

Wine Tourism Market Research: Bringing the Psychophysiology lab to the Field

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Abstract: Wine tourism is of growing academic and business interest, being also acknowledged as an important driver of rural development. Successful management and marketing decisions, matching visitor demand, requires solid market data. The questionnaire-based survey is one of the most popular approaches to collect quantitative data in tourism, with statistics playing an important role in supporting management decisions. One of the advantages of this data collection method is the possibility of obtaining large amounts of data from large numbers of tourists in a relatively easy, economic, broadly accessible and not too time-consuming way. However, given the subjective character of self-report responses, which are highly influenced by aspects such as social desirability, conscious data processing, validity and reliability of the measures used, many experts argue that questionnaires are insufficient to fully understand human behavior, attitudes and feelings. One way to obtain more objective data is through the use of psychophysiological indicators such as peripheral nervous system measurements, usually collected in the laboratory. The artificial character of this collection method (in the lab) is recognized, however, as its main disadvantage. In the present work, an innovative methodology (through peripheral nervous system measures) for collecting objective data in wine tourism contexts is proposed, thus overcoming the subjectivity of survey data and the possible bias resulting from the collection of objective measures in artificial laboratory contexts. Visitors at two Bairrada wineries wore small portable and wireless sensors to capture their electrocardiogram and electrodermal activity during guided visits to the premises. A small hand-held push button allowed them to register any moment they found particularly interesting or exciting. Signals were recorded on a smartphone by the experimenter, who was part of the visitor group, and who also registered different stimuli and activities along the visit. Additionally, psychophysiological data were complemented by an interview and survey data to enhance the interpretation of results. Preliminary results will be presented, illustrating the potential of this method to produce important and valid evidence in wine tourism, to inform stakeholders about their market and allow better management decisions.

Keywords: EDA, ECG, portable wireless sensors, wine tourism, market-informed management decisions

1. Wine tourism

Wine tourism is an area of growing academic and business interest (Charters and Ali-Knight 2002, Massa and Bédé 2018), also acknowledged as an important driver of rural development (Hall et al 2019, Kastenholz and Costa 2009). Wine tourism can be understood as a visit to vineyards, wineries, festivals and others related to wine, with wine tasting and/or contact with the attributes of a wine region being the main attractions for visitors (Hall et al 2019). However, wine tourism can also be conceptualized in a more holistic, ecosystem logic (Salvado and Kastenholz 2017), or as 'terroir tourism', valuing the broader exploration of wine-growing territories, in addition to aspects purely related to wine (Holland et al 2014), with wine sometimes actually being only one (not always essential) part of the tourist experience (Kastenholz et al 2021). Wine tourism is, indeed, more than an activity exclusively focusing on tasting wines, encompassing other activities, such as learning about the history of wine and its production, or the historical heritage of the region, the appreciation of local food and other local products (e.g., handicrafts), the enjoyment of landscape, the involvement with local communities and a whole way of life (Robles 2021). Additionally, not all visitors of wine regions are the same and some are simply 'curious' about wine, as much as about other features of the destination (Charters and Ali-Knight 2002).

In this context, scientific evidence to help make more successful management and marketing decisions, matching heterogeneous visitor demands (e.g. developing the most appealing and memorable experience designs targeting particular visitor groups), is increasingly valued by political, economic and social agents.

2. Market research and the limits of questionnaire-based surveys

The questionnaire-based survey is one of the most popular approaches to collect quantitative market data in tourism, commonly used by both academics and tourism managers, with statistics playing an important role in management and marketing decision-making (Finn et al 2010). One of the advantages of this data collection method is the possibility of obtaining large amounts of data from a big number of tourists in a relatively easy,

