

What makes a space invader? Passenger perceptions of personal space invasion in aircraft travel

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Abstract

The invasion of personal space is often a contributory factor to the experience of discomfort in aircraft passengers. This paper presents a questionnaire study which investigated how air travellers are affected by invasions of personal space and how they attempt to adapt to, or counter, these invasions. In support of recent findings on the factors influencing air passenger comfort, the results of this study indicate that the invasion of personal space is not only caused by physical factors (e.g. physical contact with humans or objects), but also other sensory factors such as noise, smells or unwanted eye contact. The findings of this study have implications for the design of shared spaces.

Practitioner summary

This paper presents a questionnaire study which investigated personal space in an aircraft environment. The results highlight the factors which affect the perception of personal space invasion in aircraft and can therefore inform the design of aircraft cabin environments to enhance the passenger experience.

Keywords

Proxemics, personal space, interpersonal distance, aviation, comfort

Introduction

The study reported in this paper aims to develop an understanding of how people perceive their personal space in-flight, and how other passengers and environmental factors have an impact on personal space and comfort.

What is personal space?

A broad study of space (including personal and social space) was considered by Hall (1990a, 1) who used the term ‘proxemics’ ‘for the interrelated observations and theories of man's use of space as a specialized elaboration of culture’. There are several descriptions of personal space in the literature, for example, it has been defined as ‘the

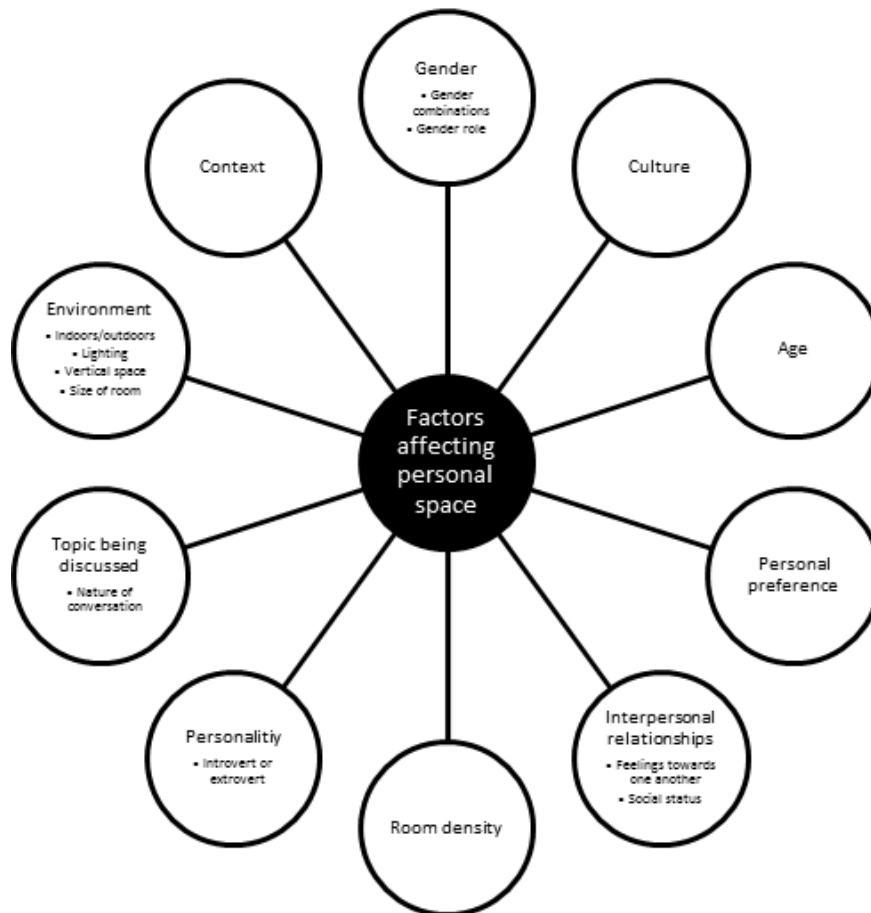
area immediately surrounding the individual in which the majority of his interactions with others takes place...it has no fixed geographic reference points, moves about with the individual, and expands and contracts under varying conditions' (Little 1965, 237). Personal space has also been described by Sommer (2002, 647) as an 'emotionally tinged zone' around the body that can vary in dimensions at any given time and context—individuals feel a sense of ownership over this space (Dosey and Meisels 1969). Intruding on this space uninvited can lead to discomfort (Hayduk 1978), stress, avoidance, withdrawal (Hayduk 1983) or arousal (Middlemist, Knowles, and Matter 1976; Hayduk 1983).

