Vitis **58** (Special Issue), 13–19 (2019) DOI: 10.5073/vitis.2019.58.special-issue.13-19

Implementation of sensory stimulation technology in an interactive room for the diffusion of wine making activities

J. C. Saavedra Campos[1)], A. E. Infantes Chávez[2)], H. J. del Carpio Beltrán[1)], J. C. Zúñiga Torres[1)] and J. J. Milón Guzmán[1)]

[1)] Laboratorio de Ergonomía, Universidad Tecnológica del Perú, Arequipa, Peru
[2)] Universidad Católica San Pablo, Arequipa, Peru

Summary

The present innovation project attempts to bolster the promotion and diffusion of wine-making activities through the introduction of 'dynamic sensory stimulation' technology (DSS). The first objective of this paper is to describe the implementation of an interactive lounge that uses this technology for the display of some organoleptic characteristics of pisco and wine. DSS technology is outfitted with synchronized equipment which provides the visitors with an integral, sensory experience consisting of climatic stimulation, similar to the one of the vineyard (principally in regard to temperature and relative humidity); olfactory stimulation with different aromas *via* a controlled spray (simulating the collection of smells associated with the processes of fermentation and distillation); scientific-gustatory stimulation (technical tasting); and audiovisual stimulation through images and sounds typical of a vineyard. The paper's second aim is to describe the perception and satisfaction level of the visitors of the interactive lounge. The results indicate that it is possible to utilize DSS technology in an interactive lounge in order to further the diffusion of wine-making activities in Arequipa, Peru.

Key words: interactive lounge; dynamic sensory stimulation; organoleptic properties; wine making.

Introduction

Sensory marketing for wine making activities: Beverage products resulting from grape (wine, brandy, pisco, etc.) are known for their organoleptic properties as their smell, color, flavor and texture (Charters and Ali-Knight 2002). Sensorial stimulus has an important impact on a consumer's perception and mental schemes about services or products: which can in turn affect its behavior, decisions and choices (Ramsoy *et al.* 2012). There are several examples that show how sensory marketing can affect the way people think about a product or service. For example, the sense of touch influences on judgement when it comes to beverages: conclusions are drawn from the container, instead of the quality of the beverage. The same phenomenon happens with bags of chips, if they are difficult to open, consumers will think that the content has a good quality and that it tastes better than the ones packed in bags that open easily (Krishna and Morrin 2008). Odors, sounds and visual stimuli can evoke emotionally charged memories (Ramsøy *et al.* 2012), but the olfactory system is even more related to memory (Van Campen 2014); furthermore, it has an impact on the attention and the time a consumer spends inside a place (Morrin and Ratneshwar 2003). Krishna and her colleagues (2016) have shown that multi-sensory marketing impacts consumers decisions, attention and perception in a positive way.

Nowadays, there is an increasing interest shown by wine enthusiasts to discover the process of wine and pisco production; this situation has led to the growth of tourism related to this productive activity (Montella 2017). Several successful cases have shown that the wine tourism market is developing, and that this kind of tourism is setting an innovative trend (Asero and Patti 2009). These experiences often include the acquisition of know-how about production, wine tours, beverage tastings, etc.; and they could be enhanced with marketing techniques (Asero and Patti 2009). Sensory marketing strategies could generate a new way to create bonds between consumers and brands (Tien Minh and Thi Truc Ly 2005). The objective of this study is to describe the technical aspects of the implementation of a pilot room that seeks to inmerge visitors in an environment that, by its sensory stimuli, reminds the one of a wine and pisco production plant. Furthermore, the perception of the stimuli and the satisfaction of customers that tested the interactive pilot room was assessed.

Gustatory senses stimulation: The sense of taste plays an important role for the survival of human species: its role transcends social and emotional spheres. It is associated with happiness. Even though it is known that the marketing strategies that involve the stimulation of this sense increase the value perceived by consumers, gustatory sense is not exploited enough (Esmailpour and Zakipour 2016). Tasting experiences must be presented in an intuitive way for the user and should be accompanied by other stimuli. For example, the use of vivid names to

Correspondence to: Dr. J. J. Milón Guzmán, Ergonomy Laboratory, Universidad Tecnológica del Perú, Av. Tacna y Arica 160, Arequipa, Arequipa, Peru, 04000. E-mail: jmilon@utp.edu.pe

describe their products improves restaurants sales by 27 % (Shabgou and Mirzaei Daryani 2014).