economic, broadly accessible and not too time-consuming way, which is particularly true for online surveys. However, on-site surveys are also popular to obtain relevant, specific experience- and context-dependent data. In this vein, visitor surveys are key tools for designing better targeted and more successful and sustainable tourism products, for example via segmentation studies (e.g., Dolnicar 2002, Carneiro et al 2013, Kastenholz et al 2018), or by assessing determinants of online travel purchase (e.g., Amaro and Duarte 2015), drivers of destination loyalty or place attachment (e.g., Alves et al. 2019, Kastenholz et al. 2013, Kastenholz et al 2020), or factors contributing to appealing and memorable experiences (e.g. Zatori 2018). Survey results may help find ways for increasing sales of local products (Kastenholz et al 2016) or generally increased expenditure levels at the visited destination (Eusébio et al 2013). Such studies also permit longitudinal comparison of visitor profiles and attitudes (Sæthórsdóttir 2013). However, given the subjective character of self-report responses about behaviors, perceptions, feelings and attitudes, which are highly influenced by aspects such as social desirability or conscious data processing, many experts question the validity and reliability of the measures used, arguing that questionnaires are inadequate or at least insufficient (Patten 2016) to fully explain human behavior, attitudes and feelings.

3. Psychophysiological indicators and field data collection

One way to obtain more objective data is through the use of psychophysiological technics like electrocardiogram (ECG) and electrodermal activity (EDA) recordings, as a measure of peripheral nervous system activation. In fact, instead of asking people if they liked or were excited about a certain experience or product, with these techniques we can monitor their physiological reactions to them, which can be a reliable indicator of the person's interest, emotional activation or amount of attention paid to specific situations or stimuli (Bailey 2017). Among other psychophysiological markers, heart rate variability (HRV), derived from the ECG signal, represents one of the most stable and reliable markers of autonomic activity (Camm et al 1996). Typically, a spectral (or frequency domain) analysis of the HRV involves decomposing the signal into frequency bands and calculating the absolute power values in each band (Shaffer and Ginsberg 2017). The most common analysis using the frequency bands is based on the Low Frequency (LF)/High Frequency (HF) ratio - also called "balance" - which is used to reveal the amount of sympathovagal modulation of the heart rate (Shiga et al., 2021). In this analysis, a low LF/HF ratio reflects parasympathetic dominance that translates into self-regulating and self-soothing behaviours (Porges 2007), while a high LF/HF ratio indicates sympathetic dominance, which mediates arousal responses (Bootsma et al 1994) or an approach-motivated appetitive state (Shiota et al 2011). Interestingly, there is evidence which suggests that a high power in the HF band is a psychophysiological marker of inhibitory control (Thayer et al 2012), and there is also literature that shows that a low power in the HF band is associated with impulsivity in consumer behaviour (Kittaneh et al 2016).

Electrodermal activity (EDA) reflects the sweat gland activity resulting from sympathetic receptor stimulation (Shiota et al 2011). According to the literature, there are two main components of EDA: the tonic component, which relates to the overall level, slow risings and declinations of the signal over time, and the phasic component, which refers to the faster changing components of the signal in response to discrete events (Braithwaite et al 2013). Skin conductance level (SCL) is the most common measure of the tonic component and is considered to be the 'gold standard' when measuring physiological arousal (Lole et al 2012). In addition to the vast psychological literature linking SCL to emotional arousal, a tourism study showed that SCL is related to emotional arousal in exploring a touristic street in Jerusalem (Shoval et al 2018).

These psychophysiological measurements are usually collected in the laboratory, where individuals may be confronted with images or videos (e.g., promotional materials from the wine tourism context) to assess emotional activation resulting from stimulus processing. However, the artificial character of this collection method is commonly pointed out as its main disadvantage. Therefore, it is important to develop and validate methodologies that allow reliable psychophysiological data collection in the field, while participants experience the target contexts. In the present work, an innovative methodology (through peripheral nervous system measures, complemented by minimal self-report indicators) for collecting objective data in wine tourism contexts is proposed, which helps to overcome the subjectivity of the data collected exclusively via questionnaire and the bias resulting from the collection of objective measures in artificial contexts.

4. Methodology

4.1 Case study and context

The present study is part of a broader project, entitled '*TWINE: co-creating sustainable Tourism & WINE Experiences in rural areas*', which aims to understand the opportunities of co-creation of attractive and sustainable wine tourism experiences as the conditions of successful and sustainable wine tourism destinations in Portugal's Central region: Bairrada, Dão and Beira Interior. The present paper uses data collected only in the Bairrada route.

The Bairrada region is located on the Portuguese coastline, more specifically between the cities of Aveiro and Coimbra. It is known for its long winemaking tradition and stands out as the main Portuguese sparkling wine region, represented mostly by small wineries. Bairrada was demarcated as certified wine region in 1979 and offers a wide range of experiences in addition to those related to wine, namely local gastronomy (e.g., suckling pig), hot springs, culture and nature. The Bairrada Wine Route was created in 1999 and has today more than one hundred members, from producers, restaurants, accommodation units, to tour operators, who seek to promote the region through wine tourism in an integrated way, namely developing various activities and attractions related to wine, also connecting them to other attractions and services (Brás et al 2010; Correia et al 2004).

4.2 Data collection

Within the here presented exploratory framework, two female visitors (aged 26 and 56) at the São Domingos winery (Bairrada, Portugal) wore a small portable and wireless device (<https://biosignalsplux.com/>) to capture their ECG and EDA at a sampling rate of 1,000 Hz, during guided visits to the premises. Signals were recorded on the OpenSignals smartphone app (<https://biosignalsplux.com/products/software/opensignals.html>) by the experimenter, who was part of the visitor group, and who also registered the different stimuli, activities, and places along the visit. Additionally, psychophysiological data were complemented by a short interview and survey data, collected at the end of the visit, to allow an adequate interpretation of the results and validate the proposed methodology.

4.3 Data processing and analysis

Signal processing was performed using AcqKnowledge 4.4 software (Biopac). The ECG raw signal was bandpass filtered between 1-30Hz and Heart Rate Variability (HRV) was subsequently derived and analysed using the classical HRV spectral bands: low frequency (LF), and high frequency (HF) bands, which have fixed boundaries (0.04–0.15 Hz and 0.15–0.40 Hz, respectively). Through this frequency analysis, the dependent variables 'Sympathetic', 'Parasympathetic' and 'Balance' were calculated. The sympathetic variable is the proportion of the heart rate change triggered by the activation of the sympathetic nervous system, the parasympathetic variable is the proportion of the heart rate change triggered by the activation of the parasympathetic nervous system and the sum of these two components is equal to 1. Balance (Sympathetic-Vagal) is the ratio between the power in the low frequency band and the power in the high frequency band (LF/HF). HRV analyses were carried out for several time windows according to the specific stages of the visit. The duration of all time windows was kept the same throughout the entire analysis.

Regarding EDA, considering the interest in autonomic activation changes over time, the tonic signal (SCL) was derived from the raw signal using the AcqKnowledge (Biopac) algorithm.