Factors affecting personal space

Personal space boundaries have been found to be affected by a number of factors including interpersonal relationships, personality (Hall 1959, cited by Felipe and Sommer 1966), sex (Evans and Howard 1973; Yee et al. 2007; Nassiri, Powell, and Moore 2005, 2010), cultural background and context (Little 1965; Sommer 2002; Beaulieu 2004). The relationship between two people may differ, be they strangers, acquaintances, friends, colleagues or partners, and this will affect comfortable interaction distances (Evans and Howard 1973). In addition, findings show that people will maintain closer distances to objects than people (Bailenson et al. 2001), indicating that the cause of discomfort is not simply that something is within the personal space zone but that a human is within the area. Figure 1 details the factors which have been found to affect personal space boundaries (Hall 1963; Little 1965; Williams 1971; Evans and Howard 1973; Adler and Iverson 1974; White 1975; Cochran and Urbanczyk 1982; Hayduk 1983; Cochran, Hale, and Hissam 1984; Hall 1990a, 1990b; Adams and Zuckerman 1991; Remland, Jones, and Brinkman 1995; Beaulieu 2004; Uzzell and

Horne 2006; Sommer 2007).

Figure 1. Factors affecting personal space.



The importance of context

It is known that a number of factors which are both personal (such as personality or preferences) and contextual (such as room density or environment) will affect the distances at which people are comfortable interacting with one another and therefore their personal space boundaries. The ways in which people cope with personal space invasions is known within broad contexts. However, aircraft environments present some unusual characteristics in that passengers are potentially subject to close interpersonal distances for prolonged periods of time. It is therefore important to understand how

these factors affect comfort during personal space invasions when on board an aircraft specifically.

Measures of personal space invasion

A number of personal space studies have been conducted over the past 50 years, although the focus of these studies has predominantly been on measurable interaction distances. Physiological measures have been used on occasion to record stress or avoidance behaviour when personal space is invaded (Sawada 2003; Wilcox et al. 2006; Wieser et al. 2010).

Observable behaviours which are adopted when personal space is invaded have been explored at some length (Argyle and Dean 1965; Felipe and Sommer 1966; Sommer 2007), although not in an aircraft context. Air travel, in its current form, poses some very specific contextual factors which may affect coping mechanisms. These include confined spaces and a requirement to be in the same location for a prolonged period of time. In addition, aircraft have a finite number of seats and therefore provide limited opportunity to remove oneself from an uncomfortable situation. These factors, combined with the duration of a flight and therefore the length of time that a person may need to tolerate personal space invasions, may affect the behaviours exhibited.

Aircraft passenger comfort

Previous studies have examined seat comfort on aircraft (Jacobson and Richards 1978; Vink and Brauer 2011; Vink et al. 2012) and the impact of other people on passenger comfort, though studies have inclined towards focusing on how cabin crew affect passenger satisfaction and comfort (Chen and Chang 2005; Bor 2007; Gountas, Ewing, and Gountas 2007).

Until recently, there was comparatively little research examining how other passengers affect an individual's perception of his/her personal space and comfort. The term proxemics has been used to define the, 'concerns for autonomy, control and privacy that the passengers potentially achieve within the limits of their seat in the aircraft' (Ahmadpour, Robert, and Lindgaard 2016, 302). In Ahmadpour et al.'s (2014) study, participants were asked to describe in detail a recent flight experience including information about their feelings, other people, the context, and how these affected their comfort. Although proxemics was one of the themes influencing comfort which emerged from their data, the authors did not specifically focus on the relationship between the individual and other passengers seated near to them, or examine adaptive behaviours when personal space is invaded during air travel.

