

Lessons for Tourism from the use of eye-tracking in wellness research

Lições para o Turismo a partir do uso de eye-tracking nas pesquisas sobre o bem-estar



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ABSTRACT

In the post-pandemic context, discussions about the recovery process in the tourism sector have accelerated trends already observed, such as a greater demand for less crowded destinations, those more committed to sustainability, and closely linked to well-being and health experiences, favoring places with lower population density, especially outdoors and with a greater possibility of contact with nature. It is observed that neuroscientific knowledge has elevated tourism to another level of questioning, allowing for a different type of theoretical and conceptual approach, as well as data collection, processing, and discussions. Therefore, the overall objective of this systematic literature review (SLR) on the use of eye-tracking (ET) to measure well-being treatment is a decisive step for advancing interdisciplinary knowledge in tourism. The research is exploratory, descriptive, qualitative in nature, and is carried out by consulting three databases: Scopus, PubMed, and Web of Science (WoS). It is essential to explain that to carry out the search, descriptors that combine the term eye-tracking and variations of the term well-being in English were determined. Additionally, the support of the textual analysis software Iramuteq was used, which allowed for an understanding of both the most recurrent terms and key terms due to co-occurrence. An inventory of eye-tracking technologies was compiled from empirical studies that utilized them, making it easier to assess the pros and cons of the lessons learned. Thus, in summary, the



results are organized into seven valuable lessons derived from the SLR. The expectation is that these lessons can contribute to future research in the field, particularly experimental research on tourism and well-being, using eye-tracking in some of its stages.

Keywords: Well-being; Eye-Tracking; Tourism; Neuroscience; Systematic Literature Review.

RESUMO

No contexto de pós-pandemia, os debates sobre o processo de retomada do setor de turismo aceleraram tendências já percebidas de maior procura por destinos menos massificados, mais comprometidos com a temática da sustentabilidade e mais vinculados com experiências de bem-estar e saúde, privilegiando locais com menor concentração de pessoas, notadamente ao ar livre e com maior possibilidade de contato com a natureza. Observa-se que o conhecimento neurocientífico tem elevado o turismo a um outro patamar de questionamentos, permitido inclusive um outro tipo de abordagem teórica conceitual, e de coleta, tratamento e discussões sobre dados. Portanto, o objetivo geral desta revisão sistemática da literatura (RSL) sobre o uso de eye-tracking (ET) para mensurar o tratamento do bem-estar é um passo decisivo para os avanços de estudos no turismo a partir de conhecimentos interdisciplinares. A pesquisa é exploratória, descritiva, de natureza qualitativa, sendo realizada através de consulta a três bases de dados: Scopus, Pubmed e Web of Science (WoS). É mister explicar que para efetivar a busca foram determinados descritores que somam o termo eye-tracking e de variações do termo bem-estar no idioma inglês. Ainda, foi utilizado o suporte do software de análise textual Iramuteq, que permitiu compreender tanto os termos mais recorrentes, quanto os chaves por conta da coocorrência. Foi inventariado, através de um quadro, tecnologias de eye-tracking a partir dos estudos empíricos que os utilizaram, o que facilitou verificar os prós e contras das lições apreendidas. Assim, em síntese, os resultados são organizados em sete preciosas lições compreendidas com a RSL. A expectativa é que essas lições possam contribuir para futuras pesquisas na área, notadamente as experimentais sobre turismo e bem-estar, utilizando eye-tracking em alguma de suas etapas.



Palavras-chave: Bem-estar; *Eye-Tracking*; Turismo; Neurociências; Revisão Sistemática da Literatura.

INTRODUCTION

The search for wellness has been consensual on tourism, regardless of segment or mode, which has turned wellness studies into a vast interdisciplinary framework from where to extract useful theories and methodologies to understand the complexities interwoven in the touristic phenomenon and the touristic experience itself in the contemporary context (Sancho-Pivoto & Raimundo, 2022). That is the case of wellness and tourism approaches in the scope of neurosciences, as the example of Mayer, Fraga, and Silva (2021), who devised a book chapter with the contributions of neuroscience for the study of wellness in tourism and identified that emotion is still a research gap.

In this direction, it is also possible to recall Moyle et al. (2019), once this group of authors had already indicated that emotions are the new frontier for tourism research. In addition, they have highlighted the use of neuroscience methodologies, such as EEG, that is, the electroencephalography — which, depending on the number of channels (that is, hardware electrodes used), contributes to measure emotions, memory, attention, and engagement (Cerf, 2017). In other words, an EEG with over 32 channels is more potent to study aspects related to memory and attention (Cerf, 2017). Although EEG is quite famous in experimental studies in interface with neurosciences, there is another method/tool that helps measuring notably the arousal, engagement, response time, among other factors — which are equally significant for the study of tourism in the wellness perspective but are still timidly seen in the tourism area literature in interface with neurosciences. This justifies seeking for lessons from the wellness area, such as the use of eye-tracking (ET), whose investigation efforts can be incorporated aiming at advancing with tourism research. This



need is even more evident when, in tourism studies, one observes the systematic literature review on eye-tracking in tourism, carried out by Scott et al. (2019), in which the authors highlight that: "Eye-tracking is a relatively new technique for study of visual attention and perception in tourism research (Scott et al. 2019, 1244).

Still according to Browatzki, Bülthoff, and Chuang (2014), the relevance of eye-tracking must be explained, and when quoting Baccino and Manunta, (2005) and Jagla et al. (2007), they corroborate that:

(...) In the context of electroencephalography (EEG) research, it allows neural activity to be co-registered with a visual stimulus that the participant chose to fixate (Browatzki, Bülthoff, and Chuang 2014, p. 1).

