Exploring the cognitive structure of aircraft passengers' emotions in relation to their comfort experience

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Abstract: Emotion descriptions were elicited from participants' written accounts of their comfort experience and grouped according to the emotion model by Ortony, Clore, and Collins (OCC). The cognitive structure and specific appraisal patterns of passengers were explored on three levels of passenger's concerns (goals, standards, and aspects), their focus during the flight (including the mediating cabin elements) and the resulting emotions. Four emotion groups were highlighted as relevant to flight comfort. Wellbeing (e.g., joy, distress) emotions were the most frequently mentioned group by participants when focused on the consequences of interaction with cabin features such as seat, IFE and service, pertaining to participants' personal goals (e.g., security, calmness). The cognitive underpinning of prospect-based (e.g., satisfied) emotions included similar goals except that participants evaluated the consequences of their interaction with the seat, legroom, IFE and service relevant to their expectations and anticipations. The emotions in wellbeing/attribution compound group were elicited upon evaluating the consequences of the actions of agents (e.g., service, neighbors). Thus emotions anger and gratitude emerged when those actions yielded pleasing or unpleasing consequences for participants. Attraction (e.g., liking) emotions were generated once passengers developed liking or disliking for certain aspects (e.g., aesthetics, physical fitting) of the seat and legroom. Subsequently, a model of cognitive structure of passengers' emotions was constructed for the flight context highlighting the seat and services as the central (most frequently regarded) features to passengers' emotional experiences. The proposed model enables designers to recognize the types of experiences that should be delivered to ensure that passengers feel comfortable.

Keywords: Comfort, Emotion, Experience, Aircraft, Passenger.

1. INSTRUCTION

Passengers' reaction to the aircraft interior environment has always been a concern for the aerospace industry. While research concerning prevention of passengers' bodily discomfort has attracted a lot of attention, the subject of emotional reactions to the aircraft environment has not inspired much research. In recent years, studies on user experience have shown that positive

emotions generated in response to product use provide pleasurable and positive experiences (Desmet et al, 2005; Desmet, 2012). Similarly it could be argued that designing for passengers' comfort and wellbeing should follow the same trend and go beyond the mere prevention of physical issues (Ahmadpour et al., 2014). This paper presents a study on the emotional reactions of passengers to the cabin environment and their relation to comfort. The aim is to uncover the nature and type of emotions as well as their attribution to environmental (cabin) elements.

There is evidence in the literature to suggest a link between comfort and emotions. For instance De Looze et al. (2003) demonstrated that emotional reactions to products such as being relaxed, improves the comfort experience. Scherer (2005) regarded comfort and discomfort as affective states, changes in which influence one's emotions, while Ortony, Clore and Collins (1988) categorized the feeling of discomfort as an emotion related to one's wellbeing. These arguments highlight the relationship between perception, emotions and comfort, although any causal relationship among them has never been established. Nevertheless, all these authors emphasize the highly subjective and personal nature of comfort. It must be noted that the concept of comfort in this document refers to all levels of comfort which also entails discomfort. Differentiating comfort and discomfort, although acknowledged as an important argument (De Looze et al., 2003; Helander, 2003; Kuijt Evers et al., 2004), is not in the focus of this paper.

Among several models of emotion, Ortony, Clore and Collins' (1988) model aimed to elucidate emotional responses through structured logic. Their model, based on a bottom-up approach, considers the nature of emotion to be determined by the eliciting conditions when people experience a positive or negative affective reaction upon appraising an object, event or agent respectively beneficial or harmful to their concerns. According to Ortony et al., events are perceived to 'happen', objects as "qua object" , and agents are characterized in terms of their "instrumentality in causing or contributing to events" (Ortony, Clore and Collins, 1988, pp.18).

