PERCEPTUAL CARRYING CAPACITY AND TRADE FAIRS – EYE TRACKING EXPERIMENT

Jan Vrána[1], Michal Pšurný[1], Ondřej Dufek[1], Stanislav Mokrý[1]

[1] *Mendel University in Brno, Czech Republic*

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ABSTRACT

This study was focused on application of perceptual carrying capacity concept in the environment of trade fairs. The main contribution of this study is exploration of customers' attitude towards overcrowding at trade fairs as there is not known any study with focus on these events. For this purpose, the eye tracking experiment was conducted, where different images depicting different level of visitors were used. In addition, the aim of the study was to identify what is at the centre of people's attention when looking at photographs taken at trade fairs. The study was conducted with 30 respondents from generation Y. The results imply that the number of people is a very important factor in deciding whether to attend these events (in this case trade fairs) or not at all. Simultaneously the in-depth interviews showed that people tend to have more of a negative attitude towards both overcrowding and a low number of people perceived at an event. This study also suggests that the optimal number of people at trade fairs is not extreme, not too low or not too high.

KEY WORDS

social carrying capacity, threshold of perceptual carrying capacity, trade fairs, crowding, eye tracking

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M310, M370

1 INTRODUCTION

Events are an important part of our culture, with last years witnessing a significant rise in the number and event diversity worldwide. This was caused mainly by the positive impact of such events on host community development with many corporations and companies using these events for promotional purposes. For the companies to be able to actually use these

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events as their marketing strategy, a high level of participants' satisfaction needs to be ensured. Because satisfied participants will share the experience with family members and acquaintances which will then lead to an increased number of visitors. Therefore, it is essential to understand the complex motivations behind one's participation in events as it can help guide the decisions for organising a successful event (Cosma et al., 2017).

One of the best known and most discussed drivers of willingness for return to such events are factors generated on-site such as satisfaction and positive emotions with event satisfaction being the significant one (Jahn et al., 2018). One of the factors of customer satisfaction is the density of people at the event. In the case visitors feel the density is too high and they feel the negative effects of overcrowding, it might lead to a lower level of their satisfaction (Zehrer and Raich, 2016).

How crowding affects local communities and its impact on tourist/visitor (dis)satisfaction is often the focus of social carrying capacity (Coccossis and Mexa, 2004). The research of the social (perceptual) carrying capacity has so far focused on natural sites such as parks (e.g. Sever et al., 2018), coasts (e.g. Gonson et al., 2018) and cities (e.g. Neuts and Nijkamp, 2012). Therefore the main contribution of this study is exploration of customers' attitude towards overcrowding at trade fairs as there is not known any study with a focus on these events. This study also aims to determine the visitors' threshold of perceptual carrying capacity. The incentive for this paper came from the BVV Trade Fairs Brno, with whom we maintain long-term cooperation.

2 LITERATURE REVIEW

2.1 Perceptual Carrying Capacity

Social (perceptual) carrying capacity is one of the components of tourism carrying capacity, which states 'the maximum number of people that may visit a tourist destination at the same time without causing destruction of the physical, economic or socio-cultural environment and an unacceptable decrease in the quality of the tourist satisfaction' (World Tourism Organization, 2004). Social carrying capacity falls under the social-cultural part and is perhaps the most difficult to evaluate in comparison with physical-ecological and economic components (Coccossis and Mexa, 2004).

The term social carrying capacity means the level of use (often, the number of visitors) for a given site, and when this limit is crossed the users' quality of experience decreases or is no longer acceptable (Shelby and Heberlein, 1984). The quality of this experience might be diminished by both the crowding effect and ecosystem degradation caused by high use level (e.g. Gonson et al., 2018). How each person subjectively views density levels in a specific place is called perceived crowding (Shelby and Heberlein, 1984) and it is usually defined as a negative assessment of visitor density within a given area (Graefe et al., 1984).

Earlier studies with focus on crowding had assumed that the visitors' perception of crowding was mainly connected to the number of other visitors with whom they came into contact and the more this number grows the more the experience decreases. However, studies conducted later showed that the perception of crowding is much more complex than that and it includes various social, psychological and situational factors (Ditton et al., 1983; Arnberger and Haider, 2005).