In a later study, Ahmadpour et al. (2016) conducted an in-flight questionnaire study with 16 passengers which asked them to describe how they enhanced their comfort, the activities they engaged in during the flight, their interactions with neighbouring passengers, and things they found pleasant and unpleasant—considering responses according to whether passengers were travelling alone or with other people. However the study had a limited number of participants and did not consider passengers' adaptive behaviours in response to violations of personal space. A questionnaire was developed to study these gaps in the literature.

Materials

An online questionnaire was developed which comprised two sections and was designed to take no longer than 15 minutes to complete. The first section of this questionnaire contained eight demographics questions which were used to categorise participants' responses to subsequent questions. These questions asked participants about their age,

sex, nationality, country of residence, frequency of flying for leisure and frequency of flying for business.

Participants were asked to note the number of the image in Figure 2 which corresponded to their preferred comfortable conversational distance from a close friend and from a stranger. Whilst it is acknowledged that projective techniques are not necessarily the most accurate method of obtaining this data (Hayduk 1983), it was felt to be the most appropriate for use in a questionnaire study with a high number of respondents.

Figure 2. Interaction distance images.



The second section of the questionnaire addressed the following themes (one question per theme):

- Forms of personal space invasions in current aircraft.
- How passengers feel when their personal space is invaded when travelling on an aircraft.
- What passengers do to make themselves feel more comfortable when their personal space is invaded.
- What people understand by the term 'personal space'.

For this section of the questionnaire, the participants were asked to respond within the context of taking a six-hour (i.e. medium haul) flight.

Method

One hundred and ninety-nine people completed the questionnaire which was distributed online using Bristol Online Surveys. All participants were aged between 18 and 70 (with a mode age range of 18-30) and all travelled by air for leisure and/or business. Participants came from and lived in a range of 24 countries across Europe and the rest of the world, including 37% originating from the UK, 13% originating from South Korea, 9% originating from Greece, 9% originating from Italy, 7% originating from Germany and 7% originating from the USA. Eighty-five of the participants were male and 114 were female. UK-based respondents were given the opportunity to be entered into a prize draw for high street vouchers at the end of the questionnaire to acknowledge their time. Non-UK-based respondents were recruited via contacts within the EC FP7 VR-HYPERSPACE project.

Results

The data collected were analysed using theme-based content analysis (Neale and Nichols 2001) as this allows for data to be summarised into broad themes whilst retaining direct quotes. The data were classified into themes which were subsequently classified into higher order themes and collated in a matrix for ease of use.

This section describes the results of each of the questions in turn.

Interaction distances

Participants were asked to note the number of the image in Figure 2 which corresponded to their preferred comfortable conversational distance from a close friend and from a stranger.

A Spearman test revealed that there was a positive correlation between these interaction distances ($R_s=0.45$, $N=199$, $p<0.05$). Table 1 shows the frequency at which

the comfortable conversational distance for each relationship was selected (the darker cells are those which were most frequent).

Table 1. Frequency of reports of conversational distance to a close friend and a stranger.

Comfortable conversational distance from a stranger	Comfortable conversational distance from a close friend			
	1	2	3	4
1	2	0	0	0
2	81	28	0	0
3	27	53	1	0
4	1	5	1	0

Two-way Chi-Square tests were carried out to determine whether there was an association between interaction distance and nationality, country of residence, age or sex. There was no association between interaction distance and nationality ($X^2=43.39$, $df=42$, $p>0.05$), country of residence ($X^2=32.21$, $df=32$, $p>0.05$), age ($X^2=11.32$, $df=8$, $p>0.05$) or sex ($X^2=0.31$, $df=2$, $p>0.05$). Therefore, when analysing the qualitative questions, the data were viewed as homogenous with respect to the acceptability of interpersonal distance. As a result, all qualitative data were analysed together and comparisons were not drawn between different groups.

How do people invade personal space on an aircraft?

Participants were asked about the ways in which they consider that other people may invade their personal space on an aircraft. The main themes which emerged are summarised in Table 2 and examples are discussed below.

Table 2. Summary of ways in which personal space can be invaded on aircraft (numbers refer to the number of reports in each category).