Ortony and his colleagues distinguish 22 emotion types (e.g. joy, distress, pride) based on their cognition patterns, categorized into six groups. These are wellbeing (e.g. joy, distress), attribution (e.g. pride, reproach), wellbeing/attribution compound (e.g. gratitude, anger), prospect-based (e.g. satisfaction, fear), attraction (e.g. like, hate) and fortune-of-others (e.g. resentment, gloating). Each emotion group descends from a unique cognitive pattern depending on the person's focus at the time and appraisal of the situation relative to their concerns. Focusing on consequences of events and evaluating their desirability relative to one's goals, results in an affective reaction of being pleased or displeased. Upon evaluating these consequences for others, fortune-of-others emotions are elicited while wellbeing and prospect-based emotions are generated when consequences for self are examined. A focus on actions of agents and evaluating their praiseworthiness relative to one's standards brings about an affective reaction of approving or disapproving and elicits attribution emotions. The co-occurrence of those two conditions, i.e., evaluating consequences of events particularly caused by agents, yields wellbeing/attribution compound emotions (this is to say that not all events in the world are necessarily caused by an agent). Finally focus on aspects of objects and evaluating the appeal of their aspects (e.g. aesthetics aspects) gives rise to an affective reaction of liking or disliking, leading to attraction emotions. This logic incorporated into the model referred to as the OCC model throughout this document. This paper employed the model in a case study of emotions in relation to passenger comfort experience and to explore the underlying cognitive patterns of passengers' reactions.

2. METHOD

A questionnaire was distributed by email to 158 participants once they were back from their summer vacation. They were asked to describe a comfortable experience inside the aircraft cabin. They were asked to describe the trip in a casual manner and include as much detail as possible. Responses from three participants were discarded prior to the data analysis because of incomplete data, yielding a sample of n = 155 (98 males, 20-61 years of age, M = 38, median 35 years). All participants had at least 5 flight experiences prior to the survey.

3. RESULT AND DISCUSSION

Content analysis was performed on the reports, identifying all emotion words that respondents used in their descriptions of comfort experience. Adopting a definition from Ortony, Clore, and Foss (1987), emotion was defined as *internal, mental states that are elicited in reaction to an ongoing situation and focused primarily on affect where affect is the perceived goodness or badness*. The data were compiled and emotion types were grouped according to the OCC model. This part of the analysis examined whether or not emotions played a role in passengers' comfort experiences as well as identifying the types of the resulting emotion groups. Furthermore, respondents' descriptions were used to isolate cabin elements that were central to each emotion group in order to identify the relationship between emotions and external eliciting factors (stimuli),

During the analysis, the emotion type "feeling uncomfortable", characterized as a wellbeing emotion in the OCC model, was not considered because it was impossible to distinguish its affective nature and because the questionnaire was inquiring about comfort. As Clore, Schwarz, and Conway (1994) mentioned in their review of emotion theories, eliciting emotion words empirically is challenging due to the lack of control on whether respondents are reporting "feeling something" or "being something". For instance, while feeling uncomfortable is an affective state, being uncomfortable is an experience that may not necessarily be affective in nature. One may experience an awkward posture but this does not necessarily lead to feeling an emotion.

A total of 92 comfort-related emotion words were identified as per the definitions given earlier. Interestingly, some respondents included descriptions of uncomfortable situations to highlight certain experiential aspects. Consequently 27 (29.35%) of the emotion words were negative. For instance one passenger described how she hates it when she does not have access to enough storage space at her seat. Since these words did exemplify an emotional component of the comfort experience, they were included in the analysis. In total, n=57 (36%) participants used at least one form of emotion-related description in their report; the term 'feeling' was used very frequently in the experiential comfort descriptions.

Finally, cabin elements that generated these emotions were categorized (one per each emotion type) including seat, legroom (the pitch between the seats of two consecutive rows), In-Flight Entertainment (IFE), service, neighbors, turbulence, etc. Once the emotions had been grouped and their associations with cabin elements established, the results were summarized as shown in Table 1.

