International Journal of Business and Management1 (2): 55-61,2017
e-ISSN:2590-3721

DOI:10.26666/rmp.ijbm.2017.2.9

Measuring Consumer Perception in Respiratory Mask Product based on Affective Evaluation

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Abstract: Haze has been an annual problem in the Southeast Asian region, especially in Malaysia where its neighbouring country Indonesia's forest fires are the main cause for this phenomenon. It has caused skies to be obscured, air to be clogged, lowered visibility and most importantly it severely affects humans' health. The objective of this study is to identify the consumer perception in mask design used during haze. The focused mainly on using the affective data to redesign the mask products. The online questionnaires about the awareness of the public regarding haze, positive and negative reviews of different types of respiratory masks were randomly sent to respondents. The data was then analyzed quantitatively using affective evaluation. Results showed the most commonly used product against haze were surgical masks and the N95. However many were reluctant users of the masks as they were uncomfortable. Results also showed that masks had to have ergonomic features to provide comfort and supported the view that the current respiratory mask designs had to be more aesthetic as well.

Keywords: *haze, respiratory mask, consumer, affective*

INTRODUCTION

Haze first made its destructive entrance in the Malaysian society in April 1983[1]. Ever since then, this phenomenon has recurred every year to plague the months of August, September and October. It is during these months when the skies are obscured and the air to be clogged by smog [2]. In the year 1997, the haze levels reached their highest peak, the incident also known as the 1997 Southeast Asian haze where its effects caused a widespread atmospheric visibility and health problems throughout the Southeast Asia. On June 23, 2013 a state of emergency was declared in Muar and Ledang where the air pollution levels surged to more than 500 Air Pollution Index (API) [3].

In Malaysia 1983, the cause of haze was speculated as suspended particles from volcanic eruptions but in recent years, it has become clear that the main reasons for haze are the forest and plantation fires in Southern Sumatra, Kalimantan in Indonesia [1]. Prolonged exposure to haze will impact on the environment and human health with the later being more significant[4]. Haze also affects the visibility and the aesthetic value of some of the nation's most pristine and treasured lands. In terms of health, depending on how sensitive a person is, the severity of the haze and the time of exposure, there may be several short term effects such as eye inflammation, running nose, throat irritation, coughing, headache, dizziness, fatigue, lung inflammation. These symptoms are usually mild and will subside when a person is indoors [5].

To counter haze, respiratory air masks are personal protective devices that cover the nose and mouth or in some cases, the face and head and operate either by purifying the air [6]. There are already several types of air respirators in the market used by the public during haze periods. The most commonly used mask by the Malaysian society is the N95 and surgical masks. Despite their effectiveness against micro particles, the current masks that are now monopolizing the market are not pleasing aesthetically and are often linked to sickness and diseases in certain cultures. Thus, it is necessary for the design of a new breed of air masks that are more stylish, aesthetic as well as comfortable to counter the problem of haze.

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LITERATURE REVIEWS

Respirators are personal protective devices that cover the nose and mouth or in some cases, the face and head and operate either by purifying the air [6]. It is suggested that the public wear respiratory masks when conducting outdoor activities during the mask period. There are different types of respirators available in the market. Respirators in the United States have to be National Institute of Occupational Safety and Health, Mine Safety and Health Administration (NIOSH/MSHA) approved [7]. There are altogether six general groups of respirators, each with their own application and limitations: paper mask, quarter mask, full-face mask, powered air-purifying respirator (PAPR) and supplied air respirator (SAR) [8]. It is to be noted that paper masks and surgical masks that are commonly used are not considered as respirators [8]. The estimated number of masks purchased was 350000, the total expenditure was a staggering RM 713,000 (US$ 285,200) during the haze period in September 1997 [1]. The groups most likely to purchase masks were schoolchildren, pedestrians, and motorists who were forced to make their way along roads to schools, offices and business centers.

Characteristics of a Respiratory Mask

Most respirators require a tight facial seal [6]. Dr Lee Lay Tin, the head and senior consultant at Tan Hock Send Hospital advised that the efficacy of the N95 mask is only as good as its fit on an individual, therefore people should use masks that suit the shape and size of their faces. Facial hair can also affect the masks' ability to protect as it may allow contaminated air to leak in, therefore must be shaved off to ensure the mask seals properly [9].