Therefore, understanding that eye-tracking is a relevant step for the study of the relationship between tourism and wellness — once it allows the comprehension of a series of phenomena imbricated to theoretical constructs and empiricism — the main goal of this systematic literature review (SLR), which primarily aims at: analyzing how eye-tracking is used in studies on wellness. While the specific goals are: (a) discussing the relationship between wellness and the use of eye-tracking within the interface between tourism and neurosciences; (b) identifying the date of publication and the journals that give more spotlight to the theme; (c) analyzing constructs, theories, and methods arising from this interface, which can be relevant to the study of the interface between tourism and wellness, in the perspective of using eye-tracking to capture phenomena such as: arousal, engagement, among others.

For that end, this research is exploratory and descriptive, conducted based on a systematic literature review (SLR) categorized by Paul and Criado (2020) as a domain one, and it uses the adaptation of the Prism Flowchart (2009) to detail its step by step.



Beyond that, it is relevant to highlight that, during the eligibility phase, the Capes' Journal Portal (2023) was used, especially to consult three bases: Web of Science (WoS), Scopus, and PubMed. To analyze the content, textual analysis was used, with the support of the Iramuteq software and the orientations by the Iramuteq App Handbook by Salviati (2017). This work is divided into a theoretical section on tourism, neurosciences, wellness, and eye-tracking, another one on methodology, followed by result presentation and discussion.

1. Tourism and Neurosciences: Eye-tracking and wellness

1.1. Tourism and Neurosciences: Eye-tracking

The relationship between tourism and neurosciences, which some authors discuss or even already call neuro-tourism (a neologism formed by the combination of the terms tourism and neuroscience) – be it from a paradigmatic view or as a subdiscipline, has encouraged a new form of observing the touristic phenomenon. Especially those focused on the touristic experience, on processes of choosing and decision-making, which thus give light to nuances of human relations that are established between visitor and visited people, among other interest parties (stakeholders). Studies such as the ones by Tosun, Ozdemir, and Cubuki, (2016), and Michael et al. (2019) portray the argumentation over the theoretical and methodological developments of this interface in scientific literature on tourism.

Self-personalization has been a challenge in contemporary tourism. In this sense, there is a series of theoretical and methodological resources that come from neurosciences to support it. For example, Corrêa and Gosling (2023) detail smart touristic experience and report the relevance of distinct responses (cognitive, behavioral, social, and emotional ones), a fact that is imbricated to the contribution of neurosciences. Therefore, it is observed



that neuroscientific knowledge has led tourism to a new level of questioning, be it regarding its own ontology, be it in relation to epistemology, once it allows for another kind of theoretical conceptual approach, as well as of data collection, treatment, and discussion. This is made clear when Scott (2020) highlights the relevance of having tourism research connected to the advances of neurosciences and cognitive psychology.

In theoretical and practical terms, further development on ethics, bioethics, and neuroethics dimensions is a great challenge to the experimental part that involves equipment, tools and methods close to or from neuroscientific knowledge. These challenges imply a self-analysis by researchers and broader dialogues involving the scientific community and all interested parties. Tham, Schaffer, and Sinay (2021) corroborate to that in collaborative ethnography based on an experiment on tourism and neurosciences. Once the parameters regarding ethics are established, the experiment designer, using eye-tracking, will demand a team made up of different fields of expertise in terms of knowledge regarding programming and neurosciences. On a scale from 1 (ones) to 5 (five), being 1 — “no knowledge” and 5 — “demands extensive knowledge” (Cerf, 2017, p. 77), this author has considered the usability of eye-tracking as 4 (four), that is, there is a complexity that demands in-depth knowledge.

Naturally, not all tourism studies that deal with eye-tracking theoretically and/or empirically are directly based on neurosciences. However, understanding that eye-tracking allows to deepen the understanding of arousal, engagement, response time, attention, recognition, projections, etc. (Cerf, 2017) — under the real interdisciplinary perspective — and also to enhance experimental studies, undoubtedly places neurosciences at the center of debate, and, with technological advancements, computation come in tow. In this sense, specifically about eye-tracking, it is worth explaining that human beings, in the visual system:



“demand knowledge on the physical properties of light and its interactions with the environment (...) electromagnetic radiation can be described as a wave of energy (...) the energy content of electromagnetic radiation is proportional to its frequency (...) only a small part of the electromagnetic spectrum is detectable by our visual system; visible light consists of ultraviolet rays (higher energy, 400 nm) to infrared rays (lower energy, 700 nm)” (Bear, Connors, and Paradiso, 2007, p. 279).

Broadly speaking, in order to understand phototransduction, that is, the conversion of light energy into neuron membrane potential changes (Bear, Connors, and Paradiso, 2017, p. 312), it is necessary to differentiate photoreceptors from vision, namely: cones and rods. Also, the path light traces aims to reach a structure located in the internal part of the eye, called fovea. While photoreceptors can be explained as: (1) rods — which allow us to view in low-light and (2) cones — which allow us to view colors under daylight, according to each type of cone related to wavelength — short, medium, and long (Bear, Connors, and Paradiso, 2017).

Tuszynska-Bogucka et al. (2020) affirm that the use of eye-tracking provides a large amount of data on visual-motor activity, that is, information on insights, fixations, areas of interest, drawing attention to changes in pupil size, once this parameter was the most commonly associated to emotional reactions in literature. These authors signal that studies such as the one by Hess & Polt (1960) have historically proved that pupil dilatation was associated with negative emotional evaluations in face of a certain image. However, currently most studies do not confirm this point of view, suggesting that pupil diameter changes when people process stimuli that are emotionally triggering, regardless of its hedonic valence (Tuszynska-Bogucka, 2020, p. 114).