When it comes to wine, it is known that its flavor, quality, stability and other sensory characteristics depend on several groups of compounds found on the grapes, and this information must be transmitted to the consumer (Jordao *et al.* 2015).

Touch sense stimulation: Skin, the largest sensory organ of the body, acts as a support to other senses when customers judge products in terms of their material, temperature, weight, and form (Shabgou and Mirzaei Daryani 2014). Even if customers do not necessarily have the same need of touching products, when they do, it always generates an impact on their purchase response (Esmailpour and Zakipour 2016).

Audio-visual stimulation: Visual stimuli impacts the judgment and decisions of the people who are submitted to it. The transmission of information through visual stimuli, mainly in the absence of verbal stimuli, creates emotional bonds and cognitive responses. For example, in response to visual stimuli, people approach objects, touch them and define their relationship with them.

Around 80 % of the communication for the commercialization of different products or services is seeks to stimulate the sight. For example, the form of an object is an example of visual stimulation that has to be defined during the conception of a product, since it will have an impact on people exposed to it (Shabgou and Mirzaei Daryani 2014).

Sensory stimuli linked to sound, such as voices and music, can improve a customer's experience when linked to visual stimuli. Sounds are the second most used sensory element in marketing (Esmailpour and Zakipour 2016). Approximately 41 % of the strategic efforts to position a brand are focused on sounds, since they affect the mood, the preferences and the decisions of the consumer (Shabgou and Mirzaei Daryani 2014).

Multi-sensory stimulation: Several studies on multi-sensory stimulation indicate that costumers of different brands link all the perceived sensory attributes of the product unconsciously. It is through the senses that people collect information from the environment that surrounds them, in an active way, to form perceptual patterns that will be stored in the different regions of memory, such as sensory memory, short-term memory and long-term memory. When a product is designed in a way that stimulates the senses, the probability of recording the memory of it increases (Esmailpour and Zakipour 2016). Sensory stimulation is used in different areas, such as neuropsychological treatments for different pathologies (Strøm *et al.* 2016). The stimulation of the sensory system impacts directly the morphology of the brain (Rowley and Williams) and influences decisions (Drønen 2016). The technology that stimulates the senses through smell, sound, sight, taste and touch allows users to enhance their experience (Esmailpour and Zakipour 2016). From the perspective of design, physical environments that stimulate the senses in a systematic way are a mean to enrich consumer experience, avoid message conflicts and enhance a product's perception and positioning in customers' minds (Schifferstein 2011).

Experimental Model: For the experimental study, a pilot room was divided into different modules (Fig. 1): 1) a climatic-stimulation module (humidity and temperature control equipment), 2) an olfactory-stimulation module (controlled-spray equipment), 3) a scientific-gustatory stimulation module, and 4) an audiovisual stimulation module.

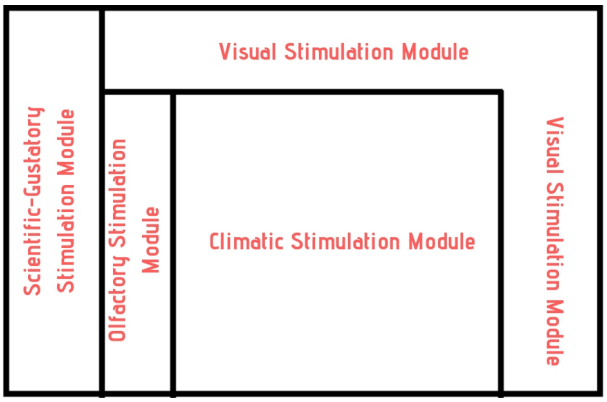

Fig. 1: Experimental model.

Scientific Gustatory Stimulation Module: This module is composed of the configuration station and the controlled tasting counter. Here, the global organoleptic characterization of grape-derived products is performed, complemented by a technical survey relating to the identification of aromas and flavors.

