Original Article

From OTA interface design to hotels' revenues: the impact of sorting and filtering functionalities on consumer choices

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ABSTRACT Using conjoint analysis and choice data from 1492 Dutch participants, this experimental study explores the impact of user interface functionalities on hotels' customer online behavior and the subsequent economic ramifications for both the search engine service providers and their hotel clients. Specifically, it explores the impact of sorting and filtering on the relationship between a hotel's placements on the initial search results booking page and the likelihood of being booked. The findings indicate that the availability of sort and filter functions generates a more balanced distribution of booking choices, as users pay more attention to the hotel characteristics that are subject to sorting and filtering functionality. If the sort and filter functions are applied to price, visitors are more likely to choose cheaper rooms, whereas when applied to customer ratings, visitors are more likely to choose rooms with better ratings. The functions affect the search agenda and consequently the economic value of placement in top positions. In addition, sorting and filtering increase the competitiveness of the search engine because it encourages users to apply additional choice criteria beyond merely relying on the hotel's placement on the search result page.
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INTRODUCTION

Industry practices and empirical observations indicate that entries at the top of a search engine's results page have higher click-through conversion rates (e.g., Bhargava and Pennock, 2003; Jeziorski and Segal, 2012). Click analyses of Google's search results show that top results receive the vast majority of clicks. Users of Google and Bing search engines clicked on one of the top-3 results in 68 per cent of the time, with 48 per cent clicking on the result listed first, 12 per cent on the 2nd, and 8 per cent on the 3rd (Goodwin, 2012). In a 2014 study of 465,000 keywords on Google, which also ranked results from top to bottom, Petrescu (2014) found that the first five organic search results received 67.6 per cent of all clicks.

Accordingly, commercial search engine services charge a higher listing fee for top-placed entries, allowing advertisers to benefit from their product's higher placement. In the case of hotel search engines, higher placement is associated with a higher likelihood of being booked. As Expedia.com's VP Brian Ferguson stated, "95 per cent of bookings occur with first page placement and almost half (47 per cent) of these bookings are made with hotels in the top six positions" (Green and Lomanno, 2012, p. 131). As top placement is highly desirable, it constitutes a higher value for the search engine service provider. Recent work by Van der Rest *et al* (2016) underscores the effectiveness of higher placement and demonstrates the manner in which OTAs (Online Travel Agencies), and their hotel clients, can monetize the economic value of these top placements.

The dominance of higher placed items in determining the consumers' booking behavior considerably reduces the commercial value of non-top positions. From the OTA's perspective, this is a strategic challenge because the economic vitality of a search engine service firm relies on its ability to feature a large vol-

ume of hotel offerings for its searching customers. This paper explores whether making changes to the user interface design, in particular, adding *search and filter* (S&F) options available to the online searching customer, could drive more click-through behavior to the (pre-filtered/-sorted) lower-positioned entries on the search results page and therefore generate a more balanced distribution of choices across the page.

This study is the first to consider insights from the general literature and practices of user interface design to improve our understanding of OTA's role in the hotels' revenue management domain. We build on the work of Van der Rest *et al* (2016) who demonstrated the use of conjoint analysis as a methodology to systematically explore and estimate the monetary equivalence of a search list placement increment on OTA sites. Specifically, this study's original contribution is to empirically investigate the impact of offering the user interface S&F features, and the impact of the customers' choice to utilize these features, on the customer's propensity to book a hotel in relation to its placement and consequently on the estimated monetary value of higher placement.

BACKGROUND

Lodging industry practices reflect the view that a higher placement on an OTA's search result page increases the likelihood of the hotel being booked by the searching customer. Recent studies explore this notion and appear to provide solid empirical support. Pan (2015) found a dramatic decrease in hotel click-through rate (CTR) from top to bottom of the search engine positions, suggesting an exponential relationship and a power-law distribution. Ghose *et al* (2014) show that hotels with lower customer ratings received less clicks than higher-ranked competitors. Examining an online retailing environment, Agarwal *et al* (2011) found that top positions had a higher CTR but this did not automatically translate into higher conversion rates. Recently, Van der Rest *et al* (2016) find a positive relationship between the probability that a hotel is booked and the hotel's rank on the landing page of an OTA website's customer search result. Further, their study indicates that the marginal economic value gained by moving up on the result page, by, for example, paying a higher commission to the OTA, depends on the hotel's characteristics, such as its distance from the city center. In other words, 'hotels vary in how much their search result position is worth in terms of room-rate-induced propensity to book' (Van der Rest *et al*, 2016, p. 14). The focus of this paper is on the conjecture that having access to, and using S&F options, impacts customer choice, their satisfaction, their booking behavior, choices, and consequently hotels' revenues and the economic value of search results placement. This conjecture is motivated by insights from two different disciplines: computer and information science, and consumer science.