Table 1. Summary of the results from the online questionnaire (n=155 participants)

	Wellbeing	Prospect-based	Attribution	Wellbeing/attribution	Attraction	*Total*
N respondents	31	14	2	16	21	
% participants (n=155)	20	9	1	10	14	
N comments	35	18	2	16	21	92
% comments	38%	20%	2%	17%	23%	
Seat	14	4		1	8	27
Service	3	1	1	5		10
IFE	6	1				7
Legroom	2	2			3	7
Neighbor	2		1	4		7

The number and percentage of respondents in each emotion group are displayed in the first two rows of Table 1, followed by the number and percentage of comments obtained for each group. The wellbeing group (e.g., joy, contentment, feeling good) received the most comments (35

comments) while the attribution group (e.g., pride, not being embarrassed) was used least often (2 comments). The Table shows only cabin elements that received at least 7 (8%) of all comments across the five emotion groups. This resulted in five elements among which the number of seat-related comments comprised the most frequently observed group with almost one third of all comments (27 comments, 29.35%) belonging to that group. It was followed by service-related comments (10 comments, 9.20%). Each group is discussed in more detail in the next section.

3.1.   Emotion groups

Wellbeing - this group of emotions was the most frequently mentioned overall. Comments relating to wellbeing expressed the desirability (appraisal) of the consequences of an event that exceeds passengers' expectations, e.g., experiencing joy due to being served quality wine, as one passenger mentioned. The associated goals were feeling peaceful, relaxed, and mentally positive. The seat played a central role in mediating these emotions compared to other cabin elements. Other comments included the ability to sleep and relax, the entertaining aspects of the IFE unit and its potential to make the passenger pass the flight time pleasurably. The specific types of emotions stated frequently were joyful, pleasantly surprised and feeling good.

Prospect-based – here the passenger is concerned with the desirability of consequences of events for him/herself based on pre-determined hopes or fears, relevant to their concerns. The most frequently mentioned goals were feeling safe, secure and stress-free, and accomplished. Examples are satisfaction with high quality seat headrest. Other comments mentioned feeling relief due to fitting comfortably to the seat or legroom, not experiencing any pain or pressure on the body and not fidgeting. Satisfaction, disappointment and relief were the most common emotion types in this group.

Attribution - when the actions of human or product agents (in the flight context) were approved or disapproved based on passengers' tacit standards (e.g., things perform smoothly and uniformly), these emotions were mentioned. A respondent mentioned that having to call the flight attendant, who does not circle around the cabin often, is embarrassing (an emotion). Another emotion mentioned in this group was admiration for how the in-flight services were performed. This group was the least mentioned overall.

Wellbeing/attribution Compound – this complex group of emotions comprised standards (concerns) such as being responsive and attentive, as the basis for the appraisal process. For instance, one passenger mentioned that he appreciated that the flight attendant checked on him to see if he was alright after that he had complained about being cold and requesting a blanket. The experienced emotion in that example is appreciation, resulting from the attentive action of an agent (the flight attendant) that matched the respondent's standards of what constitutes good service and the passenger approving the consequences for himself (comfort and health). In this group, gratitude was mentioned in relation to services (e.g., making special consideration for travelling parents with infants) and anger towards neighbors (e.g. noisy and disturbing neighbors causing irritation and consequently discomfort).

Attraction – this group of emotions was based on liking or disliking the characteristics of objects, for example, finding the cabin design tasteful. After wellbeing emotions, this group received a considerable number of comments mainly focusing on the seat and the legroom. Apart from finding the visual aspects of the seat or the cabin to one's taste (e.g. liking the bright cabin), respondents mentioned the appeal of some physical design characteristics (e.g., well-stuffed seat). Finally respondents expressed a strong dislike for a lack of personal space either because of close proximity to neighbors (e.g., narrow seat width or shared space below armrest) or other design aspects (e.g., the legroom space reduced due to the side wall curvature).

3.2.   Appraisal patterns

The major benefit of the OCC model is the framework it provides for understanding the underlying reasons for the expressed emotions in a systematic manner. This is accomplished via the identification of certain patterns characteristic for each emotion group. The discussion in this section focuses on the underlying patterns of emotion groups in the flight context in the same manner as the OCC model and revising it accordingly.