Olfactory stimulation module: The olfactory stimulation chamber emits aromatic liquids that correspond to the production stage of wine making (e.g., fermentation, distillation, etc.).

Climatic stimulation module: Relative temperature and humidity are controlled in order to simulate climatic aspects comparable to those observed in vineyards and in wine cellars. Aspects such as comfort and thermal shock are considered in the study. The climatic chamber is fed with controlled temperature humidified aromatic air from the machine room (Fig. 1). It can be observed that the temperature and humidity control system sends (and receives) air from the module through the intake and output conduits, respectively.

Visual stimulation module: This module is composed of a micro-plant that performs wine and pisco production processes at a small scale: it contains equipment for the extraction, fermentation, distillation (still), constitution, and bottling of wine and pisco. All of these processes are characteristic of the production of the grape spirit. This module also includes a stimulation area with multimedia tools that show information about the history of grapevines and wine production in the region.

Instrumentation: Thermocouples and sensors were installed to monitor relative-humidity in the lounge. This strategy was used in order to study the homogenization of temperature and humidity (climatic stimulation) and the propagation of aromas (olfactory stimulation).

Results and discussion on the interactive pilot room setup: For the analysis of customer's perception in the interactive pilot room, stimulation experiments were prepared and conducted. The customer's "immersive experience" was programmed to

last an hour, hence, the stimulation experiments were conducted based on this period.

Climatic stimulation: Temperature was fixed at 30 °C, maintaining the relative humidity (RH) at 25 %. This was registered by 27 thermocouples, as shown in Fig. 2. The thermal load of the chamber was five people. In this context, the temperature was reached in less than 75 min. The next step was to know if this curve family could be represented by just one curve (from only one thermocouple). The error propagation was analyzed, and the results showed that the margin of error went from 0.1 °C to 0.7 °C (from 0.8 % to 6 %). Those values are reasonable

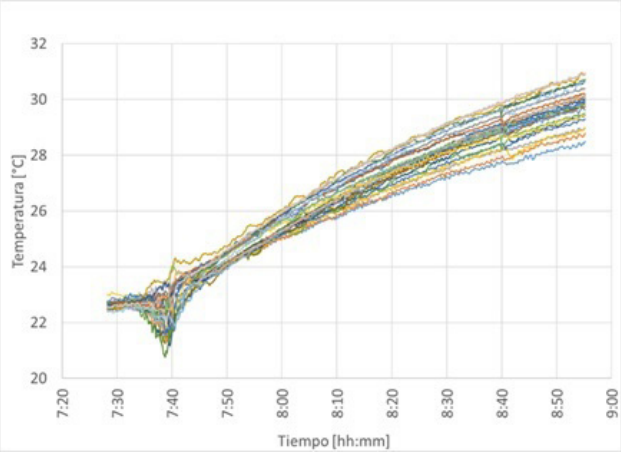

Fig. 2: Dispersion of temperature values, experiment at 30 °C and 25 % of RH.

in order to obtain only one temperature reference which is then applied to all subsequent experiments.

Fig. 3 shows the heating and cooling times at different temperatures of the lounge with a thermal load of five people. These data refer to an ambient temperature of 20 °C and a relative humidity of 25 %, constant for all the experiments. The same procedure was realized in order to find the representative curve, maintaining the margin of error between 0.1 °C and 0.7 °C (from 0.8 % to 6 %). To both curves, a logarithmic-tendency line was added. This is due to the fact that the behavior of the air-conditioning equipment is less efficient while the regulated temperature diverges from the ambient temperature. In Fig. 4, the tem-

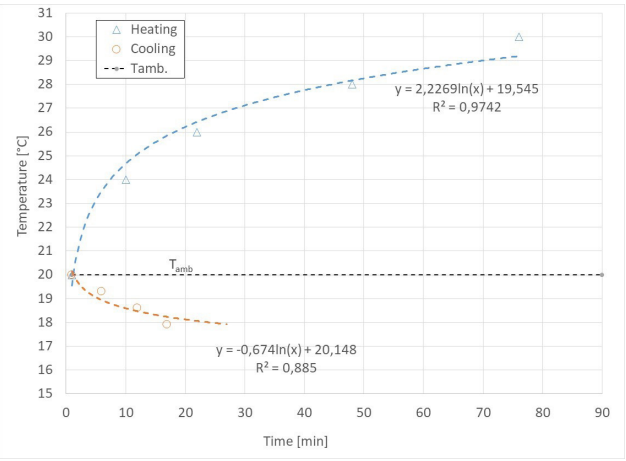

Fig. 3: Heating and cooling times, 25 % RH..