A good respiratory mask should be able to filter particles, dust, germs, pollen and airborne contaminants. Haze is caused by particulate matter from many sources including smoke, road dust and other particles emitted directly into the atmosphere [10]. The fine particles have a diameter of less than 10mm: course particles, larger than 2.5 micrometers and fine particles, less than 2.5 micrometers. The respiratory masks should be made of materials that will be able to filter the tiny haze particles.

Respirators in the United States have to be National Institute of Occupational Safety and Health, Mine Safety and Health Administration (NIOSH/MSHA) approved. A NIOSH-approved mask is certified by the US National Institute for Occupational Safety and Health (NIOSH) to have 95% filter efficiency. A NIOSH-approved respirator will have the following information printed on its packaging: NIOSH, the type of approval, the manufacturer's name [11].

Existing Technology and Product

The filter used by most respiratory masks is made of activated charcoal filter layer. A charcoal filter is highly air-permeable with a three-dimensional carrier framework essentially stable in shape, formed of wires and mono filaments. It is able to filter fine haze particles of a diameter less than 10mm [12]. Exhalation Valves are also used by respiratory masks allowing exhaled air to be rapidly purged from the mask interior. It is fitted onto the mask and allows warm and humid air trapped within the mask to escape so the user may breathe cooler fresher air.

Reusable adhesives have long existed in other products. The adhesive can be applied to a body surface and remain fixed for extended periods of time. It can be removed and reapplied multiple times and can be reused without causing significant amounts of discomfort to the person wearing the adhesive apparel. Silicone rubber is transparent, unaffected by weather, rain, snow, humidity, ozone or the sun's damaging ultraviolet (UV) rays. It also retains its natural flexibility and resilience across wider temperature range. It enhances the comfort and feel of consumer goods and has excellent sealing performance. It is also inert. Due to all these characteristics, silicone rubber is chosen as the main material for the mask's mouth piece. It can also be shaped by injection molding.

METHODOLOGY

Data were gathered from four instruments used in the data gathering procedures namely the affective evaluation, questionnaires, structured interview, and the visual product entries were analyzed using qualitative and quantitative measurements accordingly.

A. Interview

Since everyone is affected by the effects of haze, the target population is not restricted to only a certain group of people. However, the main targets for the interviews were white collars, students and pharmacists. A total of 13 interviews were conducted. According to the Malaysian Meteorological Department haze is not confined to urban environments, it may also be observed in rural area, therefore the both areas were selected. For additional information, a Taiwanese was also interviewed.

The sampling method used is convenience sampling. People are selected based on their availability and willingness to respond. It is an easier and less expensive method. Four questions were asked.

Question 1: How does haze affect you?
Question 2: What type of masks have you worn during haze periods?
Question 3: Are there any complications when wearing masks?
Question 4: How would you improve current respiratory mask designs?

The answers collected from the interviews are in the form of handwritten notes and e-mails. All the answers are transcript into written text and summarized. Similar answers are grouped together to form an overall conclusion. However, information that is not related to the topic is eliminated.

B. Survey

For quantitative research, questionnaires are prepared to obtain numerical data needed to analyze the problem faced by the public when wearing respiratory masks, the needs and demands of the public and also the types of masks that are preferred. The subjects are chosen using the random sampling method since the population is too large and it is impossible to identify the members of the population. Respondents were subjects from Malaysia that were from different ages, occupations and backgrounds. In order to obtain reliable results, 50 respondents were targeted, however only 43 respondents responded to the questionnaires. There are a total of 29 questions were created based on the conceptual framework. The questions of the questionnaire were mainly in the form of close ended questions and only a few were open ended since close ended questions are more easily compared and analyzed. The questionnaire was in the form of multiple choice questions and Likert response scales.

The questionnaire is divided into 4 parts and 6 sections. Part 1 with 5 questions was designed to obtain the respondents profile relevant to the topic. Part 2 with only 3 questions were used to obtain the public's experience with haze. Part 3 contained 2 sections, Section 1 was aimed to know the overall experience of the public when using respiratory masks whereas Section 2 was to collect information on the problems faced by the respondents when using respiratory masks. Part 4 contained 2 sections, Section 1 was created to know the design features consumers wanted in a respiratory mask and Section 2 was to know how much the public is willing to pay for a respiratory mask.