This means that studies using eye-tracking can play a decisive role in measuring and evaluating wellness and satisfaction levels in projects, including simulations in different areas, such as architecture, engineering,



and tourism. Wang et al. (2022), for example, have developed a study with eye-tracking aiming to confirm the influence of marketing images, based on landscapes of natural services or those constructed in hotels, over visual attention and the psychological responses of older adults in terms of wellness and willingness to pay for it, which subsidizes the managers of these touristic services and marketing professionals to create more appealing advertisements. For example, Levrin (2021) uses eye-tracking to understand the increase of the efficacy in traditional external media visualization. In a theoretical conceptual perspective, the author also highlights the relevance of understanding two attention processes: (1) bottom up — starting from the unconscious environment; and (2) top down — starting from conscious, internal motivations and goals.

On the other hand, it is necessary to note that there is a natural variation among human beings, therefore, eye-tracking requires understanding its types and the role of equipment calibration. Based on a specific manufacturer, Chart 1 shows the differences between fixed and mobile eye-tracking:

Chart 1. Eye-tracking and calibration.

Equipment	Calibration description
Fixed eye-tracking (screen-based)	The participant is instructed to look at calibration targets that appear at multiple locations on the plane (commonly the surface of the display monitor) where the stimulus is located. The data collected during this period are then mapped to those locations using a standard configuration of the 3D eye model. The 3D eye model in Tobii eye trackers compensates for drift and are robust against changes in head position, so the calibration is done only once before starting to collect data and does not need to be adjusted during recording.
Wearable eye-tracking (mobile)	The participant must focus their gaze on the center of the provided calibration card (...). A successful calibration with a wearable eye tracker means that the algorithm collected gaze samples and detected the calibration marker that allowed it to compute a 3D eye model. To validate the calibration, we recommend collecting pilot data during which the participant must direct their gaze on a few known targets in the environment. If the wearable eye tracker is mapping the gaze point accurately on the scene video, the eye model is good. On the other hand, if the gaze point is not being mapped correctly (offsets), recalibration is recommended. Keep in mind that various participants may require a different nose piece to ensure that the eye cameras have a clear line of sight into the eyes to detect the pupil and corneal reflections.



Source: Tobii (2023).

Calibration aims at optimizing the eye-tracking algorithm, for that, it considers the eye's geometric characteristics, estimated as the base for a completely personalized and precise gaze point calculus. The process also includes measuring the participant's eye characteristics (Tobii, 2023). Still on Chart 1, it is relevant to understand that information on shapes, light refraction, and reflection properties of the different parts of the eye (e.g.: cornea, fovea localization, among others) are collected (Tobii, 2023). Still, it is evident that there are a series of challenges for eye-tracking data collection — that is, regardless of the manufacturer — such as body positioning.

Although research using eye-tracking to capture and measure phenomena related to tourism makes us intuitively think on choosing mobile eye-tracking, this equipment tends to be more expensive, and there remains a series of problems that must be addressed in the controlled space of labs, thus avoiding noises and undesirable outcomes. Thus, deepening the knowledge on tourism and neurosciences, including computation — as described in the eye-tracking usability scale designed by Cerf (2017) — is a safe path for the experiment designer, using the tool not to fetichize results, but to open a field of investigation that is vast and indeed interdisciplinary, anchored by ethical, bioethical and neuroethical principles necessary for the theme. Lastly, Coelho, Lopes, and Fraga (2023) explained that the new research agenda on memorable experiences must consider the use of eye-tracking, thus making this tool a key element for the advances of research on tourism and wellness.

1.2. Tourism and Wellness



In the post-pandemic context, the debate on the process of recovering the tourism sector have sped-up already seen trends consisting of looking for less massified destinations, those more committed to sustainability and more linked to wellness and health experiences, favoring less crowded, notably open-air places with higher possibilities of contact with nature. According to Andreu et al. (2021, p. 01):

The current situation related to the pandemic has accelerated trends in tourism that were already taking hold in the sector: a growing preference for less crowded places; holistic and wellness experiences; and innovative tourism products that consider future generations, are more aware of sustainability, and respond to the new paradigm of heightened global attention to caring for and respecting the planet and humanity (Andreu, 2021, p. 01).

For Sancho and Raimundo (2022), rural areas and natural destinations are highlighted in this scenario, especially those that cover the possibility of getting to know and experiencing ways of life anchored on rural elements. At the same time, protected areas and its surroundings also become central by enabling the structuring of ecotourism proposals that favor arrangements in higher commitment to environmental conservation values, social responsibility, fair sharing of created benefits, cultural exchange, learning and creation of direct benefits to the visitor's health and wellness. This work adopts a broad interpretation of concept of wellness, proposed by Romagosa et al. (2015), as a "a state of successful, satisfying, and productive engagement with one's life and the realization of one's full physical, cognitive, and social-emotional potential" (p. 71).

In this sense, understanding that "wellness is not a passive state, but instead, an "active exercise" associated with intentions, options, and actions as people work towards an optimum state of health and wellness" (Andreu et al., 2021, p. 03). Therefore, with the coronavirus pandemic and a higher awareness and valorization health and wellness-related aspects, the



health tourism segment gains ground and attention in the global touristic market, according to the World Tourism Organization (UNWTO) (World Tourism Organization and European Travel Commission, 2018). This segment, according to Pessot et al. (2021):

(...) is a branch of general tourism foreseeing tourists travel with the aim of receiving specific healing treatments or enhancing their mental, physical, or spiritual well-being. Health travels can include rewarding elements of beauty, indulgence, and regeneration, and more demanding elements such as stimulating activities and sports (p. 01).

Andreu et al. (2021) also draw attention to the wellness dimension and its relationship to touristic experiences in a post-pandemic scenario, by affirming that "Wellness is related to health practices and can help recover traditional wellness methods and reduce the mental health epidemic. Wellness also plays a role in protecting natural and cultural assets, supporting environmental protection and promoting sustainable tourism" (*Op. cit.*, p. 04).