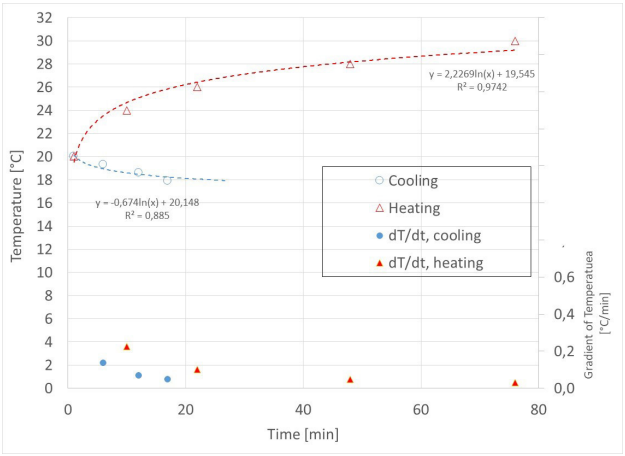

Fig. 4: Temperature gradient for heating and cooling, 25 % RH..

perature gradient has been generated, which would represent the heating and cooling velocity at which the people receive the stimulus in terms of temperature. Those values depend strongly on the heating and cooling capacity of the equipment. In this case, as it was mentioned, the air-conditioning equipment also functioned as a heat pump and had temperature gradients similar for both processes (heating and cooling). These values went from 0.13 °C·min^{-1} to 0.049 °C·min^{-1} for cooling and 0.22 °C·min^{-1} to 0.029 °C·min^{-1} for heating.

In order to know if there is a temperature difference which could affect the comfort of the visitors, the temperature difference was evaluated at different height points. They were represented by thermocouples positioned at 70 cm, 160 cm, and 230 cm. In Fig. 5, these comparative curves are presented. According to the study conducted by the National Center of Working Conditions of Spain, when the difference is of 3 °C, the percentage of dissatisfied people is 5 % (National Center of Working Conditions of Spain, 1998). Therefore, the results indicate that there should not be discomfort because of the presence of the vertical temperature gradient, since the results showed a maximum difference of 0.7 °C between the 70 cm position and that of 230 cm.

Variation in relative humidity was analyzed at the same height as temperature. This experiment was conducted at an external temperature of 21 °C and 24.7 % ex-

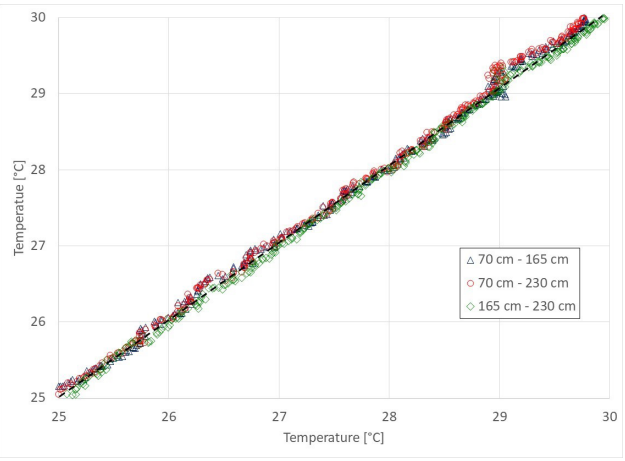

Fig. 5: Vertical variation of temperature, 25 % RH..

ternal relative humidity, for a thermal load of five people. It can be observed that the humidity presents a larger dispersion for the different positions, evidencing the sensitivity of this parameter to the slightest temperature perturbation, air flow, or internal, variable condition of the lounge (e.g., furniture, people, etc.). In order to know if this curve family could be represented by just one curve (from just one RH sensor), the error propagation was analyzed (standard deviation). In this way, Fig. 6 was generated. Upon obtaining just one curve, the average margin of error was 3.8 % (minimum of 0.23 % and maximum of 5.6 %), which is represented by the dark area in Fig. 6. These values are reasonable for the attainment of just one temperature reference which is then applied to all the following experiments.

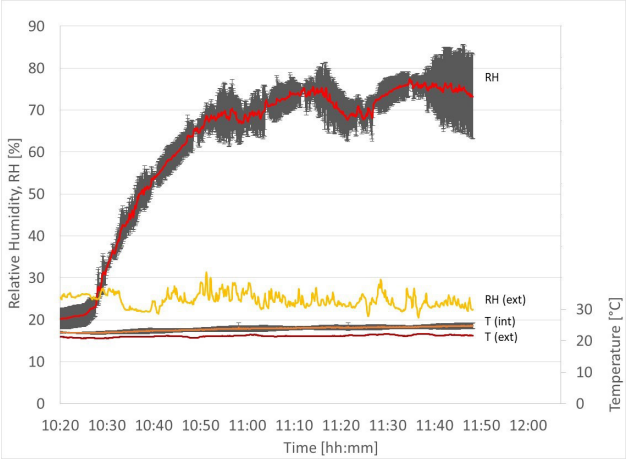

Fig. 6: Average curve with error propagation in RH at an external temperature.

In Fig. 7, the variation in relative humidity is observed for three sensor positions (*i.e.*, in the center of the lounge, in the back of the lounge, and next to the window). These particular positions are evaluated because they represent the critical points which could have different values from what is expected when dealing with a thermal load of five people. The point of reference is the center of the lounge. The back position of the lounge was evaluated because it is the farthest point from the air-conditioning system. The position next to the window represents a space which might be affected by external factors (e.g., temperature and solar radiation, among others). It should be pointed out that these experiments were conducted at an external temperature of 21 °C and 24.7 % external relative humidity. It can be observed in Fig. 6 that the critical points yield lower humidity values than those observed in the central position of the lounge.

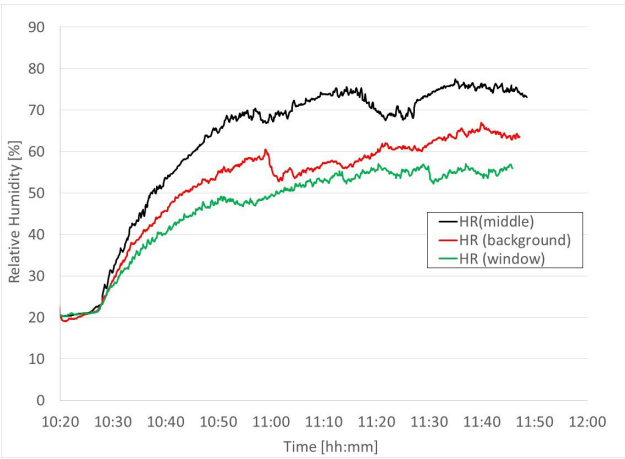

Fig. 7: Variation in RH for three sensor positions at an external temperature of 21 °C and 24.7 % external relative humidity.

In Fig. 8, the differences in relative-humidity values relative to the reference point (*i.e.*, the central position) are presented with the values on the critical positions (the back of the lounge and next to the window). It can be observed that relative humidity presents a difference of up to 18 %, but on average this value is just 10 % (for both cases). In technical terms, this difference represents an acceptable and imperceptible value difference in terms of stimulation, and this value can be considered homogeneous in the whole environment of the interactive lounge.