The computing and human factors literature offers a "technical" aspect insight. It argues that flexible design, one that, for example, includes the S&F options, helps consumers find exactly what they need and want, that is, it makes their search considerably more efficient and effective (Baeza-Yates and Ribeiro-Neto, 1999; Yee *et al*, 2003; Kules *et al*, 2009). As this connection between human/computer interface design, consumer choice, and firm performance has been validated, it follows that investigating consumer behavior of web search interaction is key to improving the user interface (White and Drucker, 2007; Hearst, 2008; Wilson *et al*, 2010; Wilson, 2011; Ceri *et al*, 2013).

This study is the first to argue that more support for this plausible connection between consumer empowering design features, customer behavior, choice and satisfaction, and the financial outcome of economic transaction, comes from another emerging school of thought in services science. Specifically, we argue that the literature on Service Dominant Logic (AKA, S-D Logic) and on customers'

co-creation of the consumed experience (e.g., Bhalla, 2011; Greer *et al*, 2016; Ramaswamy and Ozcan, 2014) provides more support for this possible relation. The idea is that a consumer's perceived value of the brand is enhanced the more he/she is actively involved in the production/consumption of the experience. This principle, we argue, could be also relevant when applied to the search activity, that is, to the earlier phase of the consumer purchase cycle of a hotel room (e.g., Chen and Schwartz, 2008). Since OTAs provide a search supporting service, their service value and the satisfaction from their service are subject to the same aspects of customer active engagement. It follows that the empowering tools of S&F might allow consumers to be more active and have more say while consuming the OTA service. The use of these options allows them to shape and tailor the search "mechanism" to better fit their preferences. As such, it is bound to affect their behavior, choices, and perception about the process.

Informed by the two school of thoughts listed above, we submit the following:

- Customers who use the S&F options are likely to book different hotels and will be more satisfied with the selection.
- The sort and filter functionality a customer has and/or uses affects the relationship between the hotel's rank on an OTA's search result page and the hotel's likelihood of being booked.

METHODOLOGY

Experimental design

The study used a between-subject design. The experimental group had the possibility to use an S&F function; for the control group, this function was made unavailable. As some of the participants in the experimental condition (with S&F function) did not use the function, a sub-division can be made as follows:

1. control group (S&F function not available): $n = 377$ and
2. experimental group (S&F function available): $n = 1115$, of which
   a. S&F function available but not used: $n = 643$,
   b. S&F function available and used (at least once): $n = 472$.

An experimental booking site was developed, inspired by OTA websites like Booking.com, to capture and assess consumer booking behavior. The website enabled choice-based conjoint analysis (CBC) on the following attributes: hotel brand, room price per night, type of hotel, distance to the city center, review scores, and position of the hotel add on the list of the results page (See Table 1 for an overview of the attribute levels). The full-profile conjoint experiment included four tasks per respondent with 50 hotel concepts per task to choose from.

The study used randomized research designs, where each respondent received four randomly assigned versions of the generated choice sets in four consecutive choice tasks. The research designs were created using the Complete Enumeration method (i.e., minimal overlap) of the Sawtooth SSI Web (8.1.3) software package. Because each respondent went through only four choice tasks, it was difficult to sustain orthogonality of research designs while collecting sufficient numbers of attribute-level choices per respondent. For this reason, 67 design versions were handpicked from a set of 1000 research designs to maintain orthogonality while obtaining solid frequencies on single individual attribute-level presence as well as two-way occurrences of attribute-level combinations within and across respondent/design versions. Individual part-worth utilities were estimated with the Hierarchical Bayes algorithm of Sawtooth's CBC/HB. Respondents' choice probabilities per hotel concept were derived from the part-worth utilities using standard logistic transformation.

Table 1: Overview of attributes

1	Hotel name (including base room price)	Sofitel (€ 349), Hilton (€ 219), Holiday Inn (€ 199), Best Western (€ 159), Metropole (€ 189), Caesar Hotel (€ 149), Park Hotel (€ 129)
2	Style of the hotel	Romantique, Spa, Gastronomy, Luxury, Design
3	Distance to city center	500m, 1km, 1.5km, 3.5km, 5+km
4	Call to action	Present, absent
5	Room price (from the base room price	−40%, −25%, −12%, 0%, +12%, +25%, +40%
6	Cleanliness (customer rating)	9.9, 9.5, 9.1, 8.7, 8.3, 7.9, 7.5, 7.1, 6.7, 6.3, 5.9, 5.5
7	Staff helpfulness (customer rating)	9.9, 9.5, 9.1, 8.7, 8.3, 7.9, 7.5, 7.1, 6.7, 6.3, 5.9, 5.5
8	Quality of facility (customer rating)	9.9, 9.5, 9.1, 8.7, 8.3, 7.9, 7.5, 7.1, 6.7, 6.3, 5.9, 5.5
9	Position (rank) (on initial search screen)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50

Sample characteristics

1492 Dutch consumers were recruited from an online panel by GMI (Global Marketing Institute). The sample included 719 men (48.19 per cent) and 773 women (51.81 per cent) with an average age of 44.5 years ($SD = 12.5$). A randomization algorithm was used to assign participants to a control group representing 25 per cent of the total sample ($n = 377$). The designation of whether a respondent would be part of the control group was random. There was no significant difference in gender [$\chi^2(1) = .838$, $p = .372$] and age [$F(1, 1490) = .141$, $p = .708$] between the two groups.