Higher Order Theme	Theme
Physical causes of personal space invasion – human body (284)	Close interpersonal distances (91)
	Physical contact (59)
	Physical encroachments with arms or legs

	(46) Physical encroachments from in front (71) Physical encroachments from behind (13) Continuous movement (4)
Physical causes of personal space invasion – objects in environment (115)	Placement of their belongings or touching others' belongings (34) Monopolising or controlling shared spaces (81)
Other sensory factors that intrude on personal space (170)	Noise (75) Smells (22) Hygiene (6) Food or drink (4) Listening to others' conversations (2) Looking at others or at what they are doing (30) Undesired conversation (31)

Invasions falling under the category of close interpersonal distances include passengers occupying space that is designated to others, especially when asleep. This may be affected by the anthropometry of neighbouring passengers. For example, someone who is broader in frame is more likely to maintain a closer interpersonal distance, however, people may also be more tolerant of this. This type of spatial invasion can also result from a passenger's arms or legs being in another person's personal space zone. Common causes are people who sit with their legs outstretched (either sideways or underneath the seat in front) or their elbows sticking out. For example, one respondent answered:

'When the other party is clearly being inconsiderate and taking up more than their fair share of space. This space depends on the size of the person—I would accept a larger person needing a bit more room, but not when someone who is average size leans over to my side or spreads their legs in a way that takes up my space when there is clearly enough room for them.' – Participant 39

Other examples of personal space invasions include those caused by people located in the seat behind on an aircraft, exhibiting behaviours such as leaning on or

kicking the back of the seat. Personal space invasions on an aircraft can also be caused by people sitting in the row in front, most commonly by reclining their seat.

Neighbouring passengers can also invade personal space by opening a newspaper widely, squeezing past or climbing over another passenger, asking others to let them out or reaching or leaning across other passengers. Cabin crew may also reach across passengers to pass something to the adjacent passenger, for example:

‘Stranger sitting next to you, I am by aisle. They are constantly ordering drinks etc. so staff always leaning over. As they've ordered so many drinks they need loo more often, so have to move for them to let them out. Even worse if they climb over.’

(sic) – Participant 41

Similarly to this, for people sitting in an aisle seat, others walking past may invade their personal space. Disturbances or hindrances such as being woken up or restricting the movement of others may also invade personal space.

Physical disturbance can be caused by specific types of contact such as passengers falling asleep on, or leaning on others. Physical personal space invasions can also involve objects in the environment as well as other people. However, their involvement is invariably a result of another person’s actions. This type of invasion may include passengers placing their belongings in another person’s space or touching or moving their belongings. It may also include monopolising shared spaces including the armrest or controlling whether the armrest is raised or lowered. If the adjacent person is eating or drinking then the act of doing so, or any spillages, may also cause passengers to feel that their personal space is being invaded.

Other sensory factors can cause psychological disturbance; these include passengers nearby being boisterous and loud (including bodily noises), noise from entertainment systems, smells (including bodily smells), looking at other people or at

what they are doing, listening to their conversations or talking to them when they do not want to engage in conversation. Conversation may also be of an unwelcome overfamiliar or personal nature, for example:

‘A stranger who is trying to discuss with me even if I am not interested in discussing with him/her or asking questions that I am not willing to answer (e.g. my salary, my girlfriend etc.)’ (sic) – Participant 93

Table 3 shows the number of participants who identified causes of personal space invasion due to physical or other sensory encroachments. All but one participant noted instances of physical encroachments. One hundred and twenty-two of these participants also noted additional sensory encroachments.

Table 3. Number of participants who noted causes of personal space invasion which were physical and/or from other sensory factors.

	Number of participants
Physical encroachments only	75
Other sensory encroachments only	1
Both physical and other sensory encroachments	122
Neither	1

How do people feel when their personal space is invaded?

For each example of personal space invasion, participants were asked to describe the feelings that they would typically experience in those situations.