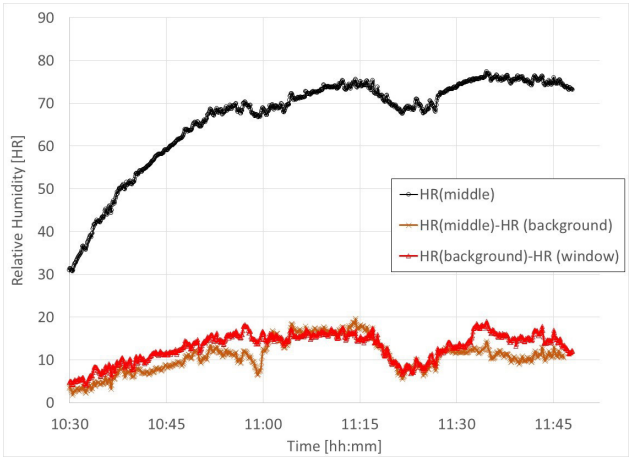

Fig. 8: Relative humidity difference with respect to the center at an external temperature of 21 °C and 24.7 % relative humidity.

Olfactory stimulation: The sensory-stimulation technique is similar to the relative-humidity control technique, which is to say that it is based on the diffusion of aromatic liquid (99.9 % water) through the air current produced by the air-conditioning system. The analysis of the olfactory-stimulation process is conducted through the diffusion of the aromatic liquid in the interactive lounge, and the results are based on the same relative-humidity graphics. The diffusion process is the same for both water vapor (in the case of relative humidity) and the aromatic liquid micro-particles: it is observed that the aromatic liquid does indeed propagate in the same conditions as the water vapor. It can also be observed that the average difference is 10 %, referring to the central position of the lounge relative to the back position and the position next to the window. These values, as for humidity, represent admissible values for the olfactory-stimulation process.

Audio-visual stimulation: The audiovisual stimulation is performed through the presentation of the wine and pisco manufacturing micro-plant, which operates and produces wine and pisco in small scale, the presentation of dioramas of the vineyard and wine-making processes (Fig. 9), and through sound and video equipment.

Gustatory-scientific stimulation: A

Fig. 9: Dioramas of the vineyard and wine-making processes.

process typical of wine and pisco tasting is performed: customers are introduced to standardized flavors as well as flavors of the grape-derived products (wine and pisco). The designated space is the tasting counter, where an expert provides technical assistance.

Results on customer's perspective: In order to assess the customer's experience and their satisfaction, an exploratory study was performed through a survey validated by experts.

Survey characteristics. Sample: The authors opted for a non-probabilistic random convenience sampling (Otzen and Manterola 2017). The interviewed visitors were not wine connoisseurs. The measuring instrument was applied to a sample of 27 people who visited the interactive room of the Wine and Pisco Museum in September 2018 and who agreed to be part of the study. 59.3 % of the visitors that composed the sample were men, while the remaining 40,7 % were women. The chosen visitors had an average age of 34 years, and 44.4 % of them were between 18 and 64 years old. Furthermore, all the sample was made up of Peruvian nationals, from which 70.4 % came from the region of Arequipa, where the study was conducted.

Data collection plan: After signing a consent concerning their voluntary participation in the study, participants were subjected to the sensory stimuli produced by the interactive room. Information concerning their reaction to the technology used and the stimuli produced, was retrieved after the visit through a questionnaire. The results are presented below.

Questionnaire: A self-report questionnaire was designed for the survey. Two versions were developed: one in Spanish, for locals, and one in English, for non-Spanish-speaking tourists. Due to the characteristics of the sample, only one of the versions was used. The questionnaire had eight sections: the first one allowed the collection of demographic data, as age, gender and country or city of origin; the following six ones allowed the recovery of information concerning the visitor's reaction to the stimuli and their satisfaction; and the final section addressed the visitor's perception and experience concerning the objects they could touch during the visit. A Likert scale was used for most of the questions of the survey.

Data analysis: Since sensory stimulation is performed in different specialized modules, this analysis was performed per sense.

Results

Reactions to audio-visual stimuli: The interactive room has multiple visual stimuli in all its area, from 2D maps and pictures to 3D images and models and videos. A grapevine, an artisanal wine production plant mock-up, a modern wine production plant mock-up, all in small-scale, were part of the visual stimuli. An organoleptic wheel, miniature wine and pisco bottles and classic bottles were also present in the exposition. According to the survey, the small-scale grapevine and the classic wine bottles were the most satisfactory stimuli. On the other hand, the videos and the organoleptic wheel, were the less preferred and described as the least satisfactory (Tab. 1).

