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The impact of an aircraft's service environment on perceptions of in-flight food quality

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ABSTRACT

Airlines are currently striving to improve the quality and quantity of in-flight food, because research has shown that catering is a key attribute for a customer's satisfaction with airline service quality. But the role of an airline's service environment in forming customer perceptions about food quality has not yet been properly investigated. Using electronic word-of-mouth data from $N = 3996$ airline passengers, this study deploys a linear regression model at multiple levels to relate perceived in-flight food quality with both the overall service environment and its formative components. The results clearly unveil the importance of an aircraft's service environment on perceived in-flight catering quality; perceptions of food quality are primarily influenced by the quality of cabin staff service, followed by entertainment and seat quality. Instead of continuing with the current practice of signing up top chefs to improve menus, airlines may instead consider putting their management focus on service improvements.

1. Introduction

Airline food. These two words are guaranteed to bring out a heated debate among airline passengers (James, 2010). Price is not the only factor when it comes to choosing an airline. Some passengers pick their carrier because of the comfort of the seats, others prize high standards of service above all else. But there is evidence that, for an increasing number of customers, the quality of in-flight food served may be the deciding factor. Aware of their reputation of serving less than satisfactory food, airlines are reacting by signing up top chefs to reorganize menus (James, 2005), thereby following the example of the haute-cuisine restaurant business, where the Michelin guide star system operates as a signaling device to tell customers that they may trust in their decision-making process (Surlemont and Johnson, 2006, p. 577). However, according to the French food critic François Simon, this heavily stylized Michelin-cuisine is outmoded: “For me it is something from another century. It goes back to a time when everybody was obeying rules and the bourgeoisie. […] Today people consider the table a place where they want to feel at ease […] But not these very serious dishes and all those boring things” (Boxell, 2011). This study now questions for the airline industry, if following the haute-cuisine approach is the most promising way for increasing passengers' satisfaction with in-flight food?

The airline industry is part of the international service sector and characterized by a small number of high-value customer transactions (Bejou and Palmer, 1998, p. 7). Growth in the tourism industry in general and in the airline industry in particular creates opportunities as well as challenges for businesses trying to understand their target groups (de Ruyter et al., 1998, p. 189). For formulating a service firm's marketing strategy, knowing a customer's evaluation of service quality and expression of satisfaction is a critical input (e.g., Ofir and Simonson, 2007, p. 164; Szymanski and Henard, 2001, p. 16; Zins, 2001, p. 271). Studies show an especially significant relationship between service quality and retained preference for services firms that operate in global markets (e.g., Ostrowski et al., 1993, p. 16; Park et al., 2004, p. 438). Given the intensive rivalry in the transport industry and its low switching barriers, a focus on customer satisfaction, loyalty, and recommendation intention is even more important (Akamavi et al., 2015, p. 528; Fornell, 1992): “Loyal passengers are essential to any successful airline” (Akamavi et al., 2015, p. 540).

This study scrutinizes feedback from $N = 3996$ airline passengers of Aeroflot, AirAsia, British Airways, Condor, China Southern, Emirates, Etihad, Germanwings, Indigo, Jet Airways, KLM, Lufthansa, Singapore Airlines, and WestJet. It relates perceived

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customer feedback on in-flight food quality to an airplane's service environment, which is made up of cabin staff service, entertainment, and seat quality. Both a pan-airline analysis on the entire dataset ($N = 3996$), as well as an ecological analysis at the aggregated inter-airline level and class of travel ($S = 23$) are conducted. In order to understand how airlines can best increase customer satisfaction and loyalty, we ask the question, "Should airlines rather improve the quality of their in-flight food offerings, or focus on improving the overall service environment? Which components of the service environment contribute the most to perceived food quality?"

After this introduction (Section 1), the remainder of the paper is organized as follows. It first looks at service quality in the airline industry (Section 2), and then explains the study's methodology in terms of research area, hypotheses, and data collection (Section 3). Next, the paper analyses the data, and presents the results (Section 4). It discusses the managerial implications of the findings (Section 5), highlights the study's limitations, and gives potential directions for further research (Section 6).

2. Airline service quality – concept and measurement

Successful companies closely measure, monitor, and manage the factors that drive profitability. The service-profit chain proposes that profit and growth are primarily fueled by customer loyalty, which is a direct consequence of customer satisfaction. Customer satisfaction, in turn, is largely influenced by the value and quality of services provided to customers (Heskett et al., 1994, pp. 164–165; Sasser et al., 1997). Following the conceptualization by Zins (2001), customer satisfaction is understood as an "overall, post-consumption affective response by the airline customer" (p. 276). This response is formed in three stages (Zhang et al., 2008, pp. 212–213): (1) a-priori expectations, (2) subsequent evaluations, and (3) reaction to the service experience. Service expectations are pretrial beliefs that serve as standards or reference points against which the process of receiving a service is judged (Zeithaml & Parasuraman, 1993, p. 1; Niccolini and Salini, 2006, p. 581), confirming or disconfirming aspects of the service quality in a personal trade-off comparison.