The most common feeling when a close friend invades someone’s personal space is that they do not mind (this was mentioned by 123 participants). Other feelings experienced are annoyance (45 participants), discomfort (34 participants) and irritation (27 participants). The most common feeling when personal space is invaded by a stranger is annoyance (99 participants) followed by discomfort (73 participants),

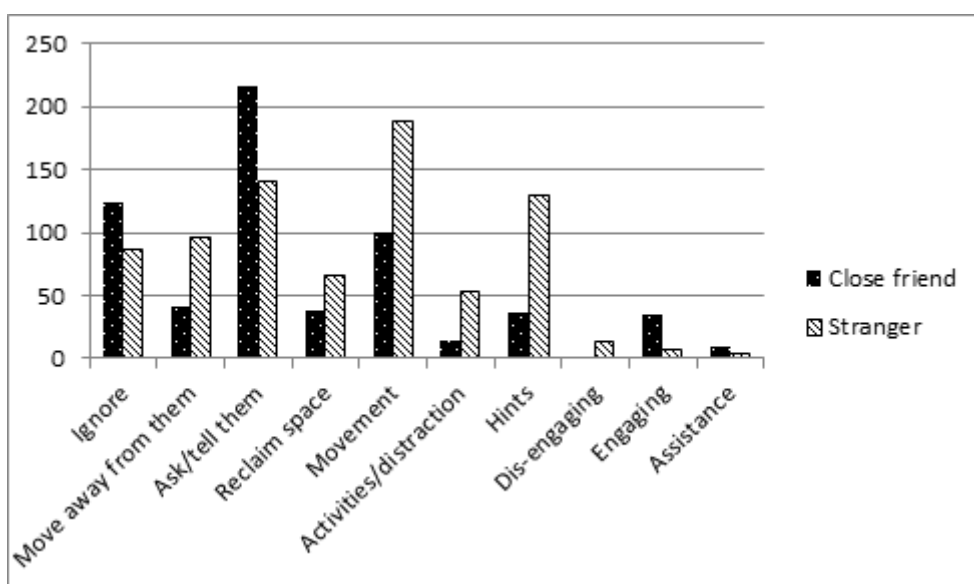
irritation (33 participants) and anger (29 participants). The findings indicate that the feelings experienced when personal space is invaded by a close friend are similar but less extreme than those experienced when the invasion is by a stranger.

In addition to the overall analysis of descriptors, patterns emerged with regard to specific descriptors relating to specific types of invasions. For example, nausea and disgust were often experienced with invasions related to smells. Terms such as ‘claustrophobia’, ‘cramped’, ‘closed in’, ‘constricted’ and ‘fidgety’ were associated with physical spatial invasions, including use of the shared armrest and outstretched legs.

What do people do to make themselves feel more comfortable during in-flight personal space invasions?

For each example of personal space invasion, participants were asked to note what they may do to make themselves feel more comfortable when their personal space is invaded by a close friend and by a stranger. Figure 3 shows the number of reports of specific types of coping strategies.

Figure 3. Coping strategies when personal space is invaded in flight.



A common coping approach for invasions by both close friends and strangers was to ask them to stop or tell them that they are invading their personal space. However, there were substantially more instances of this when a close friend compared to a stranger caused the invasion. It is surprising that this was the most commonly suggested coping approach as findings from the literature indicate that it is unusual for people to confront someone directly (Felipe and Sommer 1966). It is possible that this difference is due to the contextual factors surrounding a flight, i.e. the necessity of being in a particular space for a prolonged period of time with limited opportunity to remove oneself from a socially uncomfortable situation. These factors may cause people to exhibit different adaptive behaviours.

Other common strategies included ignoring the personal space invasion or moving further away from the person who is invading their personal space (but without leaving the situation entirely). It is interesting to note that participants reported substantially more instances of ignoring the situation during a personal space invasion by a close friend and more instances of moving away in response to personal space invasions by strangers. This indicates that personal space invasions are either more tolerable or easier to overcome when caused by a close friend.

Attempts to reclaim stolen space were also described as coping strategies, for example, using the space at the first available opportunity after it is vacated, by moving or nudging the other person or their belongings or by moving closer to the other person. Movement was also noted in various forms, including moving elsewhere, asking to swap seats, moving around in their seats, squeezing themselves into a smaller space, moving into a more comfortable position or turning away from the person who is invading their personal space.

Behaviours such as listening to music, watching films, reading books, sleeping and wearing headphones were also noted as coping strategies. These were sometimes described as distractions and sometimes as ways of appearing socially inaccessible to other people.

Hints were also noted as a coping strategy, including verbal hints to the person invading their personal space, verbal to someone else, non-verbal sounds such as sighing or through non-verbal behaviours. Where unwanted conversation was causing a personal space invasion, common strategies were to stop talking or to respond with short replies.