Table 1

Visual stimuli

Based on your experience, how satisfied you feel about the visual stimulus?	
Maps	87.0 %
Photographs	87.0 %
Vid Tree	90.7 %
Old process mock-up	87.0 %
Modern process mock-up	86.1 %
Video	35.2 %
Organoleptic wheel	30.8 %
Miniature bottles	88.9 %
Classic bottles	90.7 %

The visitor's reaction to auditory stimuli depended on the vocal characteristics of the guide. Most of them felt satisfied with the guide's voice (Tab. 2), the quality of the information she shared with them, and the pertinence of her comments during the visit of the interactive room. Concerning the auditory stimuli coming from the video, the visitors expressed their dissatisfaction.

The technology used for the vaporization of grape-related scents in the environment also generated potentially undesirable auditory stimuli. Nevertheless, the visitors concluded that the noise was mostly "acceptable".

Table 2

Auditory stimuli

Based on your experience, how satisfied you feel about the odor stimulus?	
Content of the narrative made by the guide	95.6 %
Voice tone of the guide	84.4 %
Humor sense of the guide	91.1 %
Video	37.7 %
How much did the noise from the odor machine bother you?	38.5 %

General response to other stimuli: The visitors were generally satisfied with the overall mul-

ti-sensory experience. For example, the temperature and the humidity were regarded as satisfactory elements. 77 % of visitors felt the temperature increase, in contrast to the 63 % who felt the difference in humidity. They reported more satisfaction with temperature (65.2 %) stimulus than with humidity (30.4 %).

In contrast, some visual and gustatory stimuli were the least satisfactory. Concerning the latest, the visitors affirmed that they were more satisfied when tasting wines (67.4 %) than they were when testing pisco varieties (37.6 %).

Among all the stimuli, they chose the olfactory stimulus as their favorite. The visitors agreed that their level of satisfaction caused by this stimulus was very high and that it fulfilled their expectations (68.1 %). They indicated that the scent they smelled corresponded well to the one of grapes and alcohol.

Discussion

The aim of this paper was to describe the satisfaction degree of visitors submerged in a multisensorial interactive room and submitted to different sense stimulation technologies. The results show us that the visitor's response to the technology implemented in this pilot room has been mostly satisfactory, according to the survey taken by the chosen sample. The multi-sensory experience allowed them to know the extrinsic characteristics of wine and pisco production in the region of Arequipa.

The implementation of marketing strategies based on multi-sensory stimulation by wineries can be positive for their positioning: it can generate a better brand imprint on consumers, improve the emotional bond and the recall of the product (Shabgou and Mirzaei Daryani 2014). This statement is also made by Ramsoy *et al.* (2012) , who highlight the importance of sensorial stimulus on consumer's satisfaction. Indeed, sensory marketing could become a way to develop a strong and durable connection between consumers and brands (Tien Minh and Thi Truc Ly 2005).

Shabgou and Mirzaei Daryani (2014) claim that a satisfactory experience of the consumer transcends merely economic elements. This phenomenon was perceived by the authors during the undertaking of the research. Authors can affirm that the implementation of this type of technology is highly recommended to involve the consumer in a more complete experience of wine and pisco.

Conclusions

Dynamic Sensory Stimulation technology (DSS) has been proposed in the present research. It consists of synchronized equipment that immerses the visitors in an integrated, sensory experience composed of: 1) climatic stimulation, 2) olfactory stimulation, 3) gustatory stimulation, and 4) audiovisual stimulation. The results indicate that it is possible to utilize DSS technology in order to stimulate all senses in clients so that they discover the manufacturing process of pisco and wine in a room that replicates the sensory stimuli available in a vineyard, and in this way promote the diffusion of wine-making activities in Arequipa, Peru.

The feedback given by visitors during the research will allow not only the improvement of the experimental model to increase the environmental satisfaction, but also, and most importantly, to set the basis for the design of a positioning strategy for pisco and wine in the Peruvian culture.