If levels of crowding are perceived as too high, cognitive control, behavior and affective responses during and after these situations can be all affected, as social psychology literature shows (Langer and Saegert, 1977). These high levels of perceived crowding can lead to negative behavioral consequences including decreased tolerance levels for frustration (Sherrod, 1974). Also, stress levels are higher when visitors cannot accomplish their intended goals of relaxing and socializing due to external factors (Baum and Paulus, 1987; Gramann, 1982; Schmidt and

Keating, 1979). As a result, the quality of the visitors' experience is reduced.

Many studies were conducted on age and its connection to perception of crowding and it was proven that younger people are more prone to be affected by crowding than older people (Fleishman et al., 2004). Study from 1983 found that more physical space is generally required by younger people (Golant, 1983). Study from 1990 shows, that there are also gender differences in crowding perception. In this case, men were reported with higher crowding tolerance than women (Eroglu and Machleit, 1990).

2.2 Trade Fairs and Image Promotion

For many people, the most effective way to get messages across to them is with visual aids. With the massive expansion of social media, the potential of an image grew exponentially. Images can draw people in, they give them a much clearer idea of what to expect and they can even help create an emotional bond with a potential visitor. Images elicit emotions and that is why consumers are less likely to be interested in texts only. Aesthetically appealing photographs can eventually be more helpful to a potential customer in deciding whether to attend an exhibition or not more than a text message would be (Jackson and Angliss, 2018).

As for a photograph's composition, in the center of tourists' attention are generally things associated with fun/pleasure, food and its consumption, people and places (Jackson, 2018).

3 METHODOLOGY AND DATA

The study was launched in October 2018 and concluded in December of the same year and it took place in the Eye Tracking laboratory of the Business and Economics Faculty at Mendel University. The research consisted of 2 distinct stages. The first one was the Eye-tracking experiment and after that came the second stage, in-depth interviews.

There were 30 participants (15 men and 15 women) and they all belonged to generation Y with ages between 19 to 28 years. As for their nationalities, there were 23 Czechs, 5 Slovaks and two respondents were born in Russia, but all the respondents speak Czech fluently. All the participants are either currently studying or have already finished studying at one of Brno's universities; Tab. 1 shows the respondents' birthplace according to its size.

Tab. 1: Representation of respondents according to their place of birth

4999 residents and less	7 respondents
5000–24999 residents	2 respondents
25000–49999 residents	7 respondents
50000 residents and more	14 respondents

The photographs, which were used in the Eye-tracking experiment and survey, were taken at the International Engineering Fair 2018 under the agreement with BVV Trade Fairs Brno, who organized this event. During the Eye-tracking experiment 6 photographs were used (2A, 3A, 1B, 3B, 1C, 2C), additional three (1A, 2B, 3C) were then added during the interview survey. The number of visitors in the photographs are shown in Tab. 2.

3.1 Eye-tracking Experiment

During the experiment, 6 photographs were shown to all the respondents. These photographs contained 3 different aisles taken at the International Engineering Fair 2018 and each aisle had 2 stages of crowding. The photographs were shown for 10 seconds (from 9992.0 to 10000.2 ms) in a random sequence and the respondents were then asked if they would be interested in entering the aisle shown in the photograph. The respondents had to choose between 7 levels of the response scale.

The Eye-tracking experiment was conducted using the SMI RED 250 device. This type of