Loyalty shows in retention, repeat business, or referral (Heskett et al., 1994, p. 166); it clearly affects profitability (Reichheld, 2003, p. 47). Highly satisfied customers can convert non-customers to a product or service by relating pleasant experiences, recommending to others, and conspicuously displaying branded material. On the other hand, unsatisfied customers are likely to "speak out against a poorly delivered service at every opportunity" (Heskett et al., 1994, p. 166), this includes product or service denigration, relating unpleasant experiences, rumor, and private complaining.

Throughout this paper, such positive or negative word-of-mouth (WOM) referrals denote informal communication between individuals relating to the travel experience with the airline (Dichter, 1966; Singh, 1988; Westbrook, 1987), rather than formal complaints to the airline and its personnel (Anderson, 1998, p. 6). Reviews and ratings are the popular medium by which electronic word-of-mouth (eWOM) is propagated; eWOM can function as a market signal, which influences decisions (Amblee and Bui, 2011). It has been used in the travel and hospitality industry for various different study contexts (e.g., Amblee, 2015; Casaló et al., 2015).

Airline service quality can be understood, in its simplest form, as passenger satisfaction (Bowen et al., 1992); perceived service quality influences the choice of airlines (Min and Min, 2015, p. 734). Unfortunately, there is no consensual agreed conceptualization of airline service quality in either the academic or commercial market research (Tiernan et al., 2008, pp. 214–216). Tsaur et al. (2002) identify airline service quality as a composite of attributes; they find courtesy, safety, and comfort to be the most important ones. Saha and Theingi (2009) test the order of dimensions of service quality, resulting in flight schedules, flight attendants, tangibles, and ground staff. Park et al. (2004) find that service value (perceived price and value), passenger satisfaction, and airline image have a direct effect on a passenger's decision-making process. Wu and Cheng (2013) develop a hierarchical model consisting of interaction, physical environment, outcome, and access quality. Bowen et al. (1992) highlight, that, for assessing airline quality, both qualitative and quantitative factors are important. Bejou and Palmer (1998) and Edvardsson (1992) use the critical incident technique to understand the situations in the service delivery process where airlines fail, and how this affects passengers' relations with the airline. Aksoy et al. (2003, p. 346) highlight that customers of domestic and foreign airlines may have different expectations of service quality. Economy and business class passengers attach different levels of importance to different service quality factors (An and Noh, 2009, p. 293). Other authors like Chen and Chang (2005) and Oyewole (2001) examine the gap between passengers' service expectations and actual service received. While the critical role of the physical environment in comprehending customer behavior has been largely studied in various fields, there has been little previous research in the airline industry: "Empirical research on in-flight physical surroundings and their impact on passengers' buying behaviors is almost as rare for the low-cost airline industry as well as for the full-service airline industry" (Han, 2013, p. 126). This study aims to help close this gap by examining the impact of the service environment on passengers' perceptions of in-flight food quality.

3. Methodology of the study

3.1. Research area and hypotheses

Airline food was first introduced to calm fears of flying. Today, passengers look forward to breaking the monotony of flying with pre-meal drinks, followed by a multi-course menu (de Syon, 2008, p. 207). Airlines continue to announce that they have contracted famous chefs to redesign their in-flight meals (de Syon, 2008, p. 205; James, 2005); in addition, many create seasonal meals several times a year (McGinnis, 2015). This brings expectations as an attitude into the in-flight food situation. Following Cardello (1994), expectations can be defined as the belief that food will possess certain sensory attributes at certain intensities, and that the food will be liked/disliked to a certain degree. The acceptability of food is related to both its characteristics and to what passengers expect it to be. Food that is expected to be better is rated higher, and food that is expected to be worse, is rated lower (Meiselman, 2003, pp. 101–102).

Food anthropologists note that a good meal is judged as much by the surroundings where food is served as on what appears on the table (Gottdiener, 2001, pp. 103–104). Since the middle of the 20th century, consumers have gotten used to assessing product quality in its context or environment. Food quality and food acceptability are judged by factors surrounding the food itself, and factors surrounding the eater (Meiselman, 2003, p. 99). But enjoying a meal also means a special setting, an occasion, and the choice of dining companions (Warde and Martens, 1998). The following interrelationship is therefore proposed:

H1. Airline passengers' perception of food quality (FOOD) depends on the service environment (SERV) as a whole.

In an aircraft, the illusion of a proper meal does not end with an aircraft's technological restrictions; economic reasons further restrict comfort seating. An airline operating an A320 with 150 seats has an approximately 19% higher costs of available seat mile (CASM) relative to another airline operating the same airplane with 180 seats (Hazel et al., 2014, p. 20). But what is more, the service environment does not even come close to providing a dining experience. Seats are facing the back of another seat, rather than facing over a table (de Syon, 2008, p. 205). The following hypothesis is suggested:

H2. Airline passengers' perception of food quality (FOOD) depends on the experienced comfort of the seats (SEAT).