Procedure

Figure 1 presents a screenshot of the task order. Step 3 shows the search results page including the sort and filter functions.

Participants started by indicating their travel preferences (e.g., city to be visited, number of nights) and then they were directed to the fictitious booking gallery page, which listed 50 hotels to choose from. The list of hotels on this gallery dynamically matched each participant's trip choices. The participant's task was to select a hotel given the attributes of the hotels in their entries.

Figure 2 illustrates the S&F functionality and hotel attributes on the experimental website. Upon booking a hotel – by clicking on a "book now" button – subjects progressed to each conjoint task. The details of the hotels offered and their position on the page varied based on the orthogonal research design. Participants were instructed to act as if the search at each round of the booking exercise was new.

The study was web administered to replicate real-life online booking behavior. Since a search result with 50 hotels would not fit on the initial screen of the search results page, participants saw the top of the hotel search list upon accessing the page (the number of hotels depended on the resolution of their screen and browser settings). To examine additional hotels, they had to scroll down. Participants could choose a "none" option at the bottom of the page to indicate that they choose none of the hotel rooms. The "none" stayed at the bottom of the page when the sort and filter functions were applied.

FINDINGS

Use of the S&F function

Tables 2 and 3 show whether S&F functions were used at the moment a hotel room was booked. If the S&F functions were used but

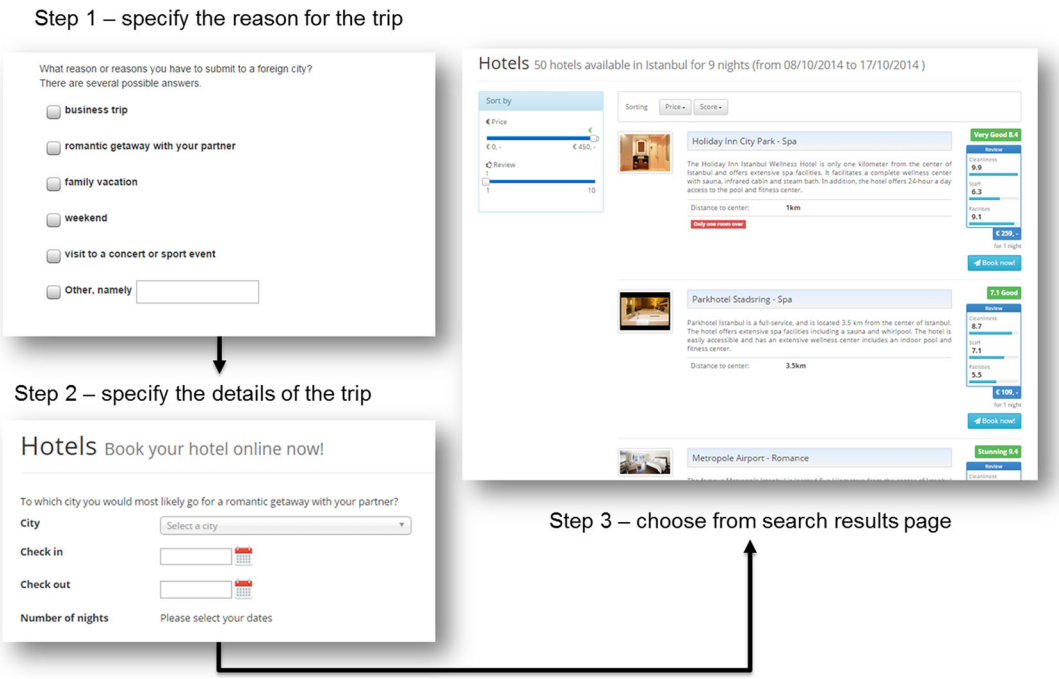

Figure 1: Task structure.