One remarkable fact was identified by the authors during the processing of the results: only 37,6 % of visitors affirmed to be satisfied by pisco's taste. Even if enterprises like "Majes Tradicion", which has been present in the wine and pisco industry during ten generations, perform different activities to strengthen the cultural link between new generations and the tradition of transformation of grapes into wine and pisco, it is clear that a more aggressive positioning strategy must be undertaken. Elements of association between Pisco and the Peruvian tradition for its production have to be conceived and tested, ideally by the means of the interactive room. The objective of this endeavor should be to create a solid relationship between Pisco and the consumer, Peruvian or tourist, as strong as the one between French people and wine.

In conclusion, this exploratory study constitutes the start of more specific and conscientious research activities undertaken from different angles, to further detail the customer's perception and to understand the sensory stimuli that would motivate the customer to consume the product and satisfy its needs. Finally, this study constitutes as a technical antecedent of the technology implemented.

Acknowledgements

The present research article was developed in the framework of an I+D+i project, which is financed by the National Program of Innovation for Competitiveness and Productivity – Innovate Peru and 'Majes Tradición S.A.C.' company, manufacturer of pisco and wine.

References

Asero, V.; Patti, S.; 2009: From wine production to wine tourism experience: the case of Italy. Am. Assoc. Wine Econ. **52**, 1-18.

Centro Nacional de Condiciones de Trabajo de España; 1998: NTP 501: Ambiente térmico: inconfort térmico local, 7 pp. Ministerio de Trabajo y Asuntos Sociales, Madrid, España.

Charters, S.; Ali-Knight, J.; 2002: Who is the wine tourist? Tourism Manage. **23**, 311-313.

Drønen, Å.; 2016: Sensory stimulation: A review of how stimulation of the senses can affect the behaviour of people with dementia, and inspire the process of designing for them, 1-15.

Esmailpour, H.; Zakipour, M.; 2016: The sensory stimuli model; engage with the consumer senses for brand distinguishes. J. Manage. Sci. **2**, 212-218.

Jordao, A.; Vilela, A.; Cosme, F.; 2015: From sugar of grape to alcohol of wine: sensorial impact of alcohol in wine. Beverages **1**, 292-310.

Krishna, A.; Morrin, M.; 2008: Does touch affect taste? The perceptual transfer of product container haptic cues. J. Consumer Res. **38**, 807-818.

Montella, M.; 2017: Wine tourism and sustainability: a review. Sustainbility **9**, 113.

Morrin, M.; Ratneshwar, S.; 2003: Does it make sense to use scents to enhance bran memory? J. Market. Res. **40**, 10-25.

Otzen, T.; Manterola, C.; 2017: Técnicas de Muestreo sobre una Población a Estudio. Int. J. Morphol. **35**, 227-232.

Ramsøy, T.; Friss-Olivarius, M.; Jacobsen, C.; Jensen, S.; Skov, M.; 2012: Effects of perceptual uncertainty on arousal and preference across different visual domains. J. Neurosci., Psychol. Econom. **5**, 212-226.

Rowley, S.; Williams, J.; 2015: Multi-sensory stimulation and infant development. Research review. Educational series, 1-6.

Schifferstein, H.; 2011: Multi sensory design. Procedings of the second conference on creativity and innovation in Design. Desire **11**, 361-362.

Shabgou, M.; Mirzaei Daryani, S.; 2014: Towards the sensory marketing: Stimulating the five senses (sight, hearing, smell, touch and taste) and its impact on consumer behavior. Indian J. Fundam. Appl. Life Sci. 4, 573-581.

Strøm, B.; Ytrehus, S.; Grov, E. K.; 2016: Sensory stimulation for persons with dementia: a review of the literature. J. Clin. Nurs. **13-14**, 1805-1834.

Tien Minh, D.; Thi Truc Ly, P.; 2005: An Emerging Marketing Technology: Sensory Marketing Applied in Retail Industry, 10 pp. Conf. paper: The Secrets of Japanese Economy. Univ. Econ., Ho Chi Minh City, Vietnam.

Van Campen, C.; 2014: The Proust Effect: The Senses as Doorways to Lost Memories. Oxford, United Kingdom.

Received September 12, 2019