Tab. 2: Number of visitors in each used photograph

	1A	2A	3A	1B	2B	3B	1C	2C	3C
Visitors	0	0	0	1–10	1–10	1–10	11–25	11–25	26+

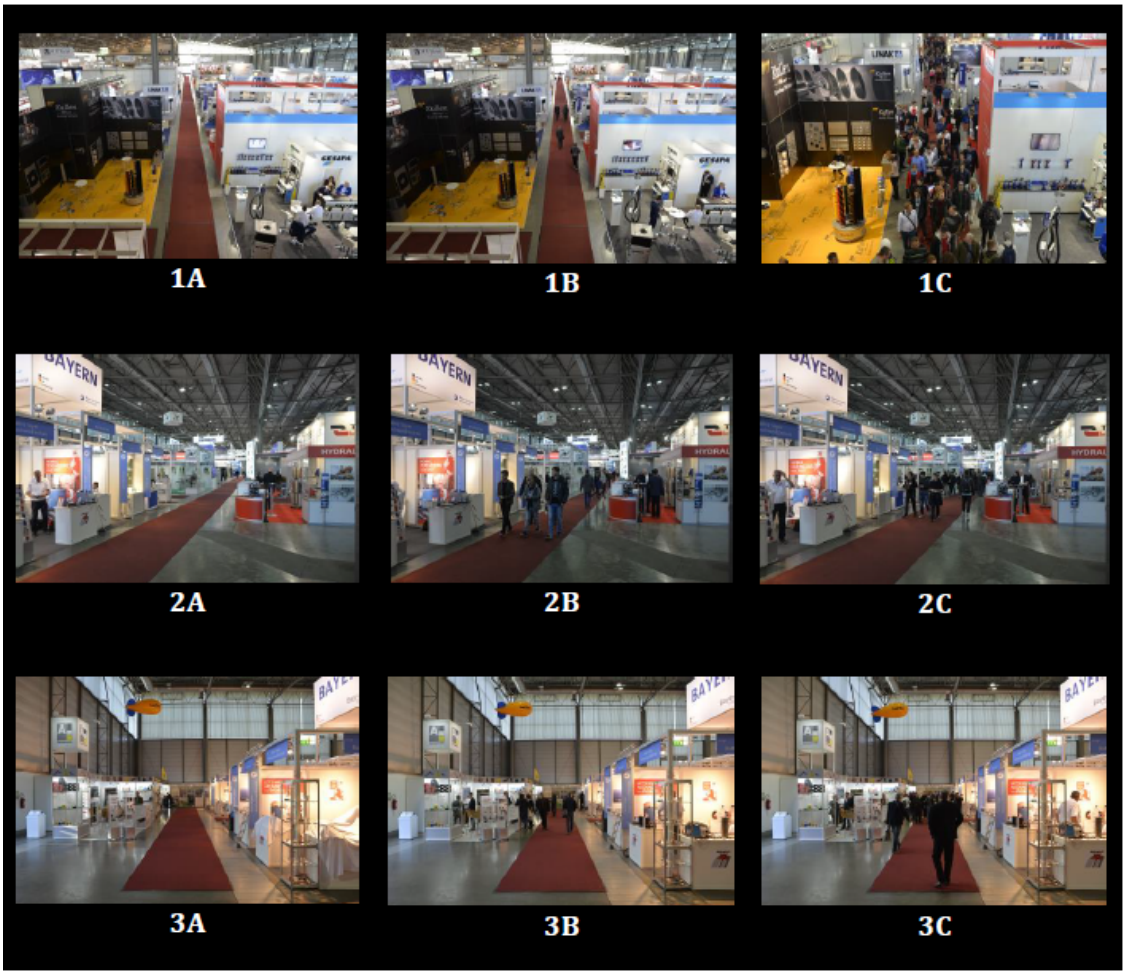

Fig. 1: Aisles showing different stages of crowding

a device is desktop/remote Eye-tracker, which means that it is attached to the area under the computer screen (with diagonal size of 22 inches with a 16:10 aspect ratio) and the respondents' vision is scanned from a distance of 60 to 66 cm. The device operated with sample frequency of 250 Hz. The experiment itself was created in SMI Experiment Centre software. Eye deviation was between 0.15 and 0.39 degrees and tracking ration was between 91.64% and 99.64%. Data obtained were then processed using the editor in SMI BeGaze software, where there were pointed out so-called areas of interest (AOI), in this case it was people and products, and for every area of interest the software produced statistical data which were then used.

3.2 In-depth Interview

The survey consisted of two parts. The first part focused on the respondents' general experience with trade fairs, and on whether they even take the number of people at trade fairs into account and how. In the second part, a visual

method was used. The respondents were shown photographs of aisles taken at trade fairs with different number of people pictured there. In this part, the respondents were supposed to evaluate the level of crowding pictured in each photograph and choose the optimal situation for them. The most frequent responses were translated into English and quoted.

4 RESULTS

4.1 Perception of People in Photographs Taken at Trade Fairs – Eye-tracking Experiment

One of the outcomes of this exploration study is survey of how much of the respondents' attention was paid to the people in the photographs taken at trade fairs. Tab. 3 summarizes times of respondents' observation of people and data about how much attention the people in the photographs paid to the products. The pictures 3B, 1C and 2C were the ones the respondents paid the most attention to people, ranging between 20 to 34%. To the people in the pictures 2A, 3A, 1B the respondents gave maximum of 16% of overall time. However, it is necessary to mention that the number of people in these photographs is either minimal or none and most people there were the staff. The results also show that with the exception of photographs 3A, 1B, more attention was being paid to the people in the photographs rather than the displayed products.

