-hoc tests. The within-subjects factor, the type of experience, had three levels: Workplace, TV and PEL. The dependent variable was the mean

Pre-experience mean HR bar chart



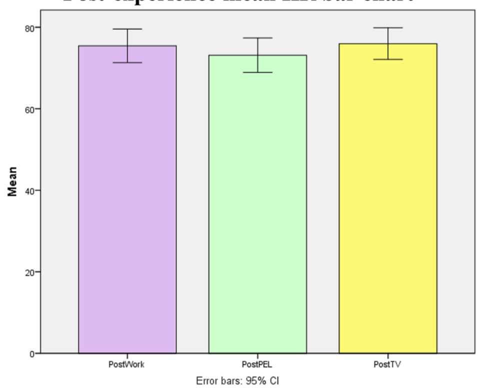
(a) A Bar chart showing participants mean HR (BPM) before commencing the Workplace, PEL and TV experiences.

During experience mean HR bar chart



(b) A Bar chart showing participants mean HR (BPM) during Workplace, PEL and TV experiences.

Post-experience mean HR bar chart



(c) A Bar chart showing participants mean HR (BPM) after the Workplace, PEL and TV experiences.

TABLE 1. Compares the before, during and after mean HR between each experience

Fig. 4 Compares the before, during and after mean HR between each experience

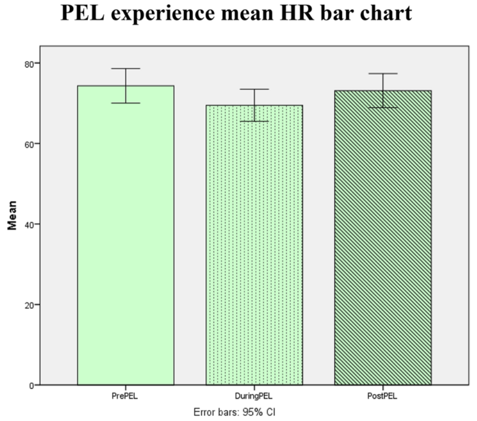
HR (beats per minute—BPM) collected before, during and after each experience. Figure 4 compares the before, during and after mean HR between each experience. Firstly, the participants' pre-experience HRs were compared between the three settings. This analysis ensured that the participants' journey between the workplace, TV and PEL experiences, along with researcher interaction had no impact on HR levels.

The pre-experience mean HR bar chart (Fig. 4a) shows the participants' mean HR data before each experience. The mean heart-rate data for the three experiences were: (1) Pre-Work 75.63 bpm, (2) Pre-PEL 74.33 bpm, (3) Pre-TV 75.40 bpm. The results from the one-way within-subject ANOVA showed no significant effect between the mean HR within experiences: F (2, 58) = 0.650, $p \geq 0.05$, partial $n^2 = 0.02$. The during experience HR bar chart (Fig. 4b) shows the participants' mean HR data during each experience. The mean HR data for the three experiences were: (1) During-Work 76.33 bpm, (2) During-PEL 69.50 bpm, (3) During-TV 74.07 bpm.

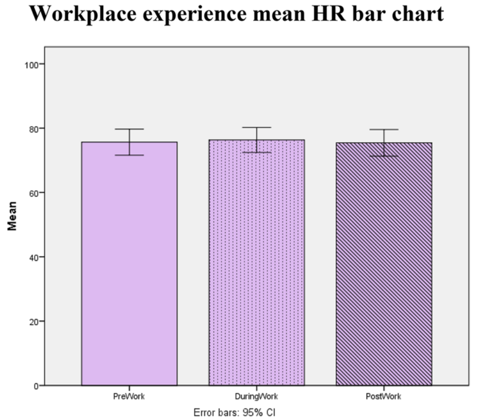
The results from the one-way within-subject's ANOVA showed a significant effect between the mean HR within experiences: F (2, 58) = 17.178, $p < 0.05$, partial $n^2 = 0.37$. A post-hoc test (Bonferroni) showed that there was a significant difference between the Workplace and PEL experiences ($p = 0.001$) and between the PEL and TV experiences ($p = 0.002$). However, there was no significant effect found ($p = 0.138$) between the workplace and TV experiences. The post-experience mean HR bar chart (Fig. 4c) shows the participants' mean HR data after each experience. The mean HR data for the three experiences were: (1) Post-Work 75.43 bpm, (2) Post-PEL 73.13 bpm, (3) Post-TV 75.97 bpm. The results from the one-way within-subject ANOVA showed no significant effect between the mean HR within experiences: F (2, 58) = 2.108, $p > 0.05$, partial $n^2 = 0.07$.