Given this debate, one of the challenges posed is precisely recognizing and measuring the types and levels of wellness and health benefits associated with travels and visitation experiences to natural and rural areas Silva (2014) and Koss & Kingsley (2010), cited by Sancho and Raimundo (2022), draw attention to the complexity of this task, once it requires the consideration of the perceptions of each subject, their experiences, daily habits, and also the characteristics of their natural, social, and economic environment.

In a recent study published by Sancho and Raimundo (2022), for example, these author conducted a Systematic Literature Review (SLT) on studies directed to recognizing the benefits of urban and natural parks visitation to the visitors' health and wellness. For that, they adopted a broad view on wellness, anchored on Maller et al. (2008) and Lemieux et al. (2012), who cover dimensions such as: psychological/emotional wellness (to



recover from tiredness/mental stress, relax, be calm, tranquil), physical-sportive wellness (for physical activities such as walking, cycling, running, swimming, among others), social wellness (for opportunities of higher social interaction/bonding with family and/or friends), intellectual wellness (for opportunities of getting involved with intellectual, critic, creative, and stimulating activities), spiritual (to connect with nature, seek meaning and sense for their identities and alterities, to be inspired by nature, seek meaning and purpose of live, meditate), ecological/environmental wellness (to experiment, know, and make bonds with the natural environment, develop ecological citizenship), occupational/work wellness (to improve working capacity after the visit), economic wellness (to support the local economy where parks are located), and cultural wellness (to experience cultural and historical heritage, rural elements, and the traditional knowledge by local communities).

This study involved a bibliometric study on bases such as Scopus e Capes Journals. Altogether, 55 works were identified by dealing specifically with the contributions of urban and non-urban park visitation to health and wellness. The results indicate a strong link between parks and health and wellness, especially regarding physical aspects, illness prevention, restoration through contact with nature, and moments of sociability. While the dimensions regarding spiritual, cultural, and intellectual/work wellness did not integrate, at the time, the scope of most studies in terms of motives for visiting and perceived benefits

(Sancho and Raimundo, 2022).

Besides that, it is important to mention that most studied considered in the mentioned study by Sancho e Raimundo (2022) have favored the investigation focus on visitors' perceptions, through the application of questionnaires and semi-structured interviews. In this direction, it is possible to glimpse that the approach to neurosciences represents a fruitful possibility to deepen the investigations on the relationship between tourism and



wellness. The use of tools such as eye-tracking, for example, can evince new research gaps and mainly new focuses that can explain other dimensions and impacts of touristic experiences over the wellness of visitors. An initial challenge, in this sense, is to recognize the state of the art in research covering the use of eye-tracking on wellness studies.

2. Methodology

This is an exploratory and descriptive study, of qualitative nature, conducted based on a Systematic Literature Review (SLR). According to Paul and Criado (2020) to be aware of the following:

Systematic literature review articles can be broadly classified as domain-based, theory-based, and method-based. In addition to these categories of systematic literature reviews, meta analytical reviews are also increasingly popular in many different subject areas (Paul and Criado, 2020, p. 1 - 101717).

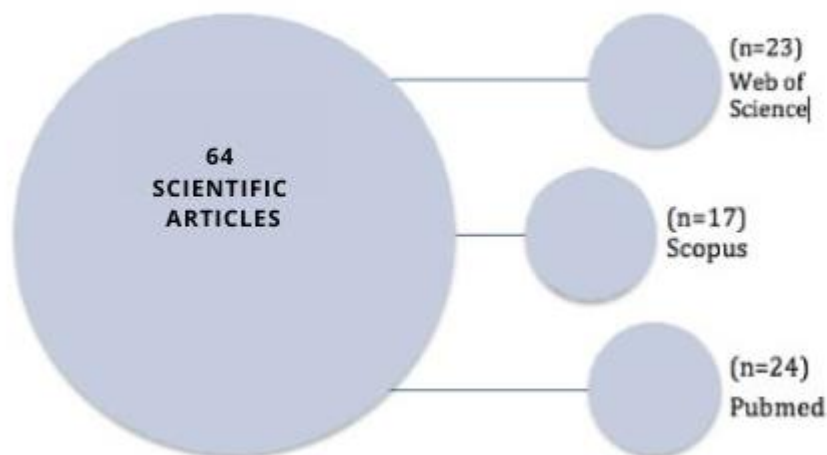
Therefore, the SLR conducted in this study is categorized with what is called "domain-based", and its main goals are to structure scientific knowledge based on the main constructs, theories, and methods used. This review category is fit to identify research gaps (Paul and Criado, 2020). There are many guidelines on how to design a Systematic Literature Review, and we chose to use the Prism Flowchart (2009) once it is widely used, including in international publications from many areas, but still little used in tourism studies.

The diagram that represents the Prism flowchart presents four well-defined and sequenced phases, namely: Identification, Selection, Eligibility, and Inclusion. A relevant details is that, based on that, it is possible to



observe when materials (in the case of this study — Scientific articles published in English) are repeated on the different consulted bases (see Prisma, 2009). Beyond that, it is important to clarify that three databases were consulted through the Capes Journal Portal (2023) via Cafè access, namely: Scopus, Pubmed, and Web of Science (WoS). For the search string, in each of the bases, descriptors were determined, which add the use of eye-tracking and variations of the wellness term in English (welfare, wellbeing, and wellness), as shown in Figure 1:

Figure 1. Initial material identification phase



Source: Designed based on an adaptation of the Prism Flowchart (2009)

During the selection phase (see Figure 1), a series of repeated articles was identified (**n= 24**), and they were excluded. After the eligibility phase, during abstract reading, it was clear that a set of articles dealt with studies on animals, and another one focused the study on the treatment of diseases or aspects of senility, being also excluded. On the other hand, a set of articles deals with aspects of consumerism, others with decision-making processes, and another article was related to the work world, and they were all included in the

qualitative analysis. Therefore, the total number of articles for textual analysis was $n=12$. No meta-analysis was conducted, once this quantitative dimension was not evident was a possibility for comparison based on the identified empirical studies. For the analysis of the contents of abstracts, the software Iramuteq version 0.7 Alpha 2 (see Salviati, 2017) was chosen since it allows to elaborate textual analyses that are useful to understand how eye-tracking is used in wellness studies. Additionally, this software is open source and free.