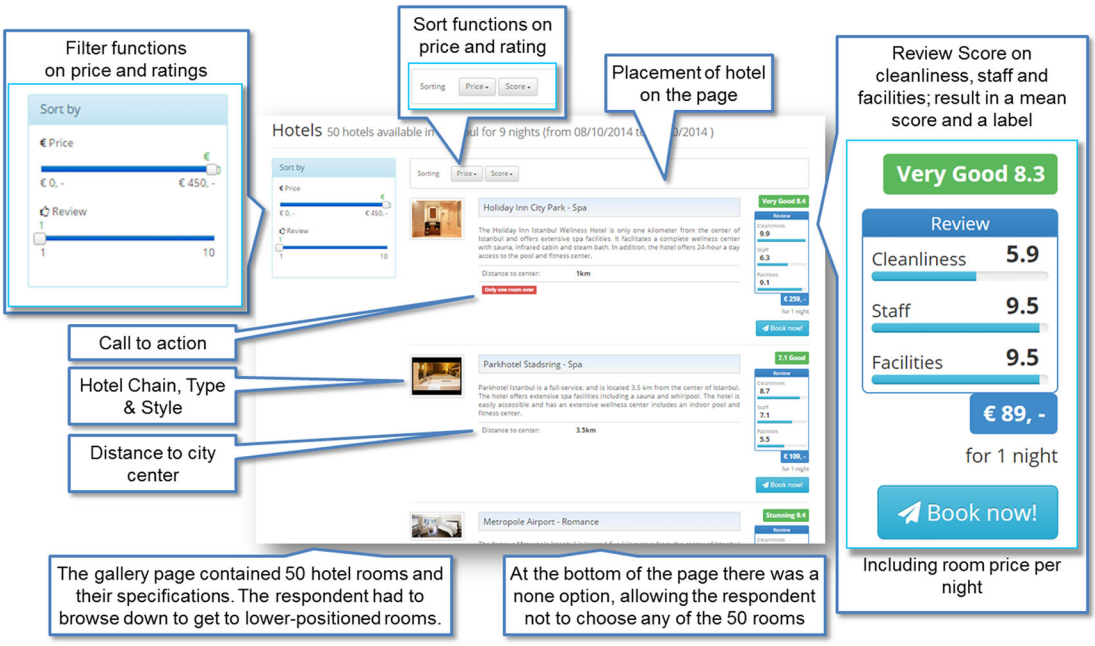

Figure 2: Search result page including sort and filter functions.

Table 2: Use of the sort function for room price and customer review rating

	Task 1 (%)	*Task 2 (%)*	*Task 3 (%)*	*Task 4 (%)*	*Across tasks (%)*
Sort on price	24.2	24.3	25.4	25.3	33.5
Of which Price|asc	24.0	24.2	25.2	25.1	
Of which Price|desc	0.2	0.1	0.2	0.2	
Sort on rating	6.7	5.8	6.1	5.7	10.9
Of which Rating|asc	0.6	0.1	0.4	0.3	
Of which Rating|desc	6.1	5.7	5.7	5.5	
Sort not used	69.1	69.9	68.5	69.0	55.6
Total	100.0	100.0	100.0	100.0	100.0

Table 3: Use of the filter function for room price and customer review rating

	Task 1 (%)	*Task 2 (%)*	*Task 3 (%)*	*Task 4 (%)*	*Across task (%)*
Filter on price					
Used	33.4	31.1	30.7	31.4	42.3
Not used	66.6	68.9	69.3	68.6	57.7
Filter on rating					
Used	21.0	19.5	18.7	18.5	27.1
Not used	79.0	80.5	81.3	81.5	72.9

their settings undone by the time the choice for a hotel room was made, the usage was not recorded.

Among the participants, 42.3 per cent used the filter function on price in at least one of the four tasks. The sort function (price) was used by 33.5 per cent. The filter function on customer review rating was used by 27.1 per cent of the participants. The sort function on rating was used by 10.9 per cent. The price S&F function was thus preferred the most. The use of S&F functions did not significantly vary across the four conjoint tasks [price filter: $\chi^2(6) = 2.18$, $p = .902$; price sort: $\chi^2(6) = 2.18$, $p = .902$; rating filter: $\chi^2(6) = 2.711$, $p = .844$; rating sort: $\chi^2(6) = 6.46$, $p = .971$].

As Table 4 illustrates, the use of the filter function and less so the sort function resulted in a difference in the use of the "none" option, the option at the bottom of the pages not to choose any of the hotel rooms offered. Those who had the price filter option available and used it (i.e., condition 2b) chose the "none" option significantly more than those who did not (conditions 2a and 1), $\chi^2(2) = 23.98$, $p < .001$. A similar effect was found for the use of the sort function, but the effect was less strong and only directionally significant, $\chi^2(2) = 5.79$, $p = .06$. The effect also impacted the utility values of the "none" option, which were also higher for those to whom the S&F functions were available (used price filter: $F(2, 1489) = 52.434$, $p = .000$; used price sort: $F(2, 1489) = 34.673$, $p = .000$).

Figure 3 shows how the availability of the S&F function affected the distribution of choices across the positions on the search results page. The results are accumulated across the four tasks. The distribution of choices in the absence of S&F functions matches Van der Rest *et al* (2016): dominance in choice of the top-ranking items. In the control group (condition 1: S&F function unavailable), the first 12 positions captured 50 per cent of the booking choices. For the experimental group (condition 2: F&S function available), this is reached at position 26.

From Figure 3, it was indicated that the booking choices in condition 1 (unavailable) were more skewed towards the top positions

Table 4: Use of the "none" option as a function of S&F function usage[a]

	(C)1: Not available (%)	*(C)2a: Not used (%)*	*(C)2b: Filter used (%)*	*Total (%)*
Filter function				
Choose a hotel	88.5	87.6	83.0	86.7
Choose the "none" option	11.5	12.4	17.0	13.3
Sort function				
Choose a hotel	88.5	86.2	85.7	86.7
Choose the "none" option	11.5	13.8	14.3	13.3

[a] Condition 1 = S&F Not Available = C1, Condition 2 = S&F Available, where condition 2a = S&F Not Used = C2a, and condition 2b = S&F Used = C2b.