The results suggested that, in this dataset, the emotion group "fortune-of-others" (e.g., gloating, resentment, pity) was not relevant to the passengers' comfort experience. This is not surprising given that comfort is a personal experience (De Looze et al., 2003) and the main concerns of aircraft passengers are how THEY feel and what THEIR physical and psychological state are (Dumur et al., 2004) rather than those of others. Furthermore, the emotion group "attribution" was apparently not strongly linked to comfort, judging by the fact that it received only two comments. This leaves four emotion groups that could be attributed to the passengers' perceived comfort among which wellbeing emotions were found the most salient and occurring most frequently. These groups and their eliciting conditions are illustrated in the model shown in Figure 1. It depicts three levels of the appraisal process: passengers' concerns (goals, standards, and aspects), their focus, and emotions that are elicited as the result of particular patterns of those two. In order to describe passengers' focus in the context of flight, a number of cabin elements (based on Table 1) are introduced as mediating elements.
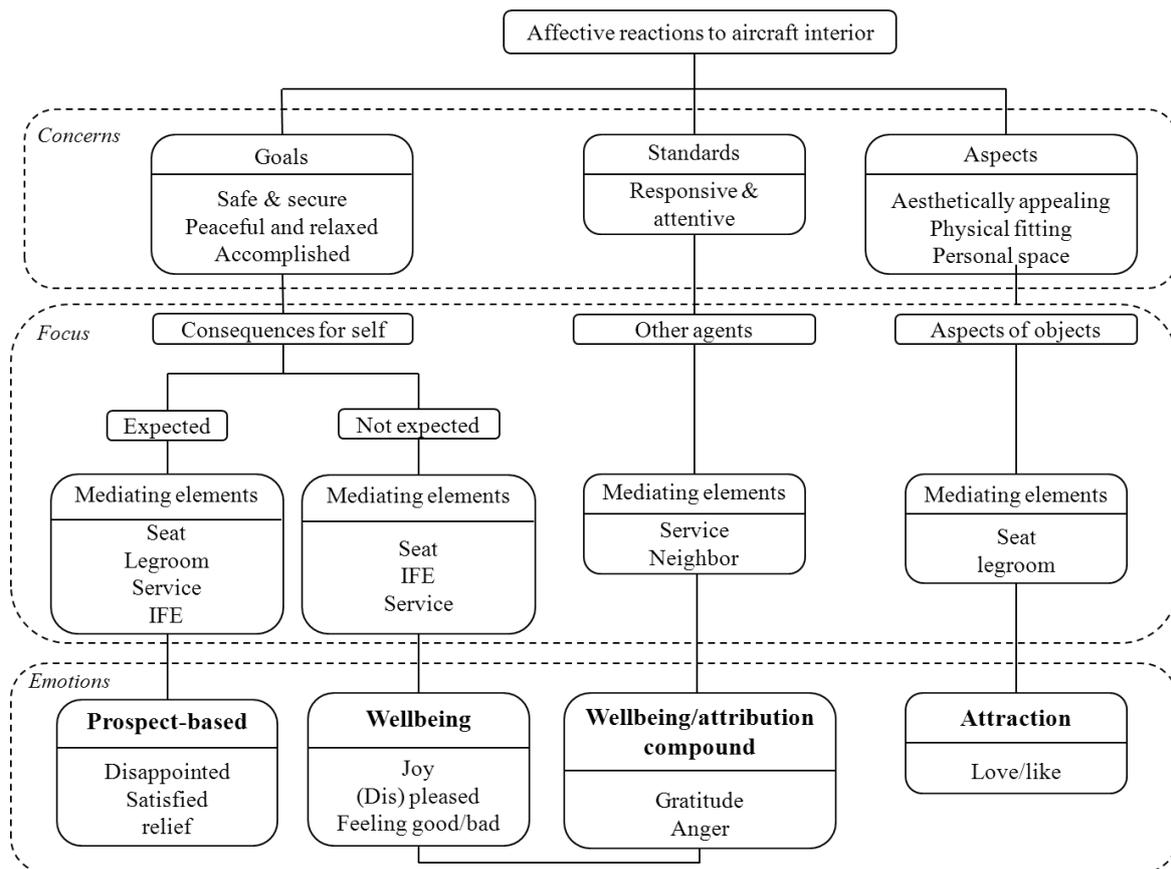
Figure 1. The cognitive structure of passengers' emotions in relation to comfort, illustrating the appraisal patterns of passengers' affective reactions to the aircraft interior during the flight (adopting and revising the cognitive structure of emotions by Ortony, Clore, and Collins, 1988).