Offers of help were also suggested as a means of improving the situation, particularly for invasions which involved people reaching across or leaning over others. Amongst close friends, copying the person who was invading their personal space, joking with them about what they were doing or engaging with them were commonly noted behaviours.

In general, negative coping behaviours were more commonly noted for invasions caused by strangers and positive behaviours were more commonly noted for invasions caused by close friends.

Defining personal space

At the end of the questionnaire, participants were asked to define personal space. Although the question specifically asked for a definition of the term 'personal space', many participants explained this in terms of personal space invasions. Table 4 illustrates how many participants mentioned physical encroachments and how many mentioned other sensory encroachments when asked to define personal space.

Table 4. Number of participants who defined personal space within the themes of physical and/or other sensory encroachments.

	Number of participants
Physical encroachments only	68
Other sensory encroachments only	4
Both physical and other sensory encroachments	28

Sixty-eight participants defined personal space in terms of physical encroachment of the space that they considered to belong to them. Twenty-eight participants noted that in addition to this, sensory encroachments also play a role in the invasion of personal space. Other participants (99) defined personal space without specifying the ways in which invasions could occur; examples include specifying the size of personal space, a ‘comfortable’ or ‘secure’ space, the space that they or their belongings are occupying or the area around their body which is theirs. Twenty-nine participants noted that personal space varies with the context or the people in their environment. Sixteen suggested that consent is required for people to enter their personal space. Twenty-nine participants also said that invasions of personal space lead to negative feelings such as discomfort, distress or unease and that personal space is required for a feeling of comfort. Comments that people are unaware of their own personal space until it is invaded were also made.

Interestingly, when defining personal space, the majority of participants did not note that personal space could be invaded in ways other than by physically crossing an invisible border, however, a substantial number of participants did recognise this when stating what other people do to invade their personal space.

Participants’ responses to the defining personal space question lead to a description of personal space that is consistent with the existing literature, that is, it is an invisible boundary surrounding a person which can be broken through spatial invasion or awareness of other people’s actions and characteristics. This boundary is variable in

size depending on context and is used to maintain a person's level of social comfort and invasion of this space can lead to negative feelings such as discomfort, distress or unease.

Discussion

This study has identified passenger perceptions of ways in which personal space can be invaded within the context of air travel and includes descriptions of both physical and other sensory encroachments (e.g. causing social and psychological disturbances).

Although some of the specific causes of the invasions identified pertain to the aircraft environment, the results are generalisable to other environments. Figure 4 illustrates the causes of personal space invasions and adaptive behaviours identified in this study. It also illustrates the factors affecting the size of a personal space zone as defined in the literature (Hall 1963; Little 1965; Williams 1971; Evans and Howard 1973; Adler and Iverson 1974; White 1975; Cochran and Urbanczyk 1982; Hayduk 1983; Cochran, Hale, and Hissam 1984; Hall 1990a, 1990b; Adams and Zuckerman 1991; Remland, Jones, and Brinkman 1995; Beaulieu 2004; Uzzell and Horne 2006; Sommer 2007).

The findings of this study are in support of recent research conducted by Ahmadpour and colleagues which found that perceived discomfort/comfort are influenced by several factors including those related to physical, psychological, environmental and social characteristics of a specific flight experience (Ahmadpour, Robert, and Lindgaard 2014; Ahmadpour et al. 2014). Eight themes (including 'peace of mind', 'physical wellbeing' and 'proxemics') were used to describe aspects of the flight experience which can influence comfort (Ahmadpour et al. 2014; Ahmadpour, Robert, and Lindgaard 2016). Interestingly, the authors found that proxemics did not have a strong association with reported comfort descriptors, although they concluded

that retrospective recall of flight experiences was insufficient to elicit the impact of largely subconscious proxemics issues and behaviours, particularly out of context (Ahmadpour, Robert, and Lindgaard 2016). A later survey conducted in-flight, found that proxemic concerns such as privacy and control were associated with the passenger attitudes avoidance and adjust respectively (Ahmadpour et al. 2016). The authors concluded that consideration of these attitudes in the design of seats and allocated passenger space can increase comfort. The current study specifically examined passenger responses to personal space invasion by others in the aircraft cabin environment.