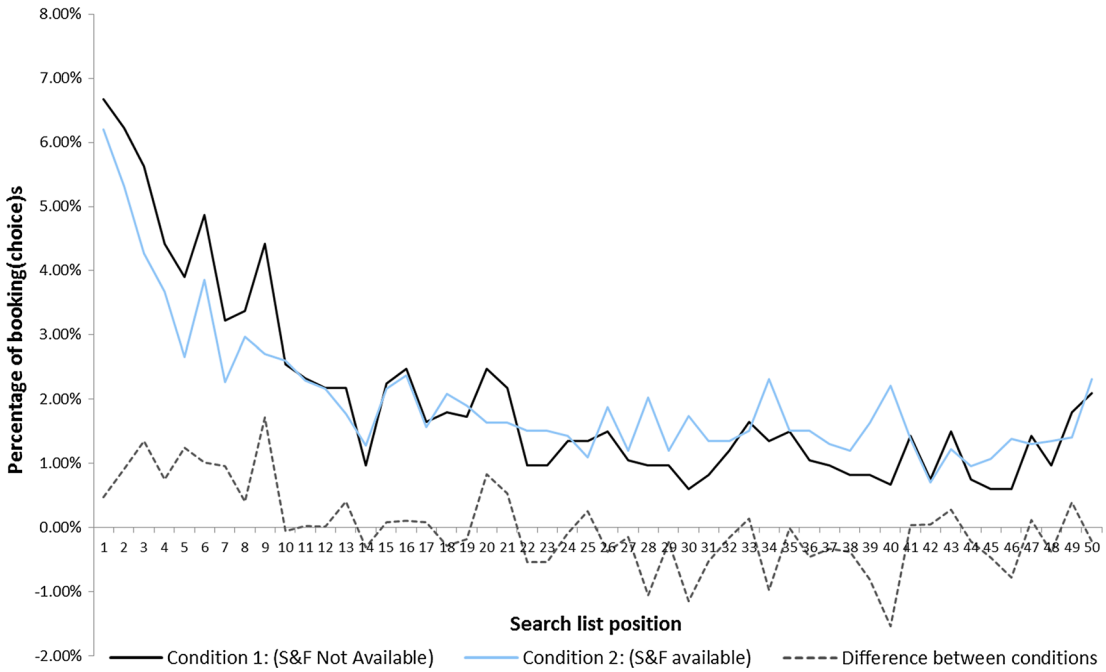

Figure 3: Impact of the availability of sort and filter functions on the distribution of choices.

than in condition 2 (S&F available: used & not used). A two-sided Kolmogorov–Smirnov test confirmed that the two conditions were not drawn from the same probability distribution ($D = 0.24619$, $p < .001$). Examining condition 2 in more detail, Figure 4 shows that the distribution of booking choices of condition 2a (use of the available S&F function) was distributed relatively evenly over the 50 search list positions, whereas in condition 2a (available but not used) the booking choices were even more skewed ($D = 0.1243$, $p < .001$) to the top positions than in condition 1 (not available not used).

The S&F function thus "redistributes" the booking choices towards entries that are more at the middle of the initial search results page list. It is worth noting that due to the use of the S&F function, the position of each hotel room may have been different on the search result pages before and after the use of the S&F function (i.e., participants may still have chosen the rooms placed at the top but then after applying sorting and filtering).

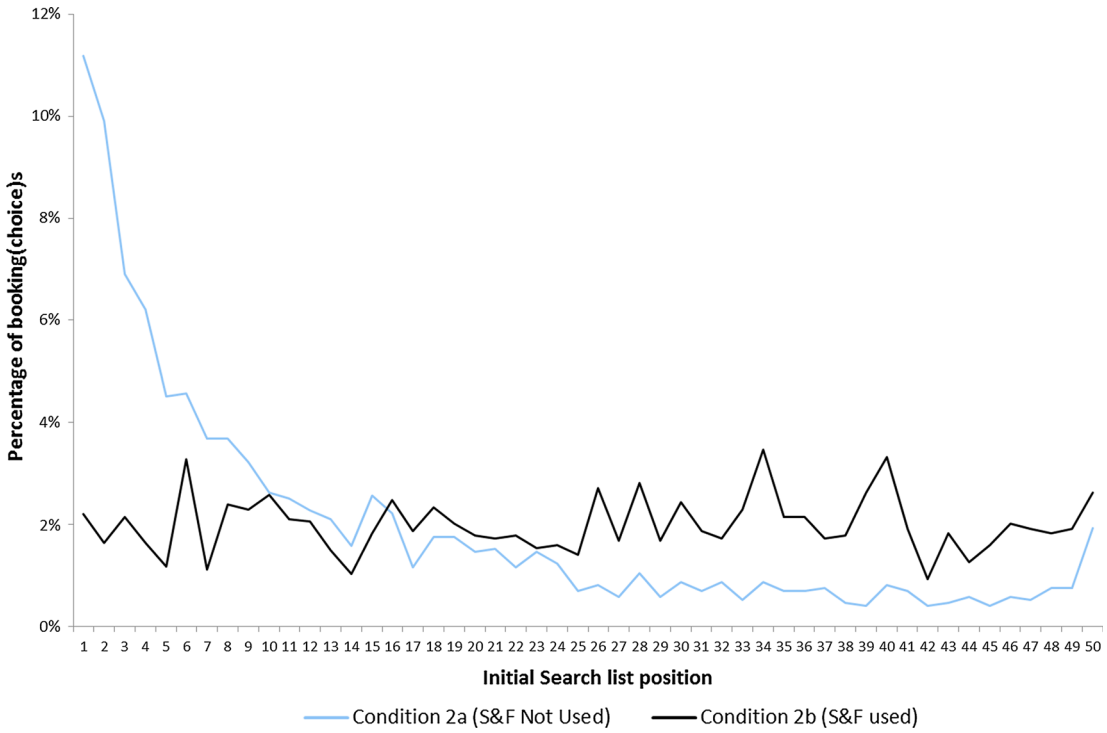

Figure 4: Impact of sort and filter functions on the distribution of choices.

Not all of the participants opted to use the S&F functionality when offered as part of the interface design. Only the choice patterns of those who used the functions were more equally distributed over the 50 search result positions. They were inclined to base their choices on key characteristics of the hotels (i.e., price and rating). Those who sorted and filtered on price tended to choose hotel rooms that were cheaper, while participants who did this by hotel rating were more likely to choose hotels with a higher rating. Those who pre-elected an acceptable price band were less responsive to higher prices because they saw fewer (variations) of them.

Those who did not use the S&F function focused even more on the top positions on the search results page. They were less price-sensitive and chose rooms at a same or higher room price. The S&F function thus primarily impacts the choices of those who used it. The others followed the order on the search list. This observation is important as it implies that user interface design solutions can steer visitors away from just the top positions, thereby helping improve the focus of consumer choices on the offerings instead of the context in which they are presented.

Impact of S&F function on the choice process

Participants who sorted and filtered on price, booked significantly cheaper rooms [filter: $F(2, 1024) = 34.35$, $p < .001$; sort: $F(2, 1024) = 53.35$, $p < .001$] than those who did not use (have) S&F function. Similarly, those who sorted and filtered on room ratings booked rooms with significantly higher ratings [filter: $F(2, 1024) = 53.22$, $p < .001$; sort: $F(2, 1024) = 28.98$, $p < .001$). Tables 5 and 6 provide an overview per conjoint task.

There was a learning effect noticeable in the average prices of rooms booked. A repeated-measures MANOVA showed a significant within-subject effect of task on price [filter:

Table 5: Average price of the chosen room as a function of S&F function usage

		Task 1	*Task 2*	*Task 3*	*Task 4*
Filter	C2b: Used	€ 103	€ 103	€ 102	€ 98
	C2a: Not used	€ 130	€ 125	€ 124	€ 124
	C2: Available	€ 119	€ 116	€ 115	€ 114
	C1: Not available	€ 127	€ 123	€ 121	€ 123
	Total	€ 121	€ 118	€ 116	€ 116
Sort	C2b: Used	€ 98	€ 94	€ 96	€ 95
	C2a: Not used	€ 130	€ 127	€ 124	€ 123
	C2: Available	€ 119	€ 116	€ 115	€ 114
	C1: Not available	€ 127	€ 123	€ 121	€ 123
	Total	€ 121	€ 118	€ 116	€ 116

Table 6: Average rating of a chosen room as a function of S&F function usage (10 = high, 1 = low)

		Task 1	*Task 2*	*Task 3*	*Task 4*
Filter	C2b: Used	8.4	8.3	8.4	8.3
	C2a: Not used	8.0	7.9	8.0	7.9
	C2: Available	8.1	8.0	8.1	8.0
	C1: Not available	8.0	8.0	8.0	8.0
	Total	8.1	8.0	8.1	8.0
Sort	C2b: Used	8.5	8.4	8.4	8.4
	C2a: Not used	8.0	7.9	8.0	8.0
	C2: Available	8.1	8.0	8.1	8.0
	C1: Not available	8.0	8.0	8.0	8.0
	Total	8.1	8.0	8.1	8.0

Table 7: Effect of the S&F function on price and customer review rating sensitivity

	Price sensitivity by filter on price (%)	*Rating sensitivity by filter on rating (%)*	*Price sensitivity by sort on price (%)*	*Rating sensitivity by sort on rating (%)*
C2b: Used	21.9	1.4	22.5	1.5
C2a: Not used	21.3	1.5	21.1	1.4
C2: Available	21.6	1.4	21.6	1.4
C1: Not available	23.3	1.3	23.3	1.3
Total	22.0	1.4	22.0	1.4

$F(3, 3072) = 5.22$, $p < .001$; sort: $F(3, 3072) = 4.58$, $p < .001$], indicating a decline in the average prices of the rooms that were booked across the four tasks.

The S&F function also affected participants' price and customer review rating sensitivity. Table 7 lists these sensitivities (measured by attribute importance).