Based on above model, Prospect-based emotions are evoked when passengers board aircrafts with certain expectations; when they encounter what they had hoped for, they experience satisfaction while disappointment results when hopes are not confirmed. They also have fears rooted in previous experiences or pre-flight experiences (e.g., airport, check-in procedures, luggage screening), which, if not confirmed, generate relief. These prospect-based emotions could be addressed in design on the basis of passengers' expectations, considering different scenarios, and developing alternative solutions to prevent experience of these fears. For instance, a lot of passengers in this survey expressed their goal as wanting to feel secure and having access to their personal effects during the flight. Finding out the typical objects passengers bring along (e.g., bottle, glasses, headphones, etc.) onboard and designing appropriate built-in compartments in the seat to store those could potentially generate an emotion of satisfaction.

Wellbeing emotions, although related to goals, are not related directly to passengers' anticipations prior to a flight but rather to the influence exerted by unexpected events. When passengers are taken by surprise, for instance, two outcomes may be expected. First, an experience of joy due to being pleasantly surprised, and second, feeling distressed due to being negatively surprised. Given the importance of wellbeing emotions for the comfort experience, it is advantageous to study what constitutes a pleasant surprise for passengers. To that end, the survey showed that feeling calm, relaxed, and secure are common goals among passengers. Designing adjustable seat headrests such that it maximizes support for the neck and keeping it steady while sleeping in various postures is likely to generate a joyful and relaxed experience. Another means to deliver joy and pleasure is to provide passengers with access to an IFE unit similar to what they have in their home, for instance access to live TV or a remote control. A lot of passengers used the phrase "something that stands out" as a determinant of joy. This is usually a small serendipitous event such as receiving chocolate as a souvenir on a Swiss airline, being served wine on a domestic short flight or listening to music local to the destination country. As for security concerns, passengers' need for a small safe to store and lock in important belongings such as passports or money could create a pleasant surprise. One passenger mentioned the joy of removing the armrest to cuddle with his wife like they do on a couch at home. These parts of the experience provide that extra touch that is not necessarily expected, but stands out and makes passengers feel they are part of the experience and not merely cargo to dispatch, as one passenger put it.

Wellbeing/attribution compound emotions represent an interesting case in relation to comfort. The results of this study suggested that attribution emotions in isolation appear trivial to a sense of comfort, yet 15 (17%) emotion comments pointed to the co-occurrence of the eliciting condition for this group and wellbeing emotions allocated it. Attribution emotions are elicited when people react to the actions of agents (self or others) and evaluate them against their standards. An example of an in-flight agent is the service, with the action represented by the response of the crew to passengers' demands. If passengers approve of the crew's responsiveness (standard), an admiration emotion is elicited. The lack of implications of these emotions for the comfort experience, however, suggests that passengers' comfort does not depend on objects or human agents to "do things right". On the one hand, this is due to the somewhat passive position of passengers as self-agents in the aircraft, and on the other hand, their awareness of the limiting circumstances (for other human or object agents) during the flight. Meanwhile, when the actions of an agent yields pleasing or unpleasing consequences for passengers that meet or disturb their personal goals, the compound emotions, anger and gratitude in particular, emerge.