Given all the possible *outputs* of the Iramuteq software, two were selected for the qualitative-quantitative analysis of the contents of the textual corpus, namely: Word Cloud and Similarity Analysis (see Salviati, 2017). Also, in methodological terms, the Iramuteq Application Guide by Salviati (2017) was used to correct the textual corpus, adjusting the terms *eye_tracking* and *eye_tracker*, just as adapting, in the properties, adverbs as supplementary. Beyond that, specifically in the Similarity Analysis, terms with frequencies equal to or above 5 were considered since this grants more visibility to the analyzed content. Next, we present and discuss the results, seeking to learn lessons from the wellness area that uses eye-tracking for advances in tourism studies.

3. Results and Discussion

3.1. Overview

The overview of the textual corpus corroborates what Paul and Criado (2020) have highlighted about this type of systematic literature review, that is, there is a scheduling with the aim of evincing what was extracted from consulted bases in an organized way for the readers. Beyond



that, in this phase, we also show the methodological aspect (see Section 3) of the codification of the textual corpus, in which abstracts were transformed into variables through the following code: ****abst_0n, in which "n" is the number of abstracts in the corpus.

Chart 2 summarizes the codes and overview, allowing to know whether the studies are theoretical or empirical, if the eye-tracking use in the studies was fixed or wearable, as well as the theoretical-conceptual framework on wellness.

Chart 2. Codes and overview

Cod.	Author(s) (year)	Journal	Article (theoretical or empirical*)	ET (fixed or wearable)	ET (Model)
****abst_01	Colombo, Laddaga, Antonietti (2015)	Procedia Manufacturing	Lab	Wearable	Tobii x-120 eye-tracker
****abst_02	Zheng,Glock, Grosse (2022)	Computers & Industrial Engineering	Not applicable	Not applicable	Not applicable
****abst_03	Lea et al. (2018)	Personality and Individual Differences	Not applicable	Fixed	Eyelink II eye-tracker
****abst_04	Birenboim, A;	Environments. Int.	Not applicable	Fixed	HTC Vive Pro

	Bloom, PB; Levit, H; Omer, I (2021)	J. Environ. Res. Public Health			Eye HMD
****abst_05	Balocco, C; Volante, G (2018)	Sustainability	Lab	Wearable	Tobii Pro Glasses2
****abst_06	Zhao, J; Yang, H; Weng, XC; Wang, ZG (2018)	Frontiers in Psychology	Lab	Fixed	EyeLink 1000 eye-tracker



****abst_07	Duclos, R (2014)	Journal of Consumer Psycholog y	Lab	Not informed	Not informed
****abst_08	Padilha, LGD; Malek, L; Umberger, WJ (2021)	Sustainability	Lab	Wearable	Tobii Pro TX300
****abst_09	Schroter, I; Mergenthaler, M (2019)	Sustainability	Lab	Wearable	Remote eye- tracker (SMI RED, Senso Motoric Instruments GmbH
****abst_10	Logar, I; Brouwer, R; Campbell, D (2020)	Resource and Energy Economics	Lab	Not informed	Not informed
****abst_11	Tuszynska- Bogucka, W; Kwiatkowski, B; Chmielewska, M; Dzienkowski, M; Kocki, W; Pelka, J; Przesmycka, N; Bogucki, J; Galkowski, D (2020)	Annals of Agricultural and Environmental Medicine	Lab	Fixed	Tobii TX300 Eye- tracking
****abst_12	Wang, TC; Tang, TW; Tsai, CL (2022)	International Journal of Environmental Research and Public Health	Lab	Fixed	Tobii X2-30, Danderyd, Sweden

* Empirical studies can involve lab studies or ecological experiments.

Source: Designed by the authors

According to Chart 2, in the 12 texts that approached the relationship between eye-tracking and wellness, it is possible to see at first that this investigation theme is still very new, gaining some interest only in the last five years. Another important data is that the studies found were conducted in labs, except for the work by Zheng, Glock, and Grosse (2022), who carried



out a systematic literature review, which suggests that the use of eye-tracking in field studies on wellness is still a challenge, possibly due to limitations imposed by external environments, such as less control, noises, unforeseen incidents, among other factors. Most of these lab studies mixes the eye-tracking with other data collection instruments, such as questionnaires, interviews, and opinion polls. This may represent a strategic path by combining different data collection and treatment techniques in studies on tourism and wellness, since it is a way of bringing together neuroscientific and traditional methods, conferring more reliability.

As for the type of eye-tracking tool used, five works prioritize the use of fixed eye-tracking, associated with monitors that capture the participants eye movements in lab studies. Four of them, however, have adopted wearable eye-tracking tools, which, on the one hand, amplifies data collection at the moment the touristic experience occurs, but is also a challenge regarding noises, as already reported.

A closer reading of the texts selected by this study allows a view over the focuses adopted by each study, as well as the contributions and challenges they present to ET use in measuring different behavioral aspects and implications of the participants' quality of life and wellness. This approach can give rise to innovative ideas and theoretical-methodological correlations for the study of wellness in tourism, through the use of eye-tracking and thus widening the spectrum and dimensions of investigation.