While one certainly eats in company on an aircraft, it is more akin to the proverbial bowling alone experience (Putnam, 2000); social interaction between airline passengers hardly happens. Unless they are travelling in pairs, passengers cannot choose the person sitting in the next seat (Warde and Martens, 1998), and most passengers tend to ignore their travel companions even though they are only an arm length away. In fact, passenger communication is often directed and limited to members of the crew. It can be said that the stewardesses and stewards take the place of the eating companions. The following hypothesis is therefore posited:

H3. Cabin staff service (STAS) has a significant impact on an airline passengers' perception of food quality (FOOD).

Airlines complement the service environment with various entertainment options: "big and small screens now grace passenger seating in a manner reminiscent of the shift in household dining when the television appeared" (de Syon, 2008, p. 207). Because realizing food as a community experience is indeed near to impossible on board a plane, "then perhaps the individual should be left to his or her own devices to acquire and partake in the food s/he enjoys" (de Syon, 2008, p. 207). Entertainment seems to take over the role of a travel companion. The following is hypothesized:

H4. Airline passengers' perception of food quality (FOOD) depends on the quality of in-flight entertainment (ENTE).

The hypotheses are summarized in the research model shown in Fig. 1. The variable service environment (SERV) is a formative variable calculated from STAS, SEAT, and ENTE, which may, despite capturing the same concept, show negative or zero correlations (Curtis and Jackson, 1962; Diamantopoulos et al., 2008, p. 1205). The formative measurement model provides an alternative to the well-established reflective measurement model of social science (Howell et al., 2007, p. 205), and is now well-accepted in mainstream research (Lee et al., 2013, p. 3). It assumes that items are causes of the latent variables, rather than its effects.

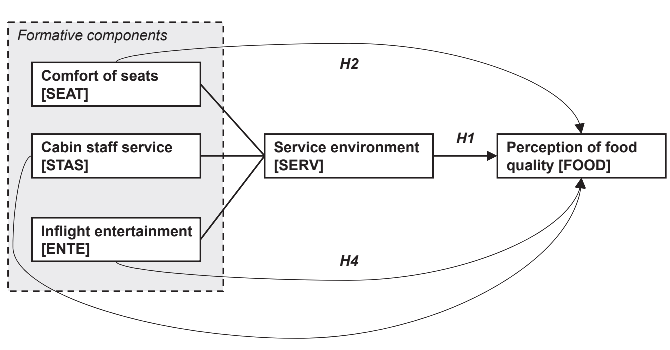

Fig. 1. Research model.

3.2. Data collection

Skytrax is a UK-based specialist research advisory to the airline industry, which also provides information to the British Government for public policy making (UK Parliament, 2008). Skytrax operates an airline and airport review ranking site (www.airlinequality.com; in the following abbreviated as ARRS), which is one of the most popular, independent air travel information websites (Miller, 2015). Skytrax conducts voting authentication and screens results to verify qualification of data entries (Skytrax, 2015).

ARRS is selected for this study because it measures transaction-specific customer satisfaction after a customer's contact with the service provider. Passengers are required to enter the airline name, write a review of the airline in a free-format textbox, provide their name, country of residence, and the email address. While the email address is only used for comment verification and is deleted within 24 hours, the name is published along with the review. Information about the recency of travel (in last month, 2–3 month ago, more than 3 month ago) and the class of travel (first, business, premium economy, economy) is also collected. Other demographic information is not captured.

For the purpose of this study, the following four ARRS items relate to service quality:

- Food and beverages (FOOD)
- Seat comfort (SEAT)
- Cabin staff service (STAS)
- In-flight entertainment (ENTE)

The question asked is: *Please rate these areas of your travel experience with this airline*. The answers are based on a 5-point Likert type scale (one to five stars) with the option to skip a rating.

Data is scraped manually from the ARSS website for the following airlines: Aeroflot (SU), AirAsia (QZ), British Airways (BA), Condor (DE), China Southern (CZ), Emirates (EK), Etihad (EY), Germanwings (4U), Indigo (I9), Jet Airways (9W), KLM (KL), Lufthansa (LH), Singapore Airlines (SQ), and WestJet (WS). This is a convenience sample based on two criteria: (1) there should be enough data available on the ARRS website, and (2) the selection should be an assorted mix of different carrier types from around the world. After deleting datasets where the passenger did not receive any food or beverages, the usable sample size is $N = 3996$.

4. Data analysis and results

To evaluate the interrelationship between the formative measure of the airline's service environment and passengers' perceptions of food quality, simple regression analysis is used (Diamantopoulos and Siguaw, 2006, p. 272). Consequently, for the interrelationship between the formative variable's components with passengers' perception of food quality, a sequence of simple regression analyses is deployed; due to the formative nature of the construct, this is more appropriate than multiple regression analysis or structural equation modeling.