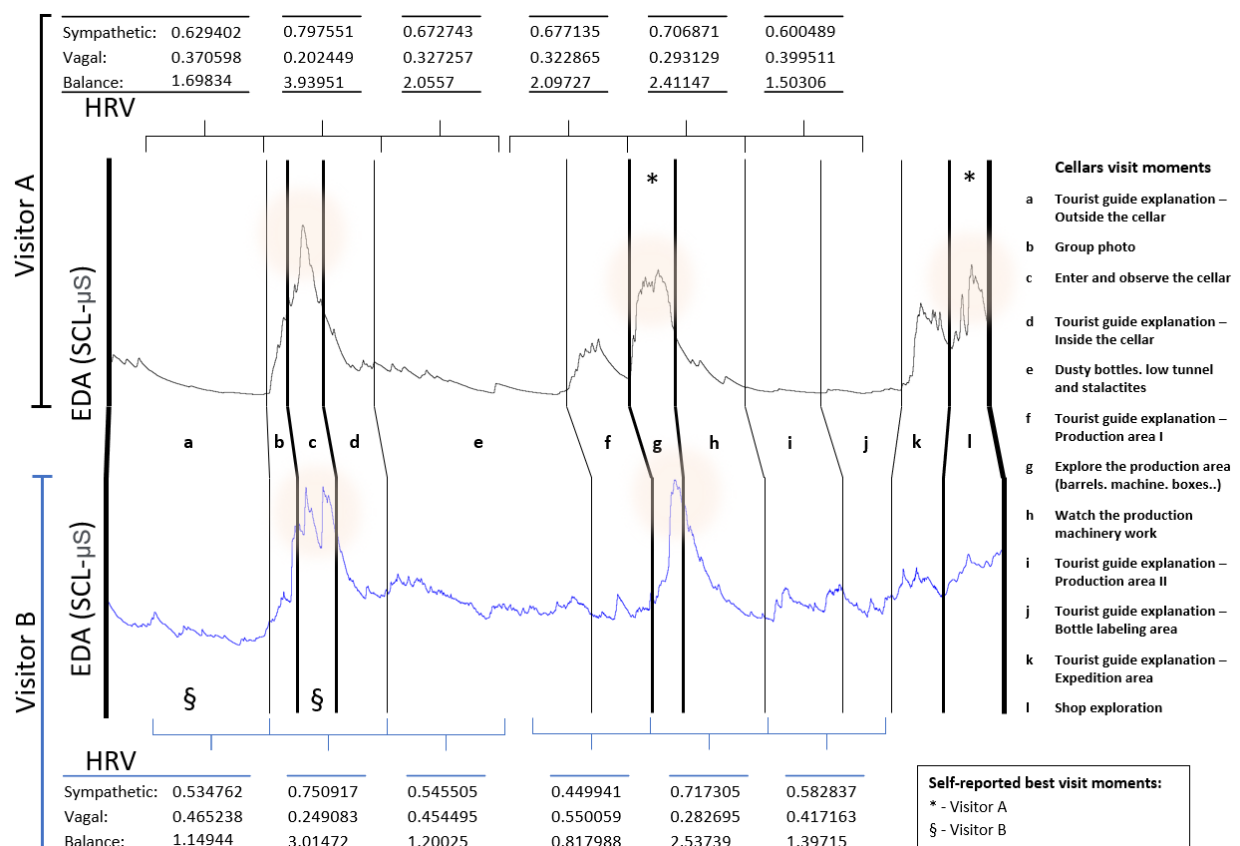
5. Results

The results of the analysis conducted with the two visitors can be seen in Figure 1. The SCL graph was divided in nine focus areas that correspond to specific moments of the visit. Through visual data analysis, we can verify that the skin conductance level varies over time, with some moments of the visit generating greater electrodermal activity caused by the activation of the sympathetic nervous system than others. Interestingly, most of the visit moments which are associated to higher EDA appear to be shared by the two visitors, with an almost superimposable SCL graph. In fact, the moments registering the highest SCL values were the entrance and observation of the wine cellar, the exploration of the production area with visualization of the barrels, machines and wine boxes, and, in the case of visitor A, also the shop. Another relevant result is the fact that the first activation peak observed started during a moment that is not directly wine-related, which was the group photography, and the moments in which visitors witnessed the explanation of the guide are characterized by less physiological activation. The HRV data are congruent with the EDA data, since the moments with the highest

SLC are also the ones with the highest proportion of sympathetic activity in the cardiac signal. The explanation moments by the guide result in a balance close to 1, with a sympathetic-vagal preponderance around 50/50. The highest balance value, which refers to a greater sympathetic component in the cardiac signal, was recorded at the entrance and when observing/ exploring independently the cellars, with the sympathetic component reaching 80% in visitor A and 75% in visitor B.

When we considered the data from the interview and from the completion of the self-report questionnaire, we found that the moments in which participant A reported the greatest satisfaction (*) were while exploring the production area and the shop. This result shows a psychophysiological-behavioural agreement, since two out of the three SCL peaks observed were in the areas reported as preferred. Regarding visitor B, we can see that the highlighted moments (§) were the explanation outside the cellar and the entrance and observation of the cellar. In the first case, no enhanced psychophysiological activity was observed. It seems, in this case, that the subjective interest reported by the participant was not matched by greater sympathetic activity, which may indicate that the moment did not involve emotional arousal.

Figure 1: Overview of HRV and SCL results from two visitors during the various moments of the cellar guided visit.