The works by Colombo et al. (2015), Padilha et al. (2022), Schroter et al. (2019), Tuszynska-Bogucka et al. (2020), and Wang et al. (2022) have used eye-tracking to measure the participants' attention pattern seeking to recognize elements that are visually more attractive, able to raise more interest, fix the attention, and create emotions in simulated processes of decision-making regarding buying and/or choosing different types of products/services/environments.

Colombo et al. (2015), for example, have focused on the study if



specific cognitive reasons that can lead people to perceive an environment as pleasant and restorative, in a context of choosing different interior design projects. Inspired by Mandler (1984), the authors consider that the type of pattern we activate determines how difficult it will be to process environmental information and it will affect the subject's attention. An environmental pattern is not a cognitive construct, but it also includes emotions (p. 2260). Simultaneously, the Attention Restoration Theory, proposed by Kaplan and Kaplan, indicates that a restorative place is a place that allows people to relax, which promote positive emotions and takes a break from daily routine (p. 2261), thus considering that the environment's characteristics can work as predictors of its pleasantness/unpleasantness.

This authors have found, in this case, that natural environments tend to attract more attention and thus promote more feelings of wellness. They have also observed that the presence of specific elements in the environment, such as human figures, doors and passages, natural elements, and daily life objects promote a positive emotional reactions and an expression of preference by buyers. Therefore, it seems relevant to consider the possibility of using eye-tracking in a lab event that seeks to simulate different touristic experiences — a track in a natural park and another one in an urban center, for example —, enabling to understand emotions, perceived comfort, emotional restoration and wellness degrees, as well as the most valued aspects for visitor experience in each case.

In the same sense, Wang et al. (2022) have conducted a study to confirm the influence of marketing images on visual attention and psychological responses by senior clients in terms of wellness and willingness to pay in hotel services. According to the authors, wellness is a central concern for older consumers. In the case of touristic hotels, the investments in improving/implementing wellness services can thus create an income increase and the business' strategic rebranding in the market. Therefore,



Wang et al. (2022) assume that, if marketing messages provided by the hotel meet the consumer's expectations to recover from mental fatigue and relieve stress, this will affect their preferences, behavior, intentions, and choice decisions (p. 03). The authors adopted in the study three investigation focuses based on the attention restoration theory: visual attention (measured by eye-tracking), perception (questionnaire with questions on perceived wellness/Likert scale) and behavioral responses (poll). These focuses would correspond, according to the authors, to three key responses of senior consumers after observing the images of wellness services.

Eye-tracking was used to assess the participants' visual attention. For Wang et al. (2022), in marketing, the eye-tracking technology, used to capture individual eye movements, has been used to assess the clients' attention regarding advertisement, proving itself an efficient tool to evaluate the images' appeal (p. 5). The main indicators used to assess individual visual attention were, according to the authors (*Idem*), fixation count, which is the number of times a person interacts with the stimulus, in which a higher fixation count indicates the participant thinks the information is more attractive, and the fixation time, which indicated a processing time for the person to observe the stimulus, in which a higher fixation time indicates that the person spent more time examining the information.

During the experiment, two images were projected: wellness services with natural elements and wellness services with human-made elements. The pictures of wellness services with natural characteristics ("yoga practitioner in a open-air and wooded place") have gained more attention, that is, the participants spent more time observing these images. These results corroborate other studies (Li et al., 2016; Wang et al., 2019) and suggest that marketing and leisure services in natural landscapes that involve practicing open-air activities are more effective in terms of publicity and visual attention. One of the indications by Wang et al. (2022) is that



natural environments have higher restoration effects, connected with the idea of relaxation and improving quality of life.

3.2. Text analysis

Text analysis allows us to go beyond the general view, zooming in on two perspectives: Word Cloud and Analysis of Similarity, respectively in Figures 2, 3, and 4. In Figure 2, it is possible to identify the most frequent terms (frequency = f) based on the textual corpus composed by n=12, with: *eye-tracking* (f=23); *visual* (f=17); *emotional* (f=14); *environmental* (f=14); *production* (f=14); *study* (f=14); *research* (f=14); *sustainable* (f=13); *information* (f=13); *result* (f=12); *attribute* (f=12); *consumer* (f=11); *light* (f=11); *word* (f=11); *design* (f=11); *environment* (f=11); *positive* (f=10); *method* (f=10), among others.

A curious data is that the terms related to wellness are not the most frequent ones. On the other hand, the repetition of the terms *environmental* (f=14) and *environment* (f=11), adding to a 25 frequency and surpassing the frequency of the *eye_tracking* term, which places it as an auxiliary tool to capture and measure environmental phenomena, be them inside a lab or in ecological studies (see Chart 2).