Correlation analysis per se only examines the interrelation of two variables; it does not uncover the direction of the cause-and-effect relationship. However, following the reasoning of concomitant variation (Mill, 1843, p. 470; Rodgers and Nicewander, 1998), it can be established that there is a valid causal inference from FOOD to SERV and its formative dimensions SEAT, STAS, and ENTE. First, the airline's service environment chronologically precedes in-flight catering. Second, using the theory of the servicescape, Bitner (1992) explains that both are related; the physical environment has become a focal point in delivering customer delight (Hightower et al., 2002, p. 697). Third, an assumption of the opposite inference is not a very plausible explanation.

4.1. Pan-airline analysis

As a first step, a pan-airline analysis is run on the entire dataset of $N = 3996$ passengers; all passengers are grouped together and analyzed without regard to the airline and service class (analog in Craig and Douglas, 2005, p. 349). The interrelationship between SERV and FOOD (*H1*) is strong at $r = 0.740$, moderate between SEAT and FOOD (*H2*) at $r = 0.544$, bordering strong between STAS and FOOD (*H3*) at $r = 0.695$, and moderate between ENTE and FOOD (*H4*) at $r = 0.460$, always highly significant at $p \ll 0.01$. The service environment's inter-component correlations are $r = 0.544$ between STAS and SEAT, $r = 0.363$ between STAS and ENTE, and $r = 0.374$ between SEAT and ENTE, always highly significant at $p \ll 0.01$. While these correlations are certainly high, they are not even ($0.363 \le r \le 0.695$). Thus the existence of a substantial halo effect can be dismissed (Thorndike, 1920, p. 27).

As the correlation exists at the individual passenger level, one can now move the analysis to a higher level (Cattell, 1950, p. 216; Chan, 1998, p. 234; Vijver van de & Poortinga, 2002, p. 141).

4.2. Intra-airline analysis

At the intra-airline level, the dataset contains $S = 23$ service environments (economy, business, and first class) for the 14 different airlines with a total of $M = 3718$ passengers. A service environment is included in the study, if it is composed of $m \ge 50$ passengers. These service environments are shown as rows in Table 1 and Table 2; they are sorted by SERV in ascending order.

Table 1 exhibits the means and standard deviations for the variables. Lower values of standard deviations mean that passengers tend to agree on their ratings, for example $\sigma_{SEAT} = 0.802$ for $LH_{[F]}$, $\sigma_{STAS} = 0.683$ for $LH_{[F]}$, $\sigma_{ENTE} = 0.645$ for 4U, $\sigma_{FOOD} = 0.850$ for $LH_{[F]}$. Higher values, on the other hand, indicate a more polarized rating: some passengers seem to like it, others seems to hate it. Examples are $\sigma_{SEAT} = 1.419$ for $LH_{[B]}$, $\sigma_{STAS} = 1.573$ for EK, $\sigma_{ENTE} = 0.802$ for $LH_{[F]}$, $\sigma_{SERV} = 1.507$ for SU, and $\sigma_{FOOD} = 1.429$ for $EY_{[B]}$. These differences can be driven by actual variances in the service environment, for example between short- and long-haul flights of the same airline. But they can also relate to different a priori service expectations; for example, an airline may attract customers from various countries (see Section 6) and walks of life.

This study covers economy and business class for British Airways (BA), Etihad (EY), Jet Airways (9W), Emirates (EK), KLM (KL), and Singapore Airlines (SQ). For Lufthansa (LH), economy, business, and first class is covered. The following observations deserve to be highlighted: First, BA's business class has the lowest SERV rating; it is noticeably lower than the economy class rating of many other airlines. Second, business is usually, and as expected, rated higher than economy class. The only exception is SQ. While both of SQ's service environments are rated at high levels, the airline's economy class receives a slightly better rating than its business class: $SERV_{SQ} = 4.057 > SERV_{SQ[B]} = 3.943$, and more pronounced for $STAS_{SQ} = 4.389 > STAS_{SQ[B]} = 4.129$. Third, the FOOD ratings show expected differences between booking classes for all airlines except SQ and EK, where economy and business class in-flight food are rated practically identical. A possible explanation for the second and third observation lies in a priori customer expectations that serve as a reference point against which the service is judged (see Section 2).

This study, however, focusses on the interrelationship between components of the service environment and food quality, and not on its absolute levels. Table 2 shows these correlations and significance levels at intra-airline level. While all of the correlations between SERV and FOOD (*H1*) and STAS and FOOD (*H3*) are at least moderate at $r > 0.5$ and always highly significant at $p \ll 0.01$, the correlations between SEAT and FOOD (*H2*) and ENTE and FOOD (*H4*) show some exceptions. For example, there is a weak correlation ($0.3 < r < 0.4$) between SEAT and FOOD (*H2*) for $SQ_{[B]}$, $LH_{[F]}$, and $9W_{[B]}$. The correlation between ENTE and FOOD (*H4*) varies from a negligible $r = 0.125$ for $SQ_{[B]}$ to a strong $r = 0.708$ for $CZ_{[B]}$; a possible explanation is that not all airlines provide the same kind of entertainment on all their sectors.

Table 1
Descriptive statistics of the service environments.

Airline	Service	*m*	SEAT		STAS		ENTE		SERV		FOOD	
	Class		Mean	σ	Mean	σ	Mean	σ	Mean	σ	Mean	σ
AirAsia (QZ)	E	172	3.093	1.230	3.267	1.422	1.337	0.811	2.566	0.910	2.901	1.269
Germanwings (4U)	E	52	3.423	1.144	3.077	1.355	1.231	0.645	2.577	0.822	2.481	1.146
Condor (DE)	E	81	2.728	1.304	3.210	1.464	2.407	1.302	2.782	1.149	2.877	1.373
Etihad (EY)	E	266	2.571	1.308	2.823	1.501	3.316	1.322	2.904	1.173	2.831	1.359
WestJet (WS)	E	58	2.983	1.207	3.328	1.444	2.414	1.364	2.908	1.130	2.672	1.220
British Airways (BA)	E	205	3.068	1.293	3.322	1.483	2.429	1.489	2.940	1.066	2.863	1.362
Jet Airways (9W)	E	325	3.231	1.199	3.166	1.378	2.837	1.415	3.078	1.032	2.938	1.236
British Airways (BA)	B	179	3.274	1.323	3.480	1.573	2.492	1.439	3.082	1.140	3.184	1.412
Indigo (I9)	E	58	3.672	0.998	4.034	1.337	1.603	1.324	3.103	0.888	3.379	1.240
China Southern (CZ)	E	172	3.471	1.089	3.517	1.374	2.924	1.266	3.304	1.063	3.174	1.192
Aeroflot (SU)	E	172	3.483	1.073	3.453	1.276	3.122	1.507	3.353	0.940	3.424	1.150
Etihad (EY)	B	115	3.409	1.317	3.565	1.557	3.313	1.379	3.427	1.216	3.504	1.429
Jet Airways (9W)	B	51	3.843	1.189	3.471	1.419	3.039	1.428	3.451	1.035	3.314	1.319
Lufthansa (LH)	E	530	3.128	1.327	3.970	1.255	3.266	1.391	3.455	0.950	3.417	1.199
KLM (KL)	E	239	3.356	1.109	4.029	1.204	3.126	1.418	3.503	0.924	3.682	1.198
Emirates (EK)	E	268	3.470	1.234	3.086	1.573	4.168	1.066	3.575	1.072	3.388	1.371
Lufthansa (LH)	B	148	3.426	1.419	4.291	1.032	3.311	1.428	3.676	1.071	3.899	1.165
Emirates (EK)	B	114	3.719	1.223	3.561	1.494	4.202	1.138	3.827	1.017	3.447	1.409
China Southern (CZ)	B	68	4.324	0.953	4.206	1.100	3.162	1.241	3.897	0.922	3.515	1.178
KLM (KL)	B	80	3.650	1.148	4.375	0.986	3.725	1.055	3.917	0.854	3.888	1.031
Singapore Airlines (SQ)	B	70	3.729	1.215	4.129	1.318	3.971	1.035	3.943	0.832	3.986	1.234
Singapore Airlines (SQ)	E	244	3.824	1.147	4.389	1.066	3.959	1.165	4.057	0.933	4.000	1.221
Lufthansa (LH)	F	51	4.608	0.802	4.667	0.683	3.941	1.047	4.405	0.674	4.392	0.850

m: sub-sample size; σ: Standard deviation; E: Economy class; B: Business class; F: First class.

Table 2
Interrelationships service environment with food at intra-airline level.