The mean HR bar chart for the PEL experience (Fig. 5a) shows the participants' mean HR data for the pre-, during and post periods of the PEL experience. The mean HR data for the three periods were: (1) Pre-PEL 74.33 bpm, (2) During-PEL 69.50 bpm, (3) Post-PEL 73.13 bpm. The results from the one-way within-subject ANOVA showed a significant effect between the mean HR periods within the PEL experience: F (2, 58) = 13.869, $p < 0.05$, partial $n^2 = 0.32$. A post-hoc test (Bonferroni) showed that there was a significant difference between the pre and during periods of the PEL experience ($p = 0.001$) as well as the during and post periods ($p = 0.003$). However, there was no significant effect found between the pre and post periods of the PEL experience ($p = 0.875$).

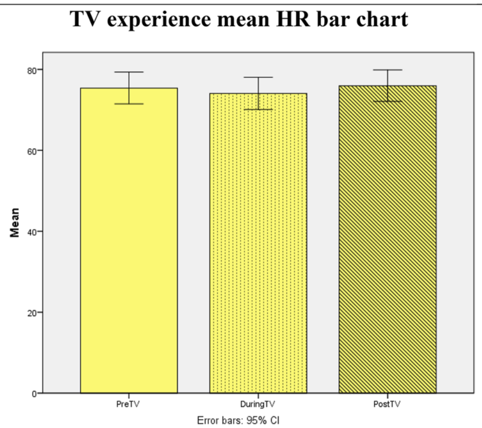
The mean HR bar chart for the workplace experience (Fig. 5b) shows the participants' mean HR data for the pre, during and post periods of the workplace experience. The mean HR data for the three periods were: (1) Pre-Work 75.63 bpm, (2) During-Work 76.33 bpm, (3) Post-Work 75.43 bpm. The results from the one-way within-subject ANOVA showed no significant effect between the mean HR periods within the Workplace experience: F (2, 58) = 0.734, $p > 0.05$, partial $n^2 = 0.03$. The mean HR bar chart for the TV experience (Fig. 5c) shows the participants' mean HR data for the pre-, during and post periods of the TV experience. The mean HR data for the three periods were: (1) Pre-TV 75.40 bpm, (2) During-TV 74.07 bpm, (3) Post-TV 75.97 bpm. The results from the one-way within-subject ANOVA showed



(a) A Bar chart showing participants mean HR (BPM) data for the Pre, During and Post periods of the PEL experience.



(b) A Bar chart showing participants mean HR (BPM) data for the Pre, During and Post periods of the Workplace experience.



(c) A Bar chart showing participants mean HR (BPM) data for the Pre, During and Post periods of the TV experience.

TABLE 2. Compares the before, during and after mean HR within each experience

Fig. 5 Compares the before, during and after mean HR within each experience a significant effect between the mean HR periods within the TV experience: F (2, 58) = 4.828, $p < 0.05$, partial $n^2 = 0.14$. A post-hoc test (Bonferroni) showed that there was no significant difference between the pre- and during periods of the TV experience ($p = 0.073$) and the pre- and post-periods ($p = 1$). However, there was a significant effect found between the during and post-periods of the TV experience ($p = 0.012$).

4.2 Mood measurement results for the workplace, TV and tourism experiences

Firstly, pre- and post-mood state ratings (Likert scale from *0* [*not at all*] to *4* [*extremely*]) were summed to yield a total mood disturbance score, before and after each experience. Due to the nature of this data, a Friedman test was applied to establish if the scores varied significantly. Figure 6 compares the pre and post-mood state between and within each experience. The Pre-Mood bar chart (Fig. 6a) shows the participants' mean mood score before starting the Workplace, PEL and TV experiences. The mean Pre-Moods for the three experiences were: (1) Pre-Work Mood 2.25, (2) Pre-PEL Mood 1.88, (3) Pre-TV Mood 1.87. A Friedman Test showed that participants mean Pre-Mood score did not vary significantly across the three experiences: χ^2 (2, n = 30) = 3.380, p > 0.05.

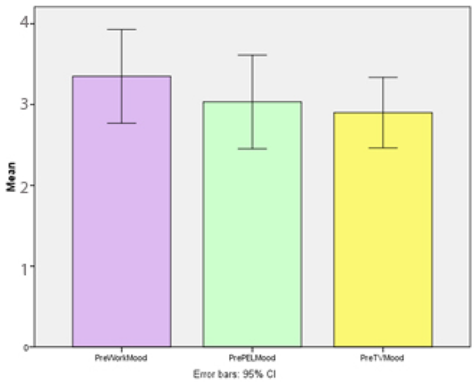
The Post-Mood bar chart (Fig. 6b) shows the participants' mean mood score after the Workplace, PEL and TV experiences. The mean Post-Mood for the three experiences were: (1) Post-Work Mood 2.53, (2) Post-PEL Mood 1.68, (3) Post-TV Mood 1.78. A Friedman Test revealed that participants mean Post-Mood score varied significantly across the three experiences: χ^2 (2, n = 30) = 16.187, p < 0.05.