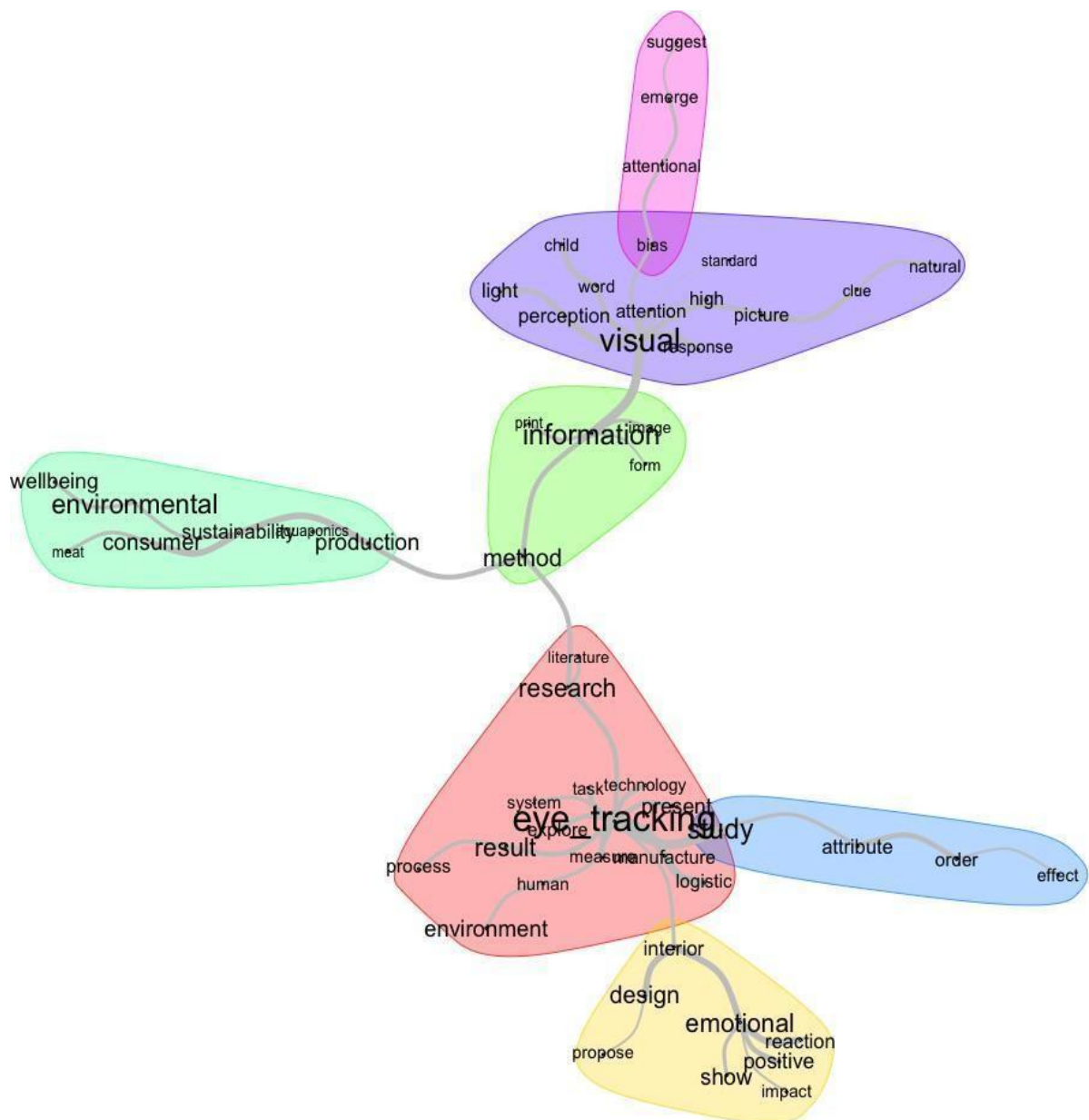
Figure 2. Word Cloud



Source: Designed by the authors based on Iramuteq

Still regarding Figure 2, it is possible to observe that in wellness, within the discussions of sustainability, the frequency of the term *sustainable* (f=13) seems to be central in studies using eye-tracking. On the other hand, these affirmations can only be confirmed with a magnifying glass to extract term occurrences in the textual corpus. This is the main goal of the Analysis of Similarity once, based on the Graph Theory, it will allow for the observation beyond the frequencies seen in Figure 2, showing the relationship between the most frequent terms (see Figure 3):

Figure 3. Analysis of Similarity (frequency equal to or above 5)



Source: Designed by the authors based on *Iramuteq*

The Analysis of Similarity provided seven word communities, for an adopted frequency equal to or above 5 (five) per term. In this sense, in Chart 3, it was possible to establish numbering to organize and discuss the halos,



with the central halo being formed by the term eye_tracking (Halo 1).

Chart 3. Lesson from wellbeing studies using eye-tracking for Tourism.

Halos	Lessons
1 – Eye-tracking	It is necessary to have well-designed tasks in experiments, be them ecological or lab ones.
2 – Emotional	Study of the emotional motives and positive impacts.
3 - Study	The attributes are related to the effects; thus, it is necessary to consider what eye-tracking hardware and software programs can offer, but also to have well-defined theoretical categories and effects to be captured.
4 – Information	Eye-tracking research demands a method that is supported by environmental issues and visual perception (with attention).
5 – Environmental	Consumption studies seem to be highlighted, thus being a possible natural path for consumption science to contribute to tourism and wellness studies.
6 – Visual	Wellness is connected to sustainability issues and it seems to be a methodological axis of eye-tracking research.
7 – Bias	Attention biases need to be considered in eye-tracking research.

Source: Designed by the authors

As mentioned, in a post-pandemic scenario, growth trends in the segment of health and wellness tourism were sped up precisely due to this “restorative” characteristic, with the observation of an increase in the search for less crowded destinations, notably open-air ones, with more possibility of contact with nature, and more committed to sustainability principles and direct benefits to health and wellness. As a result, such experiences tend to contribute directly to reduce stress, change spirits, treat illnesses, such as indicated by Andreu et al. (2021). Therefore, studies using eye-tracking could help to better understand the most valued elements of a certain touristic experience focused on wellness, identifying the stimuli that arouse the visitors' interest and attention the most (**see Halo 5**). With the exception of the work by Zheng, Glock, and Grosse (2022), it is evident (**see Halo 1**) that wellness studies using eye-tracking are mostly conducted in lab. In this sense, a frontier to be incorporated by tourism studies is to incorporate



wearable tools, such as ET glasses — which allow us to understand the experience as it happens.

Regarding Halo 3, the lesson learned from wellness studies is related to the fact that the theory has to walk *pari passus* with the used methodology. The variation of ET models (see Chart 2) needs to be scrutinized by tourism studies, as initiated by Scott et al. (2019).