Figure 4. Factors affecting personal space and adaptive behaviours during in-flight personal space invasion.



The feelings identified during in-flight personal space invasions were negative for the most part, especially when the invasions were caused by a stranger. A large number of descriptors were used to describe these feelings, the most common being feelings of annoyance, discomfort, irritation or anger. It is interesting to note that although similar descriptors were used to illustrate feelings associated with personal space invasions by both strangers and close friends, the negative feelings were noted substantially more frequently when the invader was a stranger. When the invader was a close friend, it was most common for the respondent to 'not mind' that the invasion was occurring.

Respondents suggested a number of behaviours as a means to make themselves more comfortable during in-flight personal space invasions. Some of these behaviours (including changes in position, moving further away from the person (but not away from the situation), averting their gaze, creating a barrier and leaving the situation) are congruent with the behaviours exhibited in previous studies (Argyle and Dean 1965; Felipe and Sommer 1966). Verbal responses were one set of behaviours which were commonly identified in this questionnaire. This finding contrasts with that of Felipe and Sommer (1966) who observed few verbal responses. However, it is possible that this is due to a difference in contextual factors. Felipe and Sommer (1966) conducted their study in a university library where people were able to leave the situation easily and may also only be in that environment for relatively short periods of time. In contrast, in the context of an aircraft, there is limited opportunity to leave the situation and people may be in that environment for a number of hours, which may explain the willingness to adopt more assertive verbal behaviours.

It is interesting to note that this study did not find any differences in preferred interaction distance when comparing participants based on age, nationality, country of

residence or sex. Previous studies have noted differences based on these variables (Hall 1963; Evans and Howard 1973; Hall 1990a, 1990b; Adams and Zuckerman 1991; Remland, Jones, and Brinkman 1995; Beaulieu 2004; Sommer 2007). It is possible that the lack of differences is due to the use of projective techniques which are thought to be less accurate than other approaches such as the stop-distance method because they require the person to imagine themselves in a situation (Hayduk 1983) rather than exhibiting an observable response based on the behaviour of another person. The stop-distance method involves a person moving towards a target participant until the target participant feels discomfort; the distance between the two is taken as a measure of personal space (Dosey and Meisels 1969; Hayduk 1983).

It is likely that changes in the attitude to personal space, specifically within the aircraft context over recent years, has occurred due to the reduction in the size and surrounding space of seats, as well as some airlines requiring passengers to pay to choose their seats. This has resulted in passengers who are travelling together potentially sitting in different locations. The results of this study demonstrate that while personal space can still be invaded by close family or colleagues, it is tolerated more readily and there are also opportunities to confront the situation as well as organise the shared space. When strangers invade personal space, it is more difficult to tolerate and although people will sometimes confront the situation, other coping behaviours are often employed. These findings are confirmed by Ahmadpour et al. (2016) who explored air passengers' proxemics and social interaction concerns, highlighting the importance of control over personal space for all travellers and privacy, in particular for passengers travelling alone.

These results have implications for airlines and aircraft interior designers in terms of recognising the importance of relationships between people within the plane

context and considering both physical and other sensory factors that may contribute to negative passenger experiences (e.g. noise, smell, unwanted eye contact). A confined space may be more tolerable when shared with others who have a similar travel context. For example, aircraft already have separate spaces for business class and economy passengers but this could be extended to business, leisure and/or family groups. Providing designated areas within the aircraft for certain types of passengers or activities may overcome some of the issues relating to noise and behaviours. Related research has examined the use of immersive collaborative virtual environments to enhance passengers' social experience and act as a potential distraction from their awareness of discomfort (Lewis 2015; Lewis et al. 2016). Exploring shared spaces was also part of the work of the VR-HYPERSPACE project (D'Cruz 2014).

Conclusions and recommendations

Invasions of personal space are a common source of discomfort and distress for aircraft passengers. These personal space invasions are not just concerned with physical encroachments of space but also include other sensory factors such as noise, smells or eye contact.

The findings of this research are focussed around the context of passenger aviation. However, they are also relevant to other shared spaces (e.g. other modes of public transport, offices, sports stadia etc.) and could have implications for the design of such spaces, for example in highlighting the relevance of relationships and shared travel context.

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