Wilcoxon matched-pairs tests were used to follow-up the Friedman analysis. The results showed a significant difference between the participants' mean Post-PEL Mood and Post-Work Mood (z = 3.762, N-Ties = 22, $p = 0.001$, one-tailed) and the Post-TV Mood and Post-Work Mood (z = 3.347, N-Ties = 24, $p = 0.001$, one-tailed). However, no significant difference was found between the mean Post-TV Mood and Post-PEL Mood (z = 0.616, N-Ties = 23, $p = 0.269$, one-tailed).

The Pre- and Post-Mood bar chart (Fig. 6c) shows the participants' mean mood scores before and after the Workplace, PEL and TV experiences. Wilcoxon matched-pairs tests were carried out between Pre- and Post-mean moods within corresponding experiences. The results showed a significant difference between the Pre and Post mean moods for the PEL experience (z = 4.038, N-Ties = 28, $p = 0.001$, one-tailed, r = − 0.52) and the TV experience (z = 2.842, N-Ties = 22, $p = 0.002$, one-tailed, r = − 0.37). No significant effect was found between the Pre and Post mean moods of the Workplace experience (z = 0.058, N-Ties = 15, $p = 0.47$, one-tailed, r = − 0.07). The effect size was calculated for each Wilcoxon matched-pairs test using the equation: $r = Z/\sqrt{N}$ (Rosenthal 1991, p.19). As per Cohen (1988), the workplace produced a very small effect size, the TV experience produced a small effect size and the PEL experience produced a medium effect size.

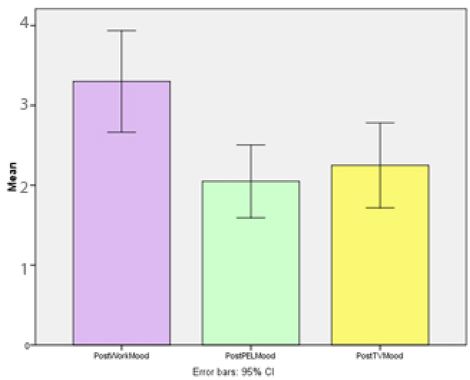
In addition to the quantitative data, participants provided qualitative feedback on each experience to provide a more in-depth exploration of individual sensory experiences and additional insight into the use of PEL to simulate a tourism

Pre-Mood bar chart



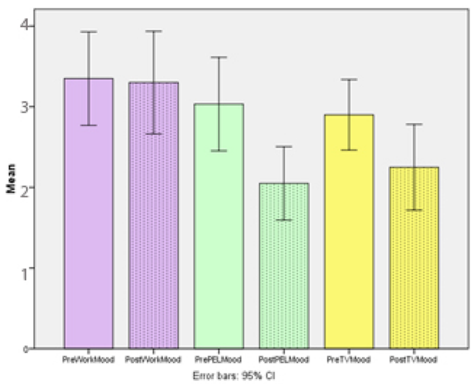
(a) A Bar chart showing participants mean mood score before commencing the Workplace, PEL and TV experiences.

Post-Mood bar chart



(b) A Bar chart showing participants mean mood score after the Workplace, PEL and TV experiences.

Pre & Post-Mood bar chart



(c) A Bar chart showing participants' mean mood score before and after the Workplace, PEL and TV experiences.

TABLE 3. Compares the pre and post mood state between and within each experience

Fig. 6 Compares the pre and post mood state between and within each experience environment for measuring stress and mood as signifiers of hedonic wellbeing. In particular, participants were asked about the effect each experience had on their mood and the extent to which they had enjoyed each experience.

The PEL and TV experience results both showed positive benefits in relation to the mood of participants. The TV experience, brought about increased feelings of relaxation and calming behaviour, as evidenced by the comment that the experience ‘relaxed my mood; felt sleepy at the end of it; really enjoyed watching the sea and looking at the landscape’ (Participant 18). However, the immersive, simulated experience in the PEL enhanced the TV experience and illustrated the importance of multisensory cues in simulated environments, as it also improved participants’ holistic connection to the tourism experience through immersion and enjoyment, as illustrated by the following comments:

‘My mood became really relaxed and I felt like I was at the beach, the breeze was especially effective as it felt like I was sat on the beach watching the waves’ (Participant 1).

‘I felt much more relaxed in this environment, the smell, sound and breeze felt almost real’ (Participant 21).