In condition 2 (where S&F functions were present), price sensitivity was significantly lower than in condition 1 (where S&F functions were absent) [filter: $F(2, 1489) = 8.88$, $p < .001$; sort: $F(2, 1489) = 12.38$, $p < .001$]. The F-values indicate that the effect was strongest for the sort function. The question arose to what attribute participants

were more sensitive if they were less sensitive to price.

In line with the more frequent use of the "none" option in condition 2b (where S&F was available and used), as illustrated in Table 8, participants were significantly more sensitive to the "none" option [sort: $F(2, 1491) = 34.673$, $p < .001$; filter: $F(2,1491) = 52.434$, $p < .001$], the option (i.e., a constant alternative) if none of the simulated concepts would satisfy participants.

Price sensitivity decreased along with sensitivities to other hotel attributes and the sensitivity of the "none" option went up.

The availability of the S&F function also had a positive relationship with task satisfaction. Booking a hotel room was significantly more pleasant when S&F functions were available (See Table 9) [partial contrasts; condition 2a&2b (presence) versus condition 1 (absence); filter price $t(1489) = -2.941$, $p < 0.01$; sort price $t(1489) = -3.013$, $p < 0.01$; filter rating $t(1489) = -2.730$, $p = 0.06$; sort rating $t(1489) = -3.103$, $p < 0.01$]. Whereas the use impacted the search result, it did not impact the pleasance of the task [partial contrasts; condition 2a (not used) vs. 2b (used); filter price $t(1491) = -1.660$, $p = 0.097$; sort price $t(1489) = -0.105$, $p = 0.97$; filter rating $t(1491) = -.993$, $p = 0.321$; sort rating $t(1489) = -.940$, $p = 0.348$]. It thus was the availability of S&F functions which impacted task satisfaction, not their use. To verify whether the availability of the S&F function also resulted in higher consistency in the completion of CBC tasks, the Root Likelihood (RLH) resulting from the Hierarchical Bayes analysis was examined. From Table 10, it was shown that the RLH values were higher when S&F functions were available [$F(1, 1490 = 8.516$, $p = .004$).

An ANOVA by means of partial contrasts (condition 2b vs. 2a) showed that the RLH

Table 8: Attribute sensitivities as a function of the S&F function

Attribute sensitivity to	*Sort function*				*Filter function*			
	C1: Not available (%)	*C2a: Not used (%)*	*C2b: Used (%)*	*Total (%)*	*C1: Not available (%)*	*C2a: Not used (%)*	*C2b: Used (%)*	*Total (%)*
Hotel chain brand	29.0	27.7	26.5	27.8	29.0	27.8	26.7	27.8
None	20.0	22.1	25.7	22.5	20.0	21.3	26.1	22.5
Room price	23.3	21.1	22.5	22.0	23.3	21.3	21.9	22.0
Distance to center	16.2	16.9	16.0	16.5	16.2	17.4	15.5	16.5
Style	7.3	7.8	5.8	7.1	7.3	7.8	6.2	7.1
Call to action	2.9	2.9	2.1	2.7	2.9	3.0	2.2	2.7
Rate for facilities	0.5	0.6	0.5	0.5	0.5	0.6	0.5	0.5
Rate for staff	0.4	0.5	0.5	0.5	0.4	0.6	0.5	0.5
Rate for cleanliness	0.3	0.4	0.4	0.3	0.3	0.4	0.4	0.3

Table 9: S&F function related to task satisfaction (1 = high; 5 = low)

	Filter on price	*Filter on rating*	*Sort on price*	*Sort on rating*
C2b: Used	1.52	1.52	1.48	1.42
C2a: Not used	1.45	1.47	1.48	1.49
C2: Available	1.48	1.48	1.48	1.48
C1: Not available	1.62	1.62	1.62	1.62
Total	1.51	1.51	1.51	1.51

Table 10: S&F function related to Root Likelihood (RLH) values

	RLH by filter on price	*RLH by filter on rating*	*RLH by sort on price*	*RLH by sort on rating*
C2a: Not Used	0.40	0.42	0.38	0.43
C2b: Used	0.46	0.45	0.52	0.41
C2: Available	0.43	0.43	0.43	0.43
C1: Not available	0.39	0.39	0.39	0.39
Total	0.42	0.42	0.42	0.42

values were significantly higher [filter on price: $t(1489) = -4.338$, $p < .001$; sort on price: $t(1489) = -8.874$, $p < .001$; filter on rating: $t(1489) = -1.737$, $p < .001$) if participants used the S&F functions [sort on rating: $t(1489) = .759$, $p = .448$]. This implied that the application of the S&F function benefitted the consistency of the CBC data.

DISCUSSION

Bates' (1989) seminal work on search engine design underscores the notion that designing an interface is not as straightforward as it appears to be. Baeza-Yates and Ribeiro-Neto (1999) stress that simplicity versus power is an important tradeoff in all user interface designs. More recently, Wildemuth (2006) argues that progress in designing user interface that matches user search strategies is likely to improve search outcomes, while Xiang and Pan (2011) argue in favor of search engine marketing for tourism industry, stressing the importance of understanding user behavior.

The findings of this exploratory study indicate that the presence of an S&F function affects the economic value of an incremental improved placement. Another finding is that the use of S&F functions lowers the average booked room rate. It follows that while the economic value of lower-ranked positions on the results page may have gone up due to the use of an S&F function, the overall business proceedings in the market might decrease. This indicates that if the user interface design is effective in this regard, it might be more beneficial for the hotel to consider investing in improved value propositions instead of in a higher placement on the search result page.

An intriguing finding of the study is that a majority of participants did not use the S&F functions. While benchmark numbers are hard to find in the public domain, in order to establish if this is high or low, there is a clear opportunity for future research to find out if changes to the interface design can nudge participants to use them. Participants' task satisfaction numbers were higher if the functions were available (regardless if they used them or not). So, participants were happy to have them and decided if they could do without them. Another intriguing finding of this study suggests that when customers used the S&F function, they are more likely to choose the "none" option (not booking). As a result, the choice model's assessed sensitivity to the "none" option increased, while the sensitivities to the other hotel attributes decreased. This is in line with Yee *et al* (2003) who state that the power of an interface leads to increased levels of rejection. It follows that the value proposition levels, as suggested by the alternative hotel attributes, may have been insufficient to compensate for a higher price.

The results indicate that an S&F function is associated with more consistent choices, a higher validity, and higher task satisfaction. These relations appear to agree with Yee *et al*'s (2003) findings in their faceted search interface for fine arts image study, and it points to an opportunity for OTAs to develop revenue-optimizing, long-term, strategies. If customer

satisfaction increases by offering user interface elements (such as the S&F function), there may be a tradeoff between the short-term (higher commission fees) gains from driving traffic to the top-ranking entries, and the long-term effects of giving customers more of what they need.

If customers are satisfied, not only with the task but also with the specifications of the hotel they have stayed in, they may be more inclined to use the hotel search engine again. Any (personalized) change to the user interface design that may help to do so (and steer the customer away from simply booking the top listed hotels), may help to drive traffic to the web site, and in the long run, help to drive a higher commercial value. Moreover, if a user interface succeeds in giving visitors more and better-designed opportunities to change the order in the search results page to their liking, the hotel attributes might influence the choice more than the interface design. Interestingly, this may be true even for attributes not subject to filtering and sorting, because the subset of hotel rooms to choose from, shrinks.

CONCLUSION

While providing additional empirical support to the view that the customers are more likely to book hotels placed high on search result pages of an OTA, this study offers new theoretical and practical insights into the topic. We explore the possible role of offering the customers the option to sort and/or filter the results of OTA search. We find solid support to the notion that customers who use the S&F options are likely to book different hotels, pay less, and be more satisfied with the selection. We also find that the relationship between the probability that a hotel is booked and its rank on an OTA's search result page is influenced by the sort and filter functionality available and/or used by the searching customer.

As with any research, the study also has limitations. First of all, only Dutch participants were included in the experiment. Secondly, our replication of a booking site did not include multiple search pages (i.e., all 50 booking options were displayed on a single results page; scrolling was needed to look into entries toward the lower end of the page). Most search and booking engines distribute the results across multiple pages, promoting clicking to a follow-up page over scrolling to the bottom of an "infinite" page. The results of our study are thus only generalizable to web environments of a similar structure.

The findings are of interest to a variety of industry stakeholders. While it is a common practice for hotels to pay a higher commission for a higher placement on the search results page, this study demonstrates how this could be mediated by additional user interface elements such as the S&F function. Hotels that target the more price-sensitive hotel guest are likely to benefit considerably since their booking is likely to increase when an S&F function is available. Booking sites and other distribution channel members can use the findings to develop discrete choice models to demonstrate to clients the effect of design changes, offering a choice-experimental variation to A/B type testing.

The theoretical contribution has to do with the realization that the concept of customer co-creation of the consumed experience could, and should, be applied earlier in the purchasing cycle. That is, it could play an important role in the (pre-purchase/consumption) search phase. The data appear to suggest that, indeed, customer empowering tools such as the S&F function enabled some of the customers to perform a search that better fitted their preference and affected their buying decision and their satisfaction. To the best of our knowledge, this study is the first to suggest and test this notion of applying co-creation activities earlier in the hotel purchasing cycle process.

Future research could expand on this idea, for example, by testing more ways in which customers can co-create in the search phase of the cycle beyond the S&F tool we discussed and tested in this study. Another area of

potential future research contribution is the relationship between the design of the computer interface's choice environment and the parameters (i.e., product characteristics) of the choice alternative itself (see for example, Hoban and Bucklin, 2015), as well as the importance of these interface and choice parameters.

Finally, the traditional information theory modeling approach suggests that a search should stop when the expected marginal cost associated with the search activity equals the expected marginal utility from the search. It would be interesting to merge the two domains of search cost/utility and the co-creation one, perhaps attempting to find out how customers' co-creation activity might influence the perceived search cost and the expected utility from search, hence affecting the length and intensity of the search phase.

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