Selection of subjects

Fifty consumers from various background were involved in the research. The subjects are chosen using the random sampling method since the population is too large and it is impossible to identify the members of the population. Respondents were subjects from Malaysia that were from different ages, occupations and backgrounds. The mind mapping as in Figure 1 was develop in order to highlight the main area that will be most crucial area to study.

Affective Evaluation

The affective evaluation consist of various keywords that represent the overall perception of masks design. The keywords listed were developed from a brainstorming session during the product analysis. The multiple choice questions contained at least 4 alternatives for the respondents to pick based on their own preference and opinions. The 5 point Likert response scale was constructed to obtain information about the problems faced by the public when using respiratory masks and also the design features that have to be included in the respiratory mask design. The respondents would be able to pick how satisfied based on the questions asked.

Image Feature Analysis

Image feature extraction is a key issue for concept recognition in images, and particularly emotions. It is crucial to understand the consumer needs before redesigning the new products. Features should be designed to carry sufficient information to be able to recognize the different concepts. As emotion recognition in images is an emergent research domain, very few works have been done to identify

the image features that are the most efficient for this purpose. The participating respondent were asked to observe the design features and select seven types of masks used during haze periods with various design attributes. These masks were commonly used by the public. The responses were counted using a tally sheet and the results were discussed under the same themes; feelings during a interview session and perception towards the products. The data were then validated in order to identify the specific design requirement of the products. Data were gathered from four instruments used in the data gathering procedures namely the affective evaluation, questionnaires, structured interview, and the visual product entries were analyzed using qualitative and quantitative measurements accordingly.

Based on the observation all of the respondents have used respiratory masks during haze periods. This therefore supports the statement that haze affects everyone and the respiratory masks are needed during haze periods. When asked to choose the types of masks the respondents have used during haze periods, 30.23% chose the 3M N95, 46.51% chose normal surgical masks, 23.26 chose a basic 3M quarter mask and only 2.33% have used the Vogmask. Therefore it can be concluded that the most common masks used by the Malaysian society are the surgical masks, 3M N95 and the quarter respirator. These masks are the most commonly used and sold in pharmacies.

Table 1: Problems faced when wearing respiratory masks.

Statements	Mean	1	2	3	4	5
		%	%	%	%	%
Respiratory masks causes fogging on my glasses.	3.95	0.0	2.33	11.63	74.42	7.44
Respiratory masks causes indentations on my face.	4.16	0.0	4.65	23.26	23.26	48.84
Straps on respiratory masks hurt my hair.	3.32	2.34	11.63	51.16	20.93	13.95
I get stared at when wearing respiratory masks.	1.23	6.98	11.63	16.28	2.34	

RESULT ANALYSES AND DISCUSSIONS

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Table 2: Respondents needs and demand in design features.

Statements	Mean	1	2	3	4	5
		%	%	%	%	%
I would use a washable respiratory mask instead of a disposable one..	3.28	6.98	2.33	46.51	20.93	18.60
I would use a respiratory mask with a changeable filter.	4.05	0.0	2.33	13.95	60.47	23.26
I would use a strapless respiratory mask.	3.23	0.0	11.63	62.79	16.28	9.30
I would prefer a respiratory mask that covers half the face instead of full faced.	4.16	0.0	0.0	6.98	69.77	23.26
I would prefer a transparent respiratory mask	3.39	0.0	2.33	48.84	46.52	2.34

The related mean for statement 2 is 4.05. 62.79% with a mean value of 3.23 had neutral feelings about using a strapless respiratory mask. 69.77% of the respondents with a mean of 4.16 agreed with the statement of preferring a respiratory mask that covers half the face instead of a full faced mask. 48.84% of the respondent had neutral feelings about the statement ' I would prefer a transparent respiratory mask'. The related mean value is 3.39.
This statement is created to find out how well the public will accept a transparent mask. The related mean value for the two statements is 4.16 and 3.32 respectively. 16.28% of the respondents have a neutral opinion with the statement 4, I get stared at when wearing respiratory masks. This statement was created after the interview where one of the interviewees stated that people stared at her when she was wearing a respiratory mask. The percentage value of 46.51% of the respondents with a mean value of 3.28 had a neutral understanding with the statement; I would use a washable respiratory mask instead of a disposable one. 60.47% agreed that they would use a respiratory mask with a changeable filter.