Airline	Service Class	H1: SERV – FOOD r	H1: SERV – FOOD p	H2: SEAT – FOOD r	H2: SEAT – FOOD p	H3: STAS – FOOD r	H3: STAS – FOOD p	H4: ENTE – FOOD r	H4: ENTE – FOOD p
AirAsia (QZ)	E	0.670	9.1E-24	0.538	2.7E-14	0.666	2.0E-23	0.271	3.2E-04
Germanwings (4U)	E	0.602	2.4E-06	0.530	5.3E-05	0.531	5.1E-05	0.245	8.0E-02
Condor (DE)	E	0.675	4.9E-12	0.491	3.3E-06	0.716	5.8E-14	0.490	3.4E-06
Etihad (EY)	E	0.787	3.3E-57	0.617	2.5E-29	0.709	6.6E-42	0.679	3.0E-37
WestJet (WS)	E	0.801	4.6E-14	0.628	1.3E-07	0.799	5.3E-14	0.589	1.1E-06
British Airways (BA)	E	0.743	3.0E-37	0.674	1.8E-28	0.692	1.6E-30	0.322	2.6E-06
Jet Airways (9W)	E	0.621	5.0E-36	0.428	6.2E-16	0.624	1.7E-36	0.388	4.1E-13
British Airways (BA)	B	0.720	7.3E-30	0.625	8.1E-21	0.767	7.1E-36	0.298	5.1E-05
Indigo (I9)	E	0.686	2.8E-09	0.457	3.2E-04	0.722	1.6E-10	0.307	1.9E-02
China Southern (CZ)	E	0.747	5.5E-32	0.531	6.6E-14	0.755	5.2E-33	0.606	1.3E-18
Aeroflot (SU)	E	0.582	5.4E-17	0.440	1.6E-09	0.534	4.8E-14	0.324	1.4E-05
Etihad (EY)	B	0.778	1.4E-24	0.598	1.7E-12	0.766	2.0E-23	0.614	3.0E-13
Jet Airways (9W)	B	0.559	2.0E-05	0.389	4.8E-03	0.764	7.2E-11	0.131	3.6E-01
Lufthansa (LH)	E	0.636	1.8E-61	0.446	2.7E-27	0.576	3.7E-48	0.358	1.7E-17
KLM (KL)	E	0.660	2.7E-31	0.465	3.3E-14	0.665	7.4E-32	0.362	7.9E-09
Emirates (EK)	E	0.731	4.2E-46	0.498	3.1E-18	0.738	2.2E-47	0.540	1.2E-21
Lufthansa (LH)	B	0.611	1.5E-16	0.532	3.3E-12	0.551	4.0E-13	0.448	1.1E-08
Emirates (EK)	B	0.795	4.1E-26	0.531	1.2E-09	0.788	2.3E-25	0.528	1.5E-09
China Southern (CZ)	B	0.760	6.0E-14	0.580	2.1E-07	0.608	3.9E-08	0.708	1.5E-11
KLM (KL)	B	0.674	7.2E-12	0.479	6.8E-06	0.578	2.0E-08	0.576	2.2E-08
Singapore Airlines (SQ)	B	0.583	1.2E-07	0.326	5.9E-03	0.705	9.2E-12	0.125	3.0E-01
Singapore Airlines (SQ)	E	0.752	1.1E-45	0.571	1.8E-22	0.709	1.6E-38	0.596	6.8E-25
Lufthansa (LH)	F	0.613	1.8E-06	0.347	1.3E-02	0.505	1.6E-04	0.588	5.7E-06

r: correlation coefficient; p: significance level; E: Economy class; B: Business class; F: First class.

Table 3
Interrelationships service environment with food at inter-airline level.

H1: SERV – FOOD r	H1: SERV – FOOD p	H2: SEAT – FOOD r	H2: SEAT – FOOD p	H3: STAS – FOOD r	H3: STAS – FOOD p	H4: ENTE – FOOD r	H4: ENTE – FOOD p
0.928	1.9E-10	0.709	1.5E-04	0.879	3.3E-08	0.706	1.7E-04

$S = 23$ service environments.
r: correlation coefficient; p: significance level.

4.3. Inter-airline analysis

At the aggregated inter-airline level (see Table 3), the interrelationship between SERV and FOOD (*H1*) is very strong at $r = 0.928$. It is strong between SEAT and FOOD (*H2*) at $r = 0.709$, STAS and FOOD (*H3*) at $r = 0.879$, and ENTE and FOOD (*H4*) at $r = 0.706$, always highly significant at $p \ll 0.01$. The fact that airline passengers are usually economically well-off leads to a high degree of homogeneity across airline samples; consequently, the samples are comparable (Agarwal and Teas, 2002, p. 214). It is therefore possible to derive observations from the inter-airline analysis to individual travelers of an airline as well (Craig and Douglas, 2005, p. 349).

Every dot in Fig. 2 represents one of the 23 airline service environments; the two-digit IATA code is used (see the first column of Table 1). The formative measure of the service environment (SERV) is displayed on the figure's abscissa, the food quality (FOOD) on its ordinate. Using least-squares estimation, the linear equation is of the form:

$$FOOD = 0.2927 + 0.906 \cdot SERV$$

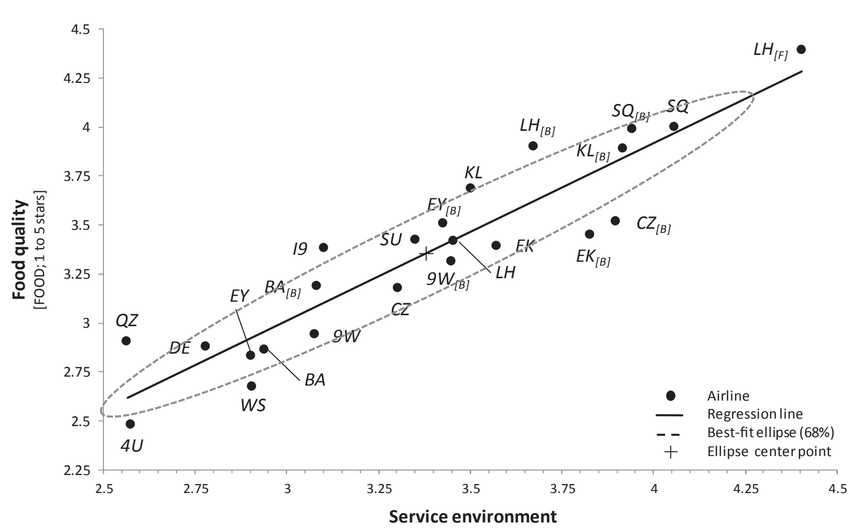

Fig. 2. Regression line and best-fit ellipse (inter-airline level).

With 22 degrees of freedom, the null hypothesis of no correlation is to be rejected at $p < 0.000000001$. The r^2 is 0.861 and adjusted $r^2 = 0.854$; that is, about 86 per cent of the variance in perceived food quality is explained by the service environment. The best-fit ellipse is centered at $SERV = 3.380$, $FOOD = 3.355$; its first standard deviations are $a = 0.659$ and $b = 0.127$. Significant influencers or outliers could not be detected. No airline service environment has a high Cook's distance (>1; max 0.292 for QZ) or DFFITS (>1; max. 0.803 for QZ); all t-tests are insignificant (>0.05; min 0.072 for $EK_{[B]}$). According to Grubb's test, $LH_{[F]}$ is not a significant outlier (max. value for SERV; $G = 2.162 < 2.924 = G_{crit}$; $\alpha = 0.05$). Both the regression line and the best-fit ellipse for the 68% confidence region are shown in Fig. 2.

4.4. Assessment of the research model

Hypothesis *H1*, the interrelationship between airline passengers' perception of food quality (FOOD) and the service environment (SERV), is strongly supported. The correlation is strong at $r = 0.740$ on a pan-airline level. It ranges between $r = 0.559$ ($9W_{[B]}$) and $r = 0.801$ (WS) at an intra-airline level. At the aggregated inter-airline level, it is very strong at $r = 0.928$.

The other hypotheses are now discussed in the order of their support. First, hypothesis *H3*, the interrelationship with cabin staff service (STAS), is supported with a moderate to strong correlation of $r = 0.695$ on a pan-airline passenger level, ranging between $r = 0.505$ ($LH_{[F]}$) and $r = 0.799$ (WS) at an intra-airline level. At the aggregated inter-airline level, it is very strong at $r = 0.879$.

Hypothesis *H2*, the interrelationship with the experienced comfort of the seats (SEAT), is supported with a moderate correlation of $r = 0.544$ on a pan-airline passenger level, ranging between $r = 0.326$ ($SQ_{[B]}$) and $r = 0.674$ (BA) at an intra-airline level. At the aggregated inter-airline level, it is strong at $r = 0.709$.

Lastly, hypothesis *H4*, the interrelationship with the quality of in-flight entertainment (ENTE), is supported with a moderate correlation of $r = 0.460$ on a pan-airline passenger level, ranging between $r = 0.125$ ($SQ_{[B]}$) and $r = 0.708$ ($CZ_{[B]}$) at an intra-airline level. At the aggregated inter-airline level, it is strong at $r = 0.706$.

In summary, the research model suggests that the perception of food quality is strongly interrelated with an airline's service environment. The model also indicates that the quality of cabin staff service is the most important variable.

5. Managerial implications and conclusion

In order to create satisfied customers, an airline needs to integrate and coordinate various variables of the service environment, and deliver consistently (Jager de et al., 2012, p. 21). This empirical study shows that there is significant variation in the level of service quality across airlines (see Section 4.2; similar in Baker, 2013, p. 67). Even more importantly, the study reveals an interrelation between the service environment of an airplane and how passengers perceive the quality of in-flight food. This interrelation reliably exists on an individual passenger level as well as on the aggregated level of airline companies. If the in-flight service environment is good, passengers also tend to perceive the food quality as good. Because the correlation between the components of the service environment is strong, but not even (see Section 4.1), this is most likely not a misjudgment arising from passengers' reliance on the service environment as a surrogate indicator (Fitzpatrick, 1991, p. 888). Instead, it is suggested that an airplane's surrounding actively influences perceived food quality; the worth of in-flight food is assessed in its environmental context (see Section 3.1). Not a single outlier is found in the 23 airline setting examined. Out of an airplane's service environment components (seat comfort, cabin staff service, and in-flight entertainment), cabin staff service shows the strongest interrelation with food quality. This is logical because “service encounters are first and foremost social encounters” (McCallum and Harrison, 1985, p. 35). The interaction with the stewardesses and stewards onboard an aircraft replaces the usual interaction with the dining companions in a restaurant setting (see Section 3.1).