According to Frijda (1988), anger is the outcome of appraising frustration for which someone else, i.e., another agent, is to blame. Although the passenger is not actively concerned with what the agent does (e.g. the service), if the consequences of their actions frustrate or benefit the passenger, anger or gratitude is generated in return. In short, in the context of a flight, passengers are not primarily concerned with how things get done but what they mean or bring to them. In this study, the results implicate that serendipitous elements which generate joy, could also elicit gratitude if they deliver something significant for passengers. As mentioned earlier, the goal of most passengers is to relax. When preparing to sleep, if the cabin light is designed to automatically dim and project a calming environment of night time, this serendipitous action delivers a level of appreciation and gratitude that belongs to the wellbeing/attribution compound group.

Finally attraction emotions are elicited when passengers appraise aspects of appealing objects. These aspects constitute aesthetics aspects as well as design aspects such as the physical fit of the seat to passengers' body or their personal space, one respondent described as a "bubble of intimacy". The physical aspects might appear odd and perhaps similar to what one might consider standard (as defined earlier) rather than aspects. However, it must be noted that all respondents had several prior flight experiences. As a result of their familiarity with the seating area, they had developed a taste for it and assigned certain characteristics to the seat and the legroom; some appealing and some not so much. Upon appraising an appealing characteristic of the seat, the passenger develops a liking for it and a positive emotion (various degrees of "love") is generated. The OCC model also describes this situation by stating that objects do not refer exclusively to physical products but also to situations in which one is evaluating aspects and attitudes of

something including people. Indeed this situation arose in this survey as well where one respondent commented on liking the friendly attitude of flight crew.

The study presented in this paper and leading to the above model has some limitations. The method of studying emotions based on written self-reports often leaves some room for interpretation by the researcher regarding both the nature and intensity of the reported emotions. In-depth interviews could potentially overcome this limitation and provide an opportunity to inquire respondent's elaboration on the experience. Having established the significance of emotions for comfort, future research should attempt to validate the model and the inter-relationship between its components.

4. CONCLUSION

This paper showed that different types of emotions are related to passengers' comfort experiences. As mentioned in the introduction, opinions vary as to whether comfort per se is an emotion. Yet, the types of emotions emerging in this study shed light on how emotions may inform a sense of comfort. The appraisal patterns of the OCC model provide a good structure for those experiences and the model was successfully adapted for the aircraft interior context. The new model highlights passengers' concerns, focuses and the types of reaction that typically result from their interactions with the cabin.

The proposed model of the cognitive structure of passengers' emotions enables us to recognize the types of experiences that should be delivered to ensure that passengers FEEL comfortable. How is this achieved? The model identified four emotion groups that are closely related to comfort. First and foremost, these involve wellbeing emotions followed by prospect-based, wellbeing/attribution compound and attraction emotions. The particular appraisal patterns (concerns, focus and moderating cabin elements) for each of these four groups are highlighted in the model.

The cognitive structure of passenger emotions in relation to comfort experience presents an opportunity for improving the design of aircraft cabin elements to elicit positive emotions. The fact that some elements such as the seat and the IFE appeared in the model several times; in association with different emotions groups, it shows that there are various ways to manipulate the cabin design and induce positive emotions and comfort. It is up to manufacturers and airlines to work out how an appealing and pleasing balance of those can be reached to enhance passenger comfort.

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BIOGRAPHY

Naseem Ahmadpour is Ph.D. candidate in Human Factors at the Department of Industrial Engineering, Polytechnique Montréal, Canada. She has received her M.Sc. in Human Factors from Chalmers University of Technology, Sweden. Her doctorate research is titled "aircraft passenger comfort experience and wellbeing" for which she collaborates with Bombardier Aerospace. Keen about understanding human responses to the social and environmental inputs, her goal is to develop a theory of comfort that accounts for various aspects of passengers' experience. As part of her research, she employs the principles of cognitive structure of emotions to study the appraisal patterns of passengers' emotional responses to the contextual elements.

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