Another study that brings important inspirations to research on tourism, wellness, and the use of eye-tracking was conducted by Birenboim et al. (2021). By adopting a new immersive virtual environment (IVE) technology, the authors sought to study the behavior during walking, aiming to better understand the experiential and emotional dimensions of walking, directly related to the wellness theme. According to Birenboim et al. (2021, p. 02), a concept that gained centrality in this sense is walkability, which represents to which extent the constructed environment eases or hinders walking in daily life. Thus, for these authors, walking-friendly environments are more attractive, inspiring, and resonate more on the creation of direct benefits. For that, they combine characteristics such as safety, presence of green areas, proper lightening, structure, cleanness, among other factors, corroborating to the indications of Wang et al. (2015), Londe & Mendes (2016), and Grilli et al. (2020) **(see Halos 2 e 6)**.

On the other hand, one must highlight that the immersive virtual environment (IVE) has incorporate the use of sensors (biosensors, walking sensors), software, and eye-tracking. The main results indicate that IVE technology allows to collect high-resolution advanced information on human behavior, using many sensors and sophisticated self-reporting, which is hard to obtain in real-life conditions. For the authors, these technological skills can help researchers to make associations between specific environmental and psycho-physiological stimuli and behavioral reactions and, thus, wellness (Birenboim et al., 2021, p. 14).

However, this study highlights that there are still limitations to the use



of immersive virtual environments once it is a technology still under development, which makes it challenging to create high-fidelity simulations; demands a limited level of interactions between users and IVE; makes treadmill walking mechanisms still imperfect; demands high resources involved in acquiring equipment; as well as there is low knowledge on the use of this technology, among other factors **(see Halos 4 e 5)**.

Anyhow, this study also suggests possible experimentations for the case of the wellness tourism segment. The use of IVE technology could allow us to simulate a visit to different touristic attractions, comparing, for example, urban and rural areas, with or without the presence of natural elements, with low and high visitor concentrations. In each case, it would be possible to recognize the impressions, emotions and level of attention given to the different elements that constitute touristic attractions, thus recognizing the most valued elements and proposals that are potentially linked to wellness sensations **(see Halo 2)**.

Tuszynska-Bogucka et al. (2020), based on the Supportive Design Theory, by Ulrich, and on the Theory of Healing Environment, by Malkin, sought to measure the reactions of study participants when looking at visualizations of many interiors, with the intention of checking whether certain parameters of an interior are related to emotional reactions in terms of positive stimulation, feeling of safety, and comfort. The architectural space can have a diverse emotional meaning and affect an individual's emotional state. This is an important conclusion from the point of view of optimizing and creating the so-called healing and supportive environment (p. 114).

For that, the study focused on pupil size changes, the parameter that is most frequently associated in literature with emotional reactions, through eye-tracking. According to the authors, the obtained results have confirmed the relationship between reactions and pupil size, suggesting that pupil dilatation was typical in positive evaluations of a presented image



(Tuszynska-Bogucka et al., 2020, p. 120).

Despite this result, changes in pupil size can be caused by other factors, according to Tuszynska-Bogucka et al. (2020), such as stress in reaction to the presented visual materials, the charge of cognitive processing, the amount of light or color in visual stimuli, and luminance-contrast (**see Halo 2**). Despite such limitations, the use of eye-tracking in this case confirms that it is possible to capture emotional reactions to different interior designs (**Halo 2**). Correlating this to the tourism and wellness area, once again, this study indicates the possibility of measuring the impact of diverse touristic projects (hotel rooms, halls, leisure, rest, and entertainment areas, among other places) over individual wellness, including to test the emotional meaning of architectural projects before they are implemented, as pointed out by Tuszynska-Bogucka et al. (2020).

Lastly, it was evident that the theoretical and conceptual advances on cognitive biases are key to a full analysis. For example, in **Halo 7** the relevance of dealing with this perspective is highlighted. Depicting this, Lea et al. (2018) has dealt with emotional intelligence from the perspective of biases for positive emotions, by using ET.

Final Remarks

The main goal of this study was achieved, that is, lessons were taken from scientific literature based on a systematic review. Moreover, with the support of the Iramuteq software, it was possible to trace a compilation of lessons learned that draw a kind of agenda for further studies, which is the greatest contribution of this study.

In practical terms, the contributions reached here light ways for advances in tourism research using ET. For example, establishing a parallel



between the analyzed works (n=12) and the tourism and wellness area, it would be possible, using eye-tracking, to investigate the levels of perceived wellness by visitors in natural parks in a methodological perspective other than the traditional self-declaration.

The limitations of this study, based on the identification of the limited bibliographical references on the theme, comprise the need to widen the search to other fronts, such as: (a) scientific events; (b) dissertations and theses repositories; (c) other scientific bases. That way, it will be possible to verify the existence of and to incorporate other works on wellness and eye-tracking, adding efforts to advances in tourism studies.

In this case, further studies in which a field search designer is possible, we suggest considering two distinct groups, namely: (A) casual visitors, and (B) regular visitors. During the experiment, it would be possible to verify the existence of possible differences in the attention pattern (fixation count and time) in relations to interpretative signs placed throughout a trail. A hypothesis to be tested is that more regular visitors, thus with higher environmental engagement, take more time reading the signs, in search of learning more with the experience. As a result, they would present higher levels of perceived wellness, as indicated by the study by Lin et al. (2013), precisely due to the level of engagement, habits/live purpose, and orientation to nature.

Thus, suggesting this experiment design for tourism and wellness is only made possible by the advance undertaken here, deepening into the theories and methodologies arising from the use of eye-tracking in wellness studies, in the midst of the interface with the further development with neuroscience and computation. Therefore, further studies must also consider the other side of the coin, investing on a systematic literature review related to the use of eye-tracking in tourism research, thus adding expertise and completing the framework (see Chart 3) of lessons to begin an agenda of experimental studies on tourism and wellness using eye-tracking.



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