While airline companies are currently striving to improve the quality and quantity of in-flight food in order to improve satisfaction ratings and, ultimately, to retain their customers, the results of this study suggest that airlines begin the improvement elsewhere. They should, first and foremost, focus on improving the overall service environment and, in particular, their staff service. Without having to make any modifications to the menu on offer, passengers would then perceive the quality of in-flight food to be better, which would in turn increase their satisfaction and retention.

Of course, airlines will need to test this approach with empirical validation (Collins and Hansen, 2011, pp. 69–89; Messner, 2013, pp. 304–308); they are advised to run limited tests to try out the effect of improved service on perceptions of food quality, and assess the success of these tests before rolling out a new idea globally. In order to gain a competitive edge, it is critical for airlines to understand customer demands and integrate them into their product and service attributes (Harrington et al., 2011, p. 273); this has to be an ongoing process rather than a one-off proposition (Moskowitz, 2001, p. 37).

However, a generalization is not warranted for the haute-cuisine industry with its Michelin-guide signaling system (see Section 1). Because in-flight catering is a very special services setting (see Section 3.1), it is not necessarily representative of the larger hospitality industry or other services industries. As the risk of new product development failure in the entire foodservice industry is a continuing concern (Ottenbacher and Harrington, 2009, p. 536; with multiple other references therein), there is a need for similar studies focusing on the food consumption and satisfaction process in the hospitality industry, ranging from fine-dining to quick-service restaurants.

6. Limitations and further research

In addition to several strengths, including a large dataset across multiple airlines, a few limitations have to be noted. First, the eWOM data is from the time period December 2011 to September 2015. The ARRS website only provides a certain number of most recent datasets in the public domain. For more popular airlines, the time period is henceforth shorter and more recent. Should an airline have substantially changed its service environment within this time period, the average calculated from the ARRS data might be diluted.

Second, filling out the ARRS questionnaire is an entirely voluntary activity and requires Internet access. That is, the forum can only track customer feedback from passengers who proactively provide feedback. Passengers from some countries or demographic segments may not be aware of the Skytrax forum. The ARRS data may consequently suffer from a non-response bias.

A third limitation is the potential of common method bias, which can inflate relationships among variables. The ARRS survey has taken several measures to minimize this risk, including using different scale endpoints and mandatory free-text feedback fields (Podsakoff et al., 2003). Despite these measures and the negative test for a halo effect (see Section 4.1), common method bias cannot be completely ruled out.

With an eye to future research opportunities, a fourth limitation refers to the variables used in this study. Food and beverages (FOOD), seat comfort (SEAT), cabin staff services (STAS), and in-flight entertainment (ENTE) are not a complete description of an airline's service environment. While there is no consensual agreed conceptualization of airline service quality (Tiernan et al., 2008, pp. 214–216; see Section 2), the concept of environmental dimensions and perceived servicescape (Bitner, 1992, p. 60) would suggest additional variables, such as cabin temperature, cleanliness, décor, flight schedules and on-time departure, lightning, and noise (Pakdil and Aydin, 2007, p. 232). These variables may interrelate. However, this study builds upon an established eWOM database and has to make do with what is available. If an airline would commission a follow-up study, this could use a more complete description of the service environment.

Fifth, passengers' evaluation of the service environment potentially differ based on the seat location (Han, 2013, p. 133) and whether they are business or leisure travelers (Ostrowski et al., 1994, p. 19); these factors could not be controlled for in this study.

Even though a passenger's country of origin is the most apparent delineator in an aircraft cabin (Kim and Prideaux, 2003, p. 489), and while model comparability between countries and cultures should never be naively assumed (Smith and Reynolds, 2002, p. 450; Verhage et al., 1990, p. 302; Wu et al., 2007), it needs to be acknowledged that cultural effects cannot be controlled for in the current study. For example, what people expect from, how they perceive, and how they evaluate a service encounter may be culturally influenced (Sultan and Simpson Jr., 2000, p. 201; Weber, 2005, p. 261; Zhang et al., 2008, p. 218). People from some countries have lower service expectations (e.g., Mexico; Herbig and Genestre, 1996), are generally more tolerant of poor service (e.g., UK; Voss et al., 2004), or express lower satisfaction even if the service environment is superior (many Asian countries; Laroche et al., 2004). Some countries generally show a poor service environment (e.g., Germany; Witkowski and Wolfinbarger, 2002). Studies find that when customers from individualistic cultures are dissatisfied, they are more likely to complain than customers from collectivistic cultures (Liu et al., 2001; Liu and McClure, 2001). Further, the brand perception of airlines from certain countries is better in some countries than in others. People from different cultures tend to respond differently to Likert-type style questions, especially if the question is posed in a non-native language (Harzing, 2006). A better controlled sampling in terms of passenger demographics would enhance the applicability of findings. It would be vitally interesting to examine the possible effect of passengers' country-of-origin and the purpose of travel.

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