The overall result from the design criteria analysis finalized that these features are required in the mask design such as:
i. Reusable mask design
ii. Transparent design made of silicone with a rubbery texture
iii. Adhesive seals around the mask to provide a tight fitting condition, the adhesive will leave no trace on the skin after removing.
v. Exhalation Valve.
iv.A replaceable filter. The filter is made of an active carbon layer, and either cotton or microfiber as a choice.
v.Exhalation Valve.

In Table 2 react to the needs and demands in design features for the masks. It is important to understand the main criteria needed for the overall masks design.
Results from the design validation shows that it is relevant and will have a market if it is produced. A table of validation was created for this reason. The Likert scale was used. 30 participants were chosen and they were showed the model of the respiratory masks. Participants were asked about several design features as shown in Figure 2.

It is observed that the overall concept of the redesigned respiratory mask had the highest mean whilst the material proposed may be variant among the users. It is speculated that people are not that accepting towards silicone as a new material for masks as it is too different from existing masks in the market. If the product is to enter the market, people have to first be persuaded to accept the silicone design.

The side of the mask that is adhesive uses adhesive silicone to adhere to the user's face. The overall perception in product appearance can be clearly identified with the application of affective evaluation. Through these practice, an improvement can easily made throughout the process of designing.

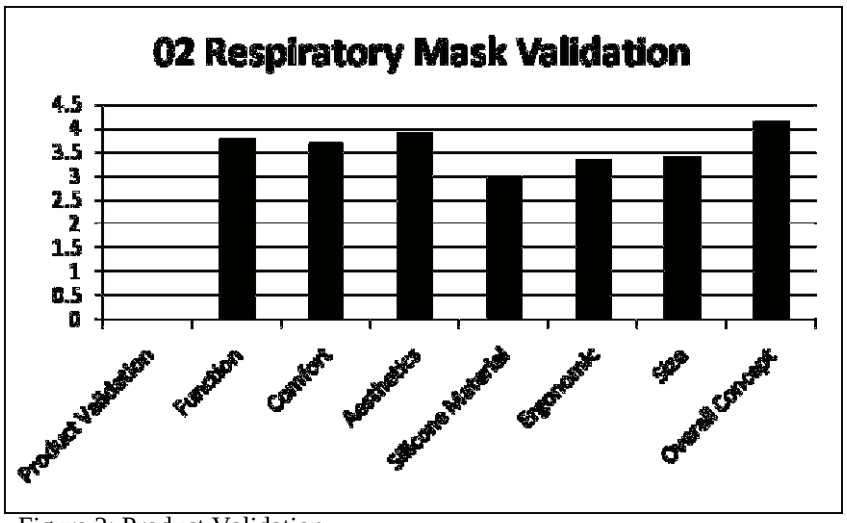

Figure 2: Product Validation

CONCLUSIONS

This research discusses the problem faced by the public during haze periods. Haze is a phenomenal that is happening more frequently in Malaysia throughout the years thus a safe and comfortable for everyday attire. This research has studied about the respiratory masks that are commonly used in Malaysia and their positive and negative features. Using affective analysis relatively reflect the most accurate perception of consumer need for their mask products. Findings of the research were found to be on suitable materials used and additional features that can improve the overall design of a respiratory mask. The solution of redesigning mask that is important in providing optimum comfort with an increased aesthetic value. It is a protection against haze and other air pollutants. Designed to counter haze, it has an exhalation valve and replaceable carbon filters that help filter dust particles. With adhesive silicone seals on the mouth piece, it sticks onto the user's face without leaving any indentations or residue on the face. The affective analysis which incorporates user's emotional experience towards particular product design will enhance
the product appearance and values. The element, character, reflects the way designers choose to represent themselves in the objects they create. The affective evaluation that relates much on emotion, is particularly important to the semantics of products because it can be derived from both physical contact with the product and from active contemplation of it before, during, and after use.

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