Tab. 3: Eye tracking experiment – Summary of results

	2A	3A	1B	3B	1C	2C
AOI Coverage – people (%)	2.8	0.3	3.0	4.8	21.0	6.9
Net dwell time – people (%)	7.4	4.1	16.0	20.6	32.2	34.4
AOI Coverage – products (%)	1.9	8.2	12.4	8.2	12.4	1.9
Net dwell time – products (%)	5.4	19.3	24.4	11.5	26.2	5.9

Notes: AOI Coverage is how much of a photograph's space is taken by a subject. Net dwell time is what percentage of the overall observation time was devoted to a specific subject.

4.2 Perception of Crowding at Trade Fairs

Descriptive analysis (see Tab. 4) of the sample shows, that more than two thirds of the trade fairs' visitors perceive overcrowding negatively, 3% neutral and less than one third perceive high number of people positively. The main reason for a negative attitude was a general reluctance to visit crowded places, a difficult passage through aisles and long queues, which make access to the stands difficult. From some responses, however, it is apparent that overcrowding is a sign of a general interest in the trade fair and that trade fair in turn gives the impression of being more attractive and livelier and overcrowding is then perceived positively.

On the other hand, more than half of the respondents perceive a small number of people negatively. It shows lack of interest and the potential visitors fear that the vendors would try to lure them to the stands and force their goods on them. In total 18% are neutral and 16% look at it positively (they do not have to push through a crowd and they have an easier access to the stands and the exposition).

Tab. 4: Perception of crowding at trade fairs and attitude toward overcrowding and spaces with a minimal number of people

	Perception of overcrowding	Perception of spaces with a low number of people
Negatively	21	20
Neutral	1	6
Positively	8	4

4.3 Threshold of Perceptual Carrying Capacity

Research shows that trade fairs' visitors are not oblivious to the number of people at the site. Subsequently the respondents were shown photographs of aisles and they were asked to decide whether they would enter the aisles based on the number of people in these photographs. According to Shelby and Heberlein (1984), if more than two-thirds of the visitors say that they are crowded, it appears likely that the capacity has been exceeded. If less than one third senses the overcrowding, the area is probably below the load capacity. When the perception of the mass is between these thresholds, determination can be made with this rule (Shelby and Heberlein, 1984).

Tab. 5: Respondents' interest to enter aisles

	1A	**2A**	**3A**	**1B**	**2B**	**3B**	**1C**	**2C**	**3C**
Yes	10	14	10	25	30	29	7	28	28
No	20	16	20	5	0	1	23	2	2

As seen in Tab. 5, an interest to enter completely empty aisles, tagged with the letter A, was shown by 10 to 14 respondents. A half of these respondents stated that their reasons were a simple passage through the aisle, an unobstructed access to the stands and plenty of personal space. The second half stated that the number of people could be higher, but they would not be discouraged. More respondents shown interest to go into the aisle 2A, because there were more staff there. The visitors who would not enter said aisle stated that their reasons were: *'Nobody is here, and the stands seem to have been just opened or recently closed – that the preparations are not finished'*, *'too few people send a message that the stands' offer is not interesting and high quality'*.

Majority of all the respondents would enter the aisles tagged with the letter B, where there were one to 10 people shown. Five respondents evaluate the aisle 1B to be too unpopulated and there are no staff at some of the stands, so they would rather not enter said aisle. The number of people in the aisles 2B and 3B is said to be ideal by more of a half of all the respondents. The most frequent reasons are: *'Optimal number of people, which allows you to easily access any stand and at the same time there is plenty of personal space'*, *'It seems natural, there are not too many or too few people there'*. The aisles 1C and 2C showed 11 to 25 people. An interest to enter these aisles was showed by 1 or 2 respondents less than the aisles 2B, 3B. Respondents' reasons for entering said aisles were the same as for the aisles 2B, 3B and those who would not enter these aisles stated that *'there are too many people there and they could not move here'*. The number of people shown in these photographs was said to be ideal by 10 people.