6. Discussion

According to literature from the experience economy context, consumers seek, above all, consumption experiences that 'dazzle their senses', 'engage them personally', 'touch their hearts' and 'stimulate their minds' (Schmitt 1999). This should be even truer for tourists, looking for enjoyable, unique and personally meaningful experiences, tourism businesses and destinations need to understand to successfully target them (Morgan et al 2009, Volo 2009). As a matter of fact, sensations and emotions have been identified as highly relevant for satisfactory and memorable tourist experiences (Agapito et al 2014, Kastenholz et al 2012, Tung and Ritchie 2011). Therefore, knowledge about the tourist's emotional reaction towards different experiences and stimuli is essential to inform stakeholders' management decisions and provide a valuable information to successfully design appealing experience opportunities and optimize marketing strategies (Volo 2009). Usually, this reactivity on destination and service attributes is assessed using self-report questionnaires, which have raised some validity and reliability issues (Baumeister et al 2007, Cunha et al 2021). To overcome these limitations, the

present study aimed to explore the possibility of using recordings of ECG and EDA in an ecological wine tourism setting to assess the psychophysiological activation during a wine cellar visit.

The results indicated that both measures provide useful information about the emotional reaction during the various moments of the visit and allow to distinguish different patterns of activation associated to specific activities. For example, it was clear that higher sympathetic activation was registered during moments where participants could freely explore different areas of the cellars compared to when the guide was giving explanations. In fact, wine tourism experiences generally place visitors in a passive posture (for example, visiting the cellar, buying wine, eating at the cellar) (Madeira et al 2019). However, tourist destinations and businesses are now increasingly aware of the benefits of a more participatory, co-creative design of tourist experience opportunities (Campos et al 2018, Carvalho et al 2021). The present results reinforce the added value of tourists' active participation, providing them personalized opportunities of free exploration (Minkiewicz et al 2014), as a crucial factor of appealing, distinctive and memorable on-site tourism experiences (Carvalho et al 2021).

The physiological activation patterns also allowed to highlight particular moments of the visit that engaged the tourists, but that were not considered in the self-report questionnaire, such as the group photography that was taken in the beginning of the tour. These moments, that imply social interaction and sharing of meaningful experience-extensions, actually deliver opportunities for 'mixing in memorabilia' that are particularly powerful when perceived as unexpected (Ellis and Rossman 2008).

Importantly, the psychophysiological patterns were consistent with the preferences reported by the visitors, which constitutes a cross-validation of the obtained results.

This is a preliminary investigation using only two cases, which provided quite promising results. More studies are needed to consolidate the methodology and the use of these techniques in the field, and to promote their usability by the tourism stakeholders.

7. Conclusion

The findings stress the importance of wine tourism experience opportunities that businesses and wine routes may design to improve overall satisfaction and memorability of such experiences, and consequently their market success (Ellis and Rossman 2008, Kastenholz et al 2021, Morgan et al 2000). According to the results of the present exploratory study, moments of autonomous and co-creative exploration should be more important than overly guided, and typically more standardized experiences (Minkiewicz et al 2014, Carvalho et al 2021). This could be an important clue for the destination managers and suppliers as facilitators of engaging and memorable wine tourism experiences, in which tourists assume a central and active role.

This approach requires a paradigm shift, however, since winery visits, which are the context of the present study, are marked by the central role of the guide, as the host and leader of the entire experience, also controlling the framework of time of the entire visit. However important also the guide may be, particularly if able to meaningfully interact with visitors (Weiler and Black 2015), results suggest a new paradigm, in which the tourist assumes the central role, while guides may become 'choreographer to co-creator of tourist experiences' (Weiler and Black 2015) or actually even step back and leave visitors with their own, personalized exploration opportunities. In any case, findings suggest suppliers to rethink the ways they interact with visitors and provide relevant information for the visit, without depriving them of their leading role in the visit co-creation.

In any case, additional evidence is needed for consolidating these results and it would be most interesting to additionally distinguish diverse experience and visitor contexts (e.g. distinguishing visitors according to age, level of education, motivation, travel group, etc.)

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