‘The whole setting in PEL took my thoughts away from workplace tasks and allowed me to enjoy the experience and feel relaxed and calm. This setting was more realistic to gauge my mood in comparison to sitting in-front of the screen in the earlier test’ (Participant 25).

In comparison, the workplace experience generated a lesser amount of relaxation and calming behaviour. This finding was anticipated, as going to work is the opposite of going on holiday, but measuring participants in their work environment was important for comparison purposes.

Generally, participants had a predilection towards the PEL experience producing more positive benefits over the TV experience, along with their reflection of their past tourism experiences. Again, this illustrates the importance of multisensory cues in stimulated environments as a way of increasing participants’ sense of presence and their immersion in the experience:

‘The fan blowing the wind, the smell and the overall images. The sand also relaxed me. Being in PEL was overall more relaxing for me because it was a sensory experience……This felt more real’ (Participant 17).

‘Visual detail, of the waves breaking and the ripples, sensory effect of the sand and stones. [PEL was] More transportive than the TV experience, could also hear gulls in my head. Evoked memories of being on seashores in my childhood and adolescence (Participant 20).

The results show that both PEL and TV experiences afforded a short period of recuperation from workplace responsibilities, ‘I enjoyed the experience because it was new and different. The environment really enabled you to imagine you were sitting on the beach on the weekend, removing daily stresses’ (Participant 8). Yet, the immersive, simulated PEL condition provoked a further type of enjoyment, a feeling of escape from the workplace ‘I enjoyed the experience because it was a complete change of scene from my day-to-day environment’ (Participant 24). Indeed, whilst the TV experience created enjoyment amongst participants, their more complete absorption in the simulated PEL experience created increased enjoyment over their TV experience:

‘I did enjoy this [TV] experience, but I noticed that time seemed to pass much more quickly than it did whilst I was in the PEL lab and I felt that I paid much less attention to the video—I did not absorb myself into it as much and did not relax as much’ (Participant 11).

‘I enjoyed the [TV] experience but felt it was not all encompassing as screen was small and I was aware of people walking up corridor, which I could see out of the corner of my eye. I preferred the PEL experience’ (Participant 12).

‘I enjoyed the peace of being away from a busy office and the sound of waves was relaxing. It [TV] was a more sterile environment and didn’t give the same sense of escape like PEL did. PEL stimulated more senses such as touch and smell which had a bigger impact on my mood and made the experience more realistic’ (Participant 26).

Whilst this was not an unexpected finding, it does demonstrate the ability of an immersive, simulated environment, such as the PEL, to re-create a tourism environment with a greater level of realism than has previously been attempted (e.g.: Agapito et al. 2013; Heilig 1961; Martins et al. 2017) in order to then measure tourisms’ potential to alleviate physiological and psychological stress and enhance mood.

5 Discussion

Generally, findings from the participants’ physiological (heart-rate—HR) data and ISP (mood) data were borne out by qualitative comments from the participants, demonstrating the realism of presence (Patton 2014) in the PEL experience. The participants’ pre-HR data showed no significant differences ($p > 0.05$) in HR between the three experiences. The mean HRs were similar prior to each experience, providing an opening baseline with several positive points, such as: data collection with the Mio Alpha 2 h watch was reliable, the physiological state of participants remained similar during the study and the researcher was consistent with the administration of the study across the three different experiences.

The mean HR during the PEL experience was significantly lower ($p < 0.05$) than that of both the TV experience and workplace datum. Although it was not the intention of this research to demonstrate *how* tourism can alleviate stress and improve mood, these exploratory findings lend support to previous research (e.g. Bell et al. 2015; Kelly 2018; Pesonen and Komppula 2010; Willis 2015) that tourism enhances psychological wellbeing through connecting people with natural environments, albeit a simulated environment in this particular instance. Moreover, there was no significant difference ($p > 0.05$) between the mean HR data for the TV experience and workplace datum. If an increased HR is a physiological indicator of stress (Akselrod et al. 1981), then these results promote PEL as being a less stressful condition. The mean HR data demonstrated that participants’ TV viewing experience of the same tourism scene produced similar HR data to that produced in the workplace. This similar HR result also suggests that participants’ experience no physiological benefits from taking time away from their work to watch TV, i.e.: they are not immersed in an alternative environment that is significantly different to their workplace.

Whilst the TV setting was used as a conventional way of viewing the beach scene; rather than as an entertainment channel, this finding suggests that the PEL's successful simulation of escape from the reality of being at work is the main reason for a lower HR in comparison to the TV setting. Qualitative responses also suggest that participants' mood levels improved during both the PEL and TV experiences in comparison to their workplace experience. Furthermore, the PEL tourism experience was more enjoyable, immersive and promoted a greater feeling of relaxation and calmness. This endorses the work of Martins et al. (2017) in relation to multisensory simulated experiences increasing the sense of presence in an experience. Whilst it was not the intention of this research to demonstrate *how* tourism can alleviate stress and improve mood, but how the PEL can be used as a methodological tool to simulate tourism environments which can then be used to measure tourisms' potential to alleviate physiological and psychological stress and enhance mood these exploratory findings lend support to previous research (Chen and Petrick 2013; Chen et al. 2014; Dolnicar et al. 2012; Toda et al. 2004) which suggests a link between tourism and hedonic wellbeing. Whilst the short-time exposure to the different settings has been acknowledged as a limitation, this research has demonstrated a positive effect of the simulated tourism experience on participants. However, the team accept that only one simulated tourism environment of a beach was used and that, for some people, pleasant stimuli, e.g. a beach scene, intervenes more effectively in bad moods and helps to maintain good moods more than unpleasant stimuli, which may exacerbate bad moods or impact negatively on good moods (Zillmann 1988).

In relation to hedonic wellbeing, the PEL and TV experiences had impacts that are more positive in comparison to the workplace; with the latter being used in the context of being the complete opposite of going on holiday. While both the PEL and TV experiences increased the feeling of escape and relaxation, participants' experience of PEL promoted further positive reflection of past tourism experiences. Although the PEL and TV experiences allowed a period away from work responsibilities, the PEL experience produced a better sensation of a tourism experience and escape from the workplace through immersion in a simulated tourism experience that featured multisensory cues (Martins et al. 2017); albeit for a limited period of time. Less positively, but as anticipated, the short-term physiological benefit (lower HR) of the PEL experience was not maintained, with post-experience HR data not being significantly different ($p > 0.05$) between experiences.

Subsequent analysis of the TV experience showed a significant difference ($p < 0.05$) between during and post-mean HR data. However, the post-mean HR ascended above the pre-mean HR. Therefore, the elevated HR data suggests that participants were in a less relaxed state after watching the TV. However, further analysis of the PEL condition revealed a significantly lower ($p < 0.05$) during mean HR in comparison to pre and post-means HR. These collective physiological results indicate that the PEL experience was able to reduce HR without causing post-experience intensifications above those recorded before the experience. These exploratory physiological results lend support to previous research on the positive psychological benefits of tourism experiences (e.g.: Bell et al. 2015; Chen and Petrick 2013; Chen et al. 2014; Dolnicar et al. 2012; Pesonen and Komppula 2010; Willis 2015). However, the long, medium or short-term benefits of tourism experiences are dependent on numerous variables and will differ across individuals (Smith and Diekmann 2017); thus, a longitudinal study of the PEL with a wider sample size would be required for more meaningful data on the physiological and psychological benefits of using a simulated tourism environment as a tool to measure stress and mood as signifiers of hedonic wellbeing.

Analysis of participants pre- and post-mood scores initially showed no significant difference ($p > 0.05$) between the three experiences, therefore providing further reliability towards the effects that each experience had on participants' post-mood scores. However, the post-mood analysis showed that participants' mood scores were significantly reduced ($p < 0.05$) after experiencing the PEL and TV experiences in comparison to the workplace. Accompanying analysis of the effect size of the PEL and TV experiences presented the PEL experience as producing a greater difference between pre- and post-mood scores. This was supported by the qualitative data which suggested that the PEL simulated tourism experience was more enjoyable, immersive and promoting a greater feeling of relaxation and calmness than the TV experience. This supports prior studies (e.g.: Martins et al. 2017; Patton 2014; Tonkin et al. 2011) that simulated environments become more comparable to real environments when improvements such as sound, props, wider field of view and improved photo-realism are made in order to stimulate as many of the human senses as possible and create a multisensory environment. The PEL utilised all these attributes to promote a convincing and immersive simulation of a tourism environment and, in doing so, has demonstrated that it is an effective methodological tool for measuring stress and mood as signifiers of hedonic wellbeing.

There are clear methodological advantages in terms of measuring the physiological benefits of a simulated tourism environment. The participants did not have to 'learn' how to use the PEL; they simply walked in and sat down. Participants were not required to wear tethered or untethered headsets which might have impinged on their level of immersion. Furthermore, the PEL setting, with the use of multisensory props, optimised user presence in the simulated tourism environment. Whilst, compared to VR technology, lack of mobility is a disadvantage for the PEL, the ability to simulate a tourism environment in a laboratory setting does counteract the inherent difficulties of measuring physiological benefits in natural tourism settings.

6 Conclusions

The PEL successfully created a simulated tourism environment (i.e.: beach), which allowed the controlled study of participant behaviour under experimental conditions. The multisensory immersive realism of the simulated tourism environment produced a greater sense of presence amongst the respondents; therefore, these preliminary findings demonstrate the suitability of the PEL to measure stress and mood as signifiers of hedonic wellbeing, which extends previous studies (e.g. Agapito et al. 2013; Chen et al. 2014; Heilig 1961; Martins et al. 2017; Patton 2014).

The use of PEL to measure the relationship between tourism, TV and workplace experiences on stress and mood has demonstrated that PEL is an appropriate methodological tool. However, this was only a preliminary study using a conservative convenience sample. Therefore, further validation studies are essential, with more investigations designed to explore PEL's capability to represent a convincing likeness to a real environment. This will add rigour and greater depth to the preliminary findings from this research. The continued use of the Mio Alpha 2 h watch in the validation study would provide further insight towards its HR-recording accuracy between experiences and associations toward stress. Furthermore, the HR watch could be explored alongside other physiological methods, such as measures of salivary cortisol, the central indicator of stress (Nabi et al. 2016) and galvanic skin response (GSR), used to measure changes in electrical resistance of the skin caused by emotional stress. Whilst participants in this study refrained from consuming caffeine prior to HR measurements for each of the three experiences, future research needs to take account of other factors that might influence individual results, e.g. the use of a beach scene if participants have a fear of water or open spaces, planning and travel to the final destination. The team accept that the beach scene was based on a hedonistic premise (Zillmann 1988), so future research could include filming additional and different tourism scenes (e.g. mountain, rural, city, domestic or overseas locations) which participants then select, alongside pre- and post-experience mood questionnaires; although this would need to take into account the logistics of installing alternative simulated tourism environments, props and evacuating smells. The use of alternative tourism scenes could also include eye-tracking to determine what, within a tourism location, visually attracts tourists and their physiological response to those stimuli. Furthermore, future research requires a sample size with greater diversity, for example, individuals with sensory impairments as the PEL would enable access and an immersive simulated experience through which to explore what elements such individuals feel contribute to their experience and level of immersion. In this way, the importance of different senses can also be explored.

Future research also needs to explore the consequences that different scene fidelities have on creating convincing environment realism within PEL's simulated environment. This would involve testing different variables within PEL, such as image resolution, sound, smell, temperature, air movement and multisensory accompanying props. Such future research could focus on providing industry-specific data on particular tourist groups and specific travel environments, e.g., measuring the impact of different aircraft spaces (i.e.: economy, business, first class) on the stress levels and mood of business travellers. As technology has developed, so the PEL has been evolving since this preliminary study designed to explore the capabilities of the PEL, rather than to test individual senses. Therefore, future research could bring in different senses one at a time to explore what each one adds to the experience and level of immersion, e.g. through the application of smell delivery technology and immersive audio systems. Finally, future research could also combine the PEL experience with more in-depth, longitudinal qualitative studies on the tourism experiences of specific population groups in relation to measuring stress and mood as signifiers of hedonic wellbeing.

References

Agapito D, Mendes J, Valle P (2013) Exploring the conceptualization of the sensory dimension of tourist experiences. J Destin Mark Manag 2(2):62–73

Akselrod S, Gordon D, Ubel FA, Shannon DC, Berger AC, Cohen RJ (1981) Power spectrum analysis of heart-rate fluctuation: a quantitative probe of beat-to-beat cardiovascular control. Science 213:220–222

Allen JJB, Chambers AS, Towers DN (2007) The many metrics of cardiac chronotropy: a pragmatic primer and a brief comparison of metrics. Biol Psychol 74:243–262

Bell SL, Phoenix C, Lovell R, Wheeler BW (2015) Seeking everyday wellbeing: the coast as a therapeutic landscape. Soc Sci Med 142:56–67

Bevan S, Brinkley I, Bajorek Z, Cooper C (2018) 21st Century workforces and workplaces: the challenges and opportunities for future work practices and labour markets. Bloomsbury, London

Breslow SJ, Sojka B, Barnea R, Basurto X, Carothers C, Charnley S, Levin PS (2016) Conceptualizing and operationalizing human wellbeing for ecosystem assessment and management. Environ Sci Policy 66:250–259

Cantoni E, Marchiori E, Cantoni L (2017) Teenagers' destination website navigation. A comparison among eye-tracking, web analytics, and self-declared investigation. In: Marcus A, Wang W (eds) Design, user experience, and usability: understanding users and contexts. Lecture Notes in Computer Science, vol 10290. Springer, Cham, pp 359–370

Chen C-C, Petrick J (2013) Health and wellness benefits of travel experiences: a literature review. J Travel Res 52(6):709–719

Chen C-C, Petrick J, Shahvali M (2014) Tourism experiences as a stress reliever: examining the effects of tourism recovery experiences on life satisfaction. J Travel Res 55(2):1–11

Cohen J (1988) Statistical power analysis for the behavioural sciences, 2nd edn. Lawrence Earlbaum Associates, Hillsdale

Connell J (2006) Medical tourism: sea, sun, sand and….surgery. Tour Manag 27:1093–1100

Cooper CL (2009) The changing nature of work: enhancing mental capital and wellbeing of the workplace. 21st Century Society 4(3):269–275

Corvo PP (2011) The pursuit of happiness and the globalised tourist. Soc Indic Res 102:95–97

De Bloom J, Kompier MAJ, Geurts SAE, De Weerth C, Taris TW, Sonnentag S (2009) Do we recover from vacation? Meta-analysis of vacation effects on health and wellbeing. J Occup Health 51(1):13–25

De Vente W, Olff M, Van Amsterdam JGC, Kamphuis J, Emmelkamp P (2003) Physiological differences between burnout patients and healthy controls: blood pressure, heart rate, and cortisol responses. Occup Environ Med 60(1):54–61

Dean JE, Whelan JP, Meyers AW (1990) An incredibly quick way to assess mood states: the incredibly short POMS. Presented at the Association for the Advancement of Applied Sport Psychology, San Antonio

Dolnicar S, Yanamandram V, Cliff K (2012) The contribution of vacations to quality of life. Ann Tour Res 39(1):59–83

Dolnicar S, Lazarevski K, Yanamandram V (2013) Quality of life and tourism: a conceptual framework and novel segmentation base. J Bus Res 66:724–729

Faulkner B, Patiar A (1997) Workplace induced stress among operational staff in the hotel industry. Int J Hosp Manag 16(1):99–117

Field A, Hole G (2003) How to design and report experiments. Sage, London
Gray WD (2002) Simulated task environments: the role of high-fidelity simulations, scaled worlds, synthetic environments, and laboratory tasks in basic and applied cognitive research. Cogn Sci Q 2:205–227
Guttentag DA (2010) Virtual reality: applications and implications for tourism. Tourism Manag 31:637–651
Hart J (2013) Association between heart rate variability and manual pulse rate. J Can Chiropr Assoc 57(3):243–250
Heilig M (1961) Sensorama: a totally mechanical VR device (one person theater), invention
Higgins-Desboilles F (2006) More than an 'industry': the forgotten power of tourism as a social force. Tour Manag 27:1192–1208
Iarocci G, McDonald J (2006) Sensory integration and the perceptual experience of persons with autism. J Autism Dev Disord 36(1):77–90
Kelly C (2018) 'I need the Sea and the Sea Needs me': symbiotic coastal policy narratives for human wellbeing and sustainability in the UK. Mar Policy 97:223–231. https://doi.org/10.1016/j.marpol.2018.03.023
Kirillova K, Lehto X (2015) An existential conceptualisation of the vacation cycle. Ann Tour Res 55(1):110–123
Konu H, Laukkanen T (2010) Predictors of tourists' wellbeing holiday intentions in Finland. J Hosp Tour Manag 17:144–149
Kuhnel J, Sonnentag S (2011) How long do you benefit from vacation? A closer look at the fade-out of vacation effects. J Organ Behav 32(1):125–143
Lin J-H, Wong J-Y, Ho C-H (2013) Promoting frontline employees' quality of life: leisure benefit systems and work-to-leisure conflicts. Tour Manag 36:178–187
Mackenzie SH, Kerr JH (2013) Stress and emotions at work: an adventure tourism guide's experiences. Tour Manag 36:3–14
Mannell RC, Iso-Ahola SE (1987) Psychological nature of leisure and tourism experience. Ann Tour Res 14:314–331
Marchiori E, Niforatos E, Preto L (2018) Analysis of users' heart-rate data and self-reported perceptions to understand effective virtual reality characteristics. Inf Technol Tour 18:133–155
Martins J, Goncalves R, Branco F, Barbosa L, Melo M (2017) A multisensory virtual experience model for thematic tourism: a port wine tourism application proposal. J Destin Mark Manag 6:103–109
McCabe S, Minnaert L, Diekmann A (2012) Introduction. In: McCabe S, Minnaert L, Diekmann A (eds) Social tourism in Europe: theory and practice. Channel View Publications, Bristol, pp 1–13
Morgan N, Pritchard A, Sedgley D (2015) Social tourism and wellbeing in later life. Ann Tour Res 52:1–15
Moscardo G (2009) Tourism and quality of life: towards a more critical approach. Tour Hosp Res 9:159–170
Nabi RL, Prestin A, So J (2016) Could watching TV be good for you? Examining how media consumption patterns relate to salivary cortisol. Health Commun 31:1345–1355
Nawijn J (2011) Determinants of daily happiness on vacation. J Travel Res 50(5):559–566
Nawijn J, Filep S (2016) Two directions for future tourism wellbeing research. Ann Tour Res 61:221–223
Nawijn J, De Bloom J, Geurts S (2013) Pre-vacation time: blessing or burden? Leis Sci 35:33–44
Neal JD, Uysal M, Sirgy MJ (2007) The effect of tourism services on travelers' quality of life. J Travel Res 46:154–163
O'Neill JW, Davis K (2011) Work stress and wellbeing in the hotel industry. Int J Hosp Manag 30:385–390
Page SJ, Hartwell H, Johns N, Fyall A, Ladkin A, Hemingway A (2017) Case study: wellness, tourism and small business development in a UK coastal resort: public engagement in practice. Tourism Manag 60:466–477
Patton D (2014) How real is good enough? Assessing realism of presence in simulations and its effects on decision making. In: Schmorrow DD, Fidopiastis CM (eds) Foundations of augmented cognition. advancing human performance and decision-making through adaptive systems. AC 2014. Lecture Notes in Computer Science, vol 8534. Springer, Cham
Pesonen J, Komppula R (2010) Rural wellbeing tourism: motivations and expectations. J Hosp Tour Manag 17:150–157
Pieper S, Brosschot JF, van der Leeden R, Thayer JF (2007) Cardiac effects of momentary assessed worry episodes and stressful events. Psychosom Med 69(9):901–909

Reisinger Y (ed) (2013) Transformational tourism: tourist perspectives. CABI, Oxford
Richardson P, Vine E, Goodwin A (2011) Research methods and design in psychology. Learning Matters Ltd, Exeter
Robbins CJ, Allen HA, Chapman P (2019) Comparing drivers' visual attention at Junctions in Real and Simulated Environments. Appl Ergon 80:89–101
Rosenthal R (1991) Meta-analytic procedures for social research. Sage, Newbury Park
Schubert C, Lambertz M, Nelesen RA, Bardwell W, Choi JB, Dimsdale JE (2009) Effects of stress on heart rate complexity—a comparison between short-term and chronic stress. Biol Psychol 80:325–332
Shoval N, Birenboim A (2019) Customization and augmentation of experiences through mobile technologies: a paradigm shift in the analysis of destination competitiveness. Tour Econ 25(5):661–669
Shoval N, Isaacson M (2007) Tracking tourists in the digital age. Ann Tour Res 34(1):141–159
Shoval N, Schvimer Y, Tamir M (2018a) Real-time measurement of tourists' objective and subjective emotions in time and space. J Travel Res 57(1):3–16
Shoval N, Schvimer Y, Tamir M (2018b) Tracking technologies and urban analysis: adding the emotional dimension. Cities 72:34–42
Slater M, Khanna P, Mortensen J, Yu I (2009) Visual realism enhances realistic response in an immersive virtual environment. IEEE Graph Appl 29(3):76–84
Smith MK, Diekmann A (2017) Tourism and wellbeing. Ann Tour Res 66:1–13
Steptoe A (2000) Stress, social support and cardiovascular activity over the working day. Int J Psychophysiol 37(3):299–308
Toda M, Makino H, Kobayashi H, Nagasawa S, Kitamura K, Morimoto K (2004) Medical assessment of the health effects of short leisure trips. Arch Environ Health 59(12):717–724
Tonkin C, Ouzts AD, Duchowski AT (2011) Eye tracking within the packaging design workplaceflow: interaction with physical and virtual shelves. In: Proceedings of the 1st conference on novel gaze-controlled applications
Tussyadiah IP, Wang D, Jung TH, tom Dieck MC (2018) Virtual reality, presence and attitude change: empirical evidence from tourism. Tourism Manag 66:140–154
Uysal M, Sirgy MJ, Woo E, Kim H (2016) Quality of life (QOL) and wellbeing research in tourism. Tour Manag 53:244–261
Walton J (2000) The British seaside: holidays and resorts in the twentieth century. Manchester University Press, Manchester
Willis C (2015) The contribution of cultural ecosystem services to understanding the tourism-nature-wellbeing nexus. J Outdoor Recreat Tour 10:38–43
Xhyheri B, Manfrini O, Mazzolini M, Pizzi C, Bugiardini R (2012) Heart rate variability today. Prog Cardiovasc Dis 55:321–331. https://doi.org/10.1016/j.pcad.2012.09.001
Zillmann D (1988) Mood management through communication choices. Am Behav Sci 31:327–340