The last aisle 1C showed 26 persons and more. The four respondents who stated they would be interested to enter this aisle said: *'this number of people can show there are interesting products there but it can be uncomfortable'* and the other three stated that *'this number of people is the limit for what they can stand'*. The respondents who would not enter this aisle said *'there are too many people there so it would be impossible to move there'*, *'it is too much, I would avoid the site completely or I would wait for it to become less crowded'*.

The respondents were also asked to determine the ideal number of people, this is summarized in Tab. 6.

Tab. 6: Ideal number of people

Crowding	Empty	1–10	11–25	26+
Optimum for	10%	53,3%	33,3%	3,3%

What the interviews show is that 10% of respondents prefer minimal number of people at trade fairs and their reasons are: they do not have to push through crowds, easier access to information, the staff at the stands show more interest in the visitors. The largest group of people considers one to 10 people in a trade fair's aisle to be ideal because: *'there is plenty of personal space there, but the place is not totally deserted'*. One third of the overall number of respondents prefers 11 to 25 visitors in an aisle because: *'it shows that the trade fair has interesting goods to offer'* and only one respondent chose the option of 26 people and more.

4.4 Testing Hypothesis

H0: The perception of crowding is not dependent on gender.

This dependence is based on the assumption that men are more likely to tolerate overcrowding than women (Eroglu and Machleit, 1990). To determine whether the dependence exists, contingency analysis was used with level of significance at 5%. This analysis showed Pearson's χ^2 statistic of 3.281250 and p-value of 0.19386. This means that the null hypothesis is not rejected, and the perception of crowding is not dependent on gender.

H0: The perception of crowding is not dependent on a respondent's place of residence.

This dependence assumes that the size of one's place of residence and so the number of people surrounding the respondent is dependent on the perception of crowding. To determine whether the dependence exists, contingency analysis was used with level of significance at 5%. This analysis showed Pearson's χ^2 statistic of 7.0000 and p-value of 0.32085. This means that the null hypothesis is not rejected, and the perception of crowding is not dependent on a respondent's place of residence.

5 DISCUSSION AND CONCLUSIONS

The results of this exploration study imply that the level of crowding at trade fairs and the number of people in general is the centre of attention when looking at photographs taken at trade fairs and it can influence a potential visitor. Unfortunately, earlier studies were focused mainly on outdoor venues (e.g. Sever et al., 2018; Gonson et al., 2018; Neuts and Nijkamp, 2012) so any comparisons of the previously achieved results might not be relevant. The main contribution of this paper is thus it's exploration of customers' attitude towards overcrowding at trade fairs.

The eye-tracking experiment's results show that when the respondents were showed photographs taken at trade fairs, the most attention was being paid to the people rather than the products displayed. This can be used for further studies, with focus on whether the people showed in the promotional photographs are indeed that important in deciding whether to attend an event or not. The outcome of the in-depth interviews is that people have a negative attitude towards both overcrowding and a minimal number of people shown, and, in these cases, they are prone to not attend at all. This was supported by determining the thresholds of perceptual carrying capacity where most of the respondents had a positive attitude towards photographs with a medium number of people, which tended to be the ones most interesting to them and because of those they would consider attending the event.

Another part of this study was testing dependence of gender and the size of one's place of birth on the level of tolerance for overcrowding. Although the literary review stated that this dependence should exist, neither was confirmed. Among the reasons for why these dependencies were not confirmed can be: small sample size and small age range. As for the dependence of the size of one's place of birth, the cause can be that the size of one's place of birth often does not match the size of one's place of current residence. Therefore that person is actually more comfortable in a different setting.

Because of the technical orientation of fair trade used in this paper (International Engineering Fair 2018), the results of this paper might not be applicable to the trade fairs in general. In addition, the photographs picked and the locations displayed in them played a significant role in conducting this research. Furthermore, these photographs were shown in a laboratory environment and it may have affected the respondents' attitude towards crowding.

These events, trade fairs especially, is a relatively unexplored area and further research into crowding at trade fairs in relation to deciding whether to attend such an event and in connection to satisfaction after leaving

such an event should be more explored. In future studies, the researchers could also use other neuroscience devices such as face reader or electroencephalograph (EEG) to study the emotional state of participants.

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AUTHOR'S ADDRESS

Jan Vrána, Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic, e-mail: xvrana4@mendelu.cz

Michal Pšurný, Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic

Ondřej Dufek, Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic

Stanislav Mokrý, Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic