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Influence of consumer reviews on online purchasing decisions in older and younger adults

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ABSTRACT

We investigated how product attributes, average consumer ratings, and single affect-rich positive or negative consumer reviews influenced hypothetical online purchasing decisions of younger and older adults. In line with previous research, we found that younger adults used all three types of information: they clearly preferred products with better attributes and with higher average consumer ratings. If making a choice was difficult because it involved trade-offs between product attributes, most younger adults chose the higher-rated product. The preference for the higher-rated product, however, could be overridden by a single affect-rich negative or positive review. Older adults were strongly influenced by a single affect-rich negative review and also took into consideration product attributes; however, they did not take into account average consumer ratings or single affect-rich positive reviews. These results suggest that older adults do not consider aggregated consumer information and positive reviews focusing on positive experiences with the product, but are easily swayed by reviews reporting negative experiences.

1. Introduction

Understanding how people make online purchasing decisions is of growing importance. With an increase of 19.9% in 2016 and a forecasted growth of 17.5% for 2017, global business to consumer (B2C) e-commerce is now accounting for 8.7% of retail sales worldwide.[1] Overall, e-commerce is still dominated by younger and middle-aged consumers, but older consumers (55-year-old and older) are increasingly buying goods or services online [1]. So far most research has focused on younger adults, leaving it unclear how older adults deal with the challenges involved in online consumer decisions (for notable exceptions see [1–3]).

The goal of the present research is to contribute to understanding how older adults make on-line purchasing decisions. Do they differ in their decision process from younger adults? What information do they consider? And last but not least: how can we use this knowledge to ensure better decision making on their part? We focus on how older adults use three main types of information: product attributes, average consumer ratings, and single positive and negative reviews that contain an affect-rich and vivid description of the reviewers' experiences. We also take into account how the products are presented i.e. whether they are presented simultaneously or sequentially and which product is presented as the first/on the left.

In the following, we first review the literature on the influence of consumer ratings and reviews on online purchasing decisions and on how decision making processes change with age. Then, we report two experimental studies investigating how younger and older adults use consumer reviews in hypothetical online purchasing decisions. Finally, we discuss the results of the studies and consequences of our findings for designing e-commerce systems.

2. Related work

2.1. Influence of consumer reviews on attitudes and purchasing intentions

The effect of consumer reviews on online decisions is widely recognized. Numerous studies have shown that consumer ratings and reviews impact people's purchasing behavior and intentions, as well as attitudes towards products and retailers (e.g., [4–6]).

According to recent meta-analyses, the most important features influencing sales and attitudes are the valence and the volume of reviews [5,7]. In general, more positive reviews increase sales and attitudes,

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[1] https://www.ecommercewiki.org/Prot:Global_B2C_Ecommerce_Report_2016.

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whereas negative reviews reduce them (e.g., [5,8]). Their effect, however, also depends on review exposure [9], the characteristics of the reviewer [10], and the source of the review [5].

Although positive and negative reviews can sway consumers' behavior, some research has indicated that they differ in their impact. Purnawirawan et al. [7] reported that negative reviews had the strongest effect on attitudes and usefulness, suggesting that negative reviews may carry more weight than positive reviews [11,12] — a finding that resonates with research in further areas of communication [13,14]. However, other research has reported that with consumer reviews the negativity bias is limited to hedonic goods [12]. Furthermore, Wu [15] suggested that consumers may not weigh negative reviews more strongly per se, but perceive them as more informative because they often are rarer and of higher quality.

Besides the valence of the review, the format of the information matters. Online platforms often provide consumer reviews in two formats: average ratings giving an overview over the overall perceived quality of the product (i.e., statistical information) and single reviews that contain personal narratives of experiences made with a specific product. The relative importance of these types of information is still under debate. A recent consumer survey indicated that customers rate average ratings as most important [16]. Hong and Park [17] found that both statistical information and narrative information are equally convincing, whereas Ziegele and Weber [18] reported that although average ratings were considered important, single vivid narratives overrode average ratings. This picture is consistent with research in the medical domain showing that anecdotal or narrative evidence can be more convincing than statistical evidence of treatment quality [19-21]. The question of how strongly single reviews influence behavior is particularly important because people often only read a small number of reviews before making a decision, focusing on the most recent reviews [16].

In sum, research suggests that younger adults' purchasing decisions are strongly influenced by average consumer ratings. Average ratings of a product, however, may loose their influence on decisions if they are inconsistent with a well-written, single review [18]. Furthermore, some research indicates that negative reviews exert stronger influence than positive ones [7] suggesting that negative single reviews may carry more weight than positive single reviews. In contrast, little is known about how older adults make online consumer decisions and react to consumer ratings and reviews.

2.2. Aging, decision making, and online purchasing

Aging is characterized by a number of changes in cognitive abilities, affect and motivation [23-25] that impact how older adults make decisions (e.g., [25,26]).

In terms of cognitive abilities, growing old is related to a decrease in fluid cognitive abilities such as working memory capacity, processing speed and visual processing, resulting in older adults having difficulties in a number of cognitive tasks (e.g., [27–29]). This age-related decline also affects the decision making process. Older adults tend to perform worse than younger adults, in particular, if tasks are complex, demand the processing of large amounts of information (e.g., [30,31]), or require learning [32,33].

Despite the decline of fluid abilities, older adults show an increase in crystallized abilities; that is, higher levels of declarative knowledge and experience [23]. Using this knowledge and experience, older adults can devise strategies to compensate for their limited fluid cognitive abilities (e.g., [26]). Specifically, they are more selective in their information search and frequently rely on less information-intensive strategies [26,34]. Moreover, older adults may simplify decision problems by focusing more on affective cues [25]. Although these simpler strategies often perform somewhat worse than more information-intensive strategies, they perform very well if they are suited to the task (e.g., [35]). Accordingly, the loss in decision quality can be quite small [36,37].

In line with this, research in consumer contexts indicates that older adults have more difficulties when options differ on many attributes (e.g., [38]). Furthermore, older adults tend to search for less information than younger adults while making consumer decisions [39] and prefer to stick to the same brand [40,41].

Relatively little research has considered how older adults navigate the online world, but the number of studies is rising with more elderly adults using the Internet [1,2,42]. Still, older adults seem to be more reluctant than younger adults to use e-commerce and are less familiar with computer technology in general [1,43]. In addition, a study in Hong Kong found that older adults perceived online purchases as less easy than middle-aged adults [2]. Most relevant, Ma et al. [3] found that age was negatively related to self-reported perceived benefits of consumer reviews, their persuasiveness, and use.

2.3. Aging and processing of affect-rich consumer reviews

Although overall text comprehension suffers in old age [44], older adults' ability to process narrative and emotional texts is well preserved [45,46]. Accordingly, single consumer reviews presented in a narrative format may present a source of information that is easily accessible for older adults and thus exert a strong influence on their decisions, even if the information is not representative of overall consumer opinions. Yet, whether older adults are equally influenced by negative and positive affect-rich reviews is unclear.

Besides changes in cognitive processing, aging is also related to changes in affect and motivation, which may influence the information older adults pay attention to. Socio-emotional selectivity theory proposes to that with increasing age people focus more on maintaining positive affect and less on increasing their knowledge [24,47]. In line with this idea, older adults have been shown to report improved psychological well-being and lower levels of negative affect [48]. Moreover, older adults often show a positivity effect; that is, they exhibit a preference for positive over negative information in processing information [49]. Specifically, older adults pay more attention to positive information and remember it better than negative information [49,50].

At face value the positivity effect would suggest that older adults will pay more attention to and consequently are more influenced by positive reviews. However, a focus on maintaining positive affect may not always go hand in hand with a focus on positive information. In this vein, Depping and Freund [51] proposed that to maintain positive affect older adults focus on preventing losses, resulting in a higher sensitivity and more attention to losses. In line with this idea, it has been shown that in learning paradigms older adults learn better from negative than from positive consequences [52,53] — a bias that is not shown by younger adults [54]. A focus on preventing losses, however, suggests that older adults should be influenced more strongly by negative reviews.

2.4. Presentation of options

In laboratory decision tasks, options are usually presented simultaneously, side by side. However, when purchasing products online consumers often need to consider options sequentially. Although in principle the decision task is the same, simultaneous or sequential presentations can affect the decision process. Presenting options sequentially can result in order effects, leading often to a preference for the first option (e.g., [55]). Furthermore, people seem to be more satisfied with choices from simultaneous presented options (e.g., [56]). Last but not least, decision processes may change depending on the presentation with simultaneous presentation facilitating attribute-wise comparisons, whereas presenting a single option may lead to more alternative-wise comparisons (see, [57]). Although the influence of the presentation type on choices is not the focus of our research, we manipulated whether products were presented sequentially or

Fig. 1. Exemplary products card showing a choice between vacuum cleaners in the positive review condition. The affect-rich positive review is presented for the lower rated product (left) and the short baseline review for the higher rated product (right).

simultaneously to ensure that effects of average ratings and single narrative reviews are not limited to one type of presentation.

3. Predictions and research questions

We investigated three problems. First, we wanted to know whether older and younger adults rely on average consumer ratings and how this depends on products' characteristics and their presentation. Second, we examined whether single, vivid, and affect-rich positive and negative reviews can override their preferences for products with higher average consumer ratings. Third, we inquired how these two groups perceive the affect-rich reviews. To analyze these three problems we conducted two empirical studies, one with young adults (Study 1) and one with older adults (Study 2).

In Study 1 we expect to replicate the main findings from the literature. For one, we expect that young adults will in general prefer options that have higher average ratings to options with lower average ratings (e.g., [5]). Secondly, following Ziegele and Weber [18] we expect that preferences for options with higher average ratings will be reduced when a single affect-rich review favors the option with the lower rating. In addition, we aim to examine whether a single negative consumer review will have a stronger effect than a single positive consumer review, following up on research suggesting a bias for negative information.

In Study 2 we expect that older adults will prefer options with better attributes but that their choices will be more noisy due to the decrease in decision making capacities in older adults [33]. Secondly, we aim to test whether older adults will also prefer options with better average ratings. On the one hand, Ma et al. [3] report that older adults do not trust consumer ratings, indicating that they may not pay attention to this information. On the other hand, if older adults recognize the value of average consumer ratings, they might focus even more strongly on this information than younger adults as older adults tend to consider less information than younger adults [3,26].

Thirdly, we investigate the relative influence of positive and negative, affect-rich reviews on older adults' choices. For a stronger effect of positive affect-rich reviews speaks the fact that older adults have been shown to pay more attention to positive information [49]. On the other hand, Depping and Freund [51] argued that older adults are motivated to prevent losses. A focus on preventing losses, in turn, should result in older adults being more strongly influenced by negative consumer reviews.

Lastly, we examine how older adults perceive the affect-rich consumer reviews in comparison to the baseline reviews we used. Although comprehension of emotional texts is fairly well preserved in older adults [45,46], in general text comprehension is lower in older adults [44] and older adults have less experience with online shopping. Thus, it is possible that older adults will report problems in understanding reviews or perceive less of a difference in valence between affect-rich consumer reviews and baseline reviews.

4. Methods

During the studies participants were presented with pairs of household products (for example two vacuum cleaners) and had to indicate for each pair which of the two options they would prefer to buy. Products were presented on cards and described by four relevant attributes (e.g., prize, power). In addition to the products' attributes, an average consumer rating was shown for each product. All average ratings were positive but one product was always rated somewhat better than the other product.

We tested three between-participants conditions that varied whether a single written review was shown in addition to the average consumer rating and the affective content of this review: In the “no single review condition”, participants only received information about average consumer ratings. This condition allowed us to test whether

participants relied on average consumer rating in their choices. In the "positive single review condition" the lower rated product was presented together with a highly positive, vivid, and affect-rich review while the higher rated product was presented with a somewhat positive but short baseline review. In the "negative single review condition" the higher rated product was presented with a highly negative, vivid, and affect-rich review while the lower rated product was presented with the baseline review. Thus, in both conditions the single review was inconsistent with the average consumer rating allowing us to test whether it influences how frequently the higher rated product is chosen. Fig. 1 illustrates a choice in the positive single review condition.

In addition, we varied presentation-type (simultaneous vs. sequential presentation of the options) between participants resulting in a 3 (single review condition) by 2 (presentation type) design.

Studies were conducted by the Polish Japanese Academy of Information Technology (PJAIT). They were approved by the Ethics Committee of the Department of Psychology at the University of Basel. The study with older adults was conducted on the premises of PJAIT supervised by the research team. In the case of younger participants (i.e., students of PJAIT), the study was run as an unsupervised online survey.

4.1. Participants

Study 1 involved 154 younger adults who were students at PJAIT. Their average age was 20.8 years (SD = 2.3) and 140 of them were male. Study 2 involved 165 older adults who were recruited via a LivingLab project run by PJAIT and focused on older adults [58–60]. Older adults' average age was 69 years (SD = 6.8, range: 58–87 years) and most of them were female (109 participants). Similar to the student group, the vast majority of older adults (157 participants) had at least secondary education.

As a compensation for taking part in the study, older participants received a pen drive (a USB flash drive) with additional materials related to the LivingLab and younger participants (students) received extra credit points. On average, it took younger adults 8 min and older adults 19 min to complete the study. Participants were randomly assigned to one of the six conditions.

4.2. Materials

4.2.1. Product cards

Participants made choices for three types of products: Vacuum cleaners, irons, and drills. Product types were selected to ensure that most participants would have some but not too much knowledge about them. Each product card contained a product photo and its four attributes including price.

For vacuum cleaners and irons, the attributes' values were chosen so that it was unclear which of the two products was the better choice because each of them was superior in at least one attribute. For drills, one drill in the pair clearly dominated the other option because it had better values on three attributes (it was faster, cheaper, and worked longer on a battery) and similar values for the fourth attribute (it was slightly heavier).

All product descriptions can be found in the online supplementary material and on the Open Science Framework (OSF, folder materials).[2]

4.2.2. Average consumer ratings

For each product the average consumer rating was presented as a number of filled-in stars from a total of 5 stars, similar to the way consumer ratings are presented on websites of online retailers, see Fig. 1. All average ratings were positive (e.g between 3.9 and 4.7 stars) but in each product pair one of the products was rated between 0.5 and 0.6 points higher than the other product, reflecting typical rating differences found on online retail websites. Which of the two products in a pair was presented with the better rating and which product was presented first/on the left side of the screen was counterbalanced across participants (within each of the six conditions) to separate the influence of average ratings from the influence of product attributes on choices.

In addition to the average rating we showed the distributions of the ratings below the average rating (see Fig. 1). The number of ratings was kept similar across all products (around 150).

4.2.3. Single consumer reviews

Depending on the single review condition, participants received a single narrative consumer review in addition to the product information and the consumer ratings. The reviews were adapted from reviews of similar products taken from a website of a large online retailer. They were presented to subjects as randomly selected consumer reviews to emphasize that any of the reviews for the product could have been selected. In each pair one product received an affect-rich review, whereas the other product was presented with a baseline review. The baseline review was a short (typically one sentence) comment that was in general positive but lacked detail, vividness, and emotional content such as "Not too heavy, steams well, and delivered on time. Good price to value ratio." (for an iron).[3] The affect-rich single review was selected to be of high emotional intensity and of extreme valence (i.e. highly positive in the positive single review condition and highly negative in the negative single review condition). They contained vivid and detailed descriptions of positive/negative experiences the consumer had made with the product to facilitate putting one self in the position of the person writing the review (see Fig. 1). Affect-rich positive and negative reviews were selected to be of similar length, affective intensity, and detail. Neither the single affect-rich reviews nor the baseline reviews contained an explicit star-rating.

In the single positive review condition, the affect-rich review was presented with the lower rated product and the baseline review with the higher rated product. In the negative review condition, the affect-rich review was presented with the higher rated product and the baseline review with the lower rated product.

4.2.4. Presentation type

The two products were presented simultaneously or sequentially. In the first case, the two product cards were shown on the same screen, one next to the other. In the second case, they were presented on separate screens. After seeing the first option, participants had to click to move on to the next screen to see the second option. Participants were not allowed to go back. In both, the simultaneous and the sequential condition, the decision itself was made on a yet separate screen that was presented after the product cards.

4.2.5. Ratings of product attributes, consumer ratings and reviews

In addition to participants' choices we measured how they perceived the presented information. Each choice was followed by a short survey asking the subjects to rate the importance of the product attributes, the average consumer rating, and the single consumer review (if applicable) for the decision that they had just made. In addition, they rated the difficulty of the decision and their knowledge about the product type (i.e., vacuum cleaners, irons, and drills). All ratings were made on 7-point Likert scales ranging from (1) not at all to (7) very much.

[2] https://osf.io/3n8xw/.

[3] We chose these statements as a comparison for the vivid emotional reviews over completely neutral statements because they better reflect typical short reviews that are found on online retailer websites and which are in general positive [4,61,62]. Thus they provide a realistic baseline to which reviews could be compared.

4.3. Procedure

After signing a consent form, participants were asked to provide basic demographic characteristics (gender, education and age) and to rate their experience with online shopping on a scale from (1) not at all experienced to (7) very much experienced. Afterwards, they were informed about the study and the consumer decisions they would make. Before each decision participants received information regarding product attributes and why they may be important while choosing between the products. Then the two products were presented to the participants and they had to indicate their choice. After the choice was made, participants responded to the survey about the decision process and then continued with the next decision. At the end of the study, participants read all the consumer reviews used in the study (just the texts) and rated their valence and understandability on a scale from (1) very negative/do not understand at all to (7) very positive/understand very much respectively. The latter questionnaire was added only later for the older adults, thus information from 41 people is missing. After the study, participants received their reimbursement.

5. Results

In the following, we first analyze whether product attributes, their presentation and average consumer ratings influenced the choices. After that we examine how single affect-rich positive and negative consumer reviews changed the frequency with which the product with higher average rating was chosen and how participants perceived the single reviews. Further (exploratory) analyses investigating participants' ratings are reported in the supplementary online material and on the OSF (folder Results).[4] To facilitate the comparison between the age groups, we report the results from Study 1 and Study 2 side by side in each section.[5]

5.1. Influence of average ratings and product attributes on choices

Our first research questions focused on whether younger and older adults used average consumer ratings in their decisions and if older adults were able to reliably choose products with better attributes.

In order to test to what degree participants considered product attributes, we constructed an index of product quality that indicated how much better the attributes of one product were in comparison to the other product in the product pair. To this end, we first calculated for each product attribute the percentage by which the product with higher average rating was superior/worse than the product with lower rating and then averaged across product attributes. A low absolute value indicates that the two products are of similar quality and that making a choice required a trade-off between the products' attributes. In contrast, a high absolute value indicates that one product is clearly superior to the other product and no trade-offs are necessary. Although this index can not account for subjective differences in the importance of the attributes, it provides a useful index of how clearly one product in the pair was better than the other product. As designed, for vacuum cleaners and irons, the two products did not differ much in terms of quality (i.e., ± 0.5), whereas for drills one product was clearly superior to the other (i.e., ± 29.3).

In the studies, each product in a pair was presented equally often with a higher and a lower average consumer rating. Accordingly, if participants did not consider average ratings in their choices, the product with the higher rating should be chosen as often as the product with the lower rating. In contrast, if participants preferred products with higher average ratings, the higher rated product should be chosen more frequently. Thus, in a first step we tested whether the probability with which the product with the higher average rating was chosen differed from 0.5 in the no single review condition.

Overall, younger participants in Study 1 strongly followed the average ratings. As illustrated in Fig. 2 (left panel), when no consumer review was shown to participants, they chose the higher rated product in 80% of the cases. The choice proportions differed significantly from 0.5 for all three products (vacuum cleaner: $\chi^2(N = 46) = 8.10$, $p = 0.004$; iron: $\chi^2(N = 46) = 11.13$, $p < 0.001$; drill: $\chi^2(N = 45) = 4.61$, $p = 0.032$).

In contrast, for older adults we did not find an influence of average ratings on choices (see Fig. 2, right panel). Participants chose the higher rated product in 58% of the choices when no review was provided. This did not significantly differ from 50% when considering all choices together, $\chi^2(N = 163) = 1.63$, $p = 0.20$, nor for any of the three products separately (in all three cases $p > 0.38$). This, as can be seen below, does not mean that their choices were random.

To test for the influence of product attributes on choices, we ran multilevel mixed effects logistic regressions with random intercepts for subjects with choice of the higher rated product as a dependent variable and product quality (z-transformed), presentation type (0 - simultaneous, 1 - sequential), and order (1 - First/Left, 0 - Second/Right) and their two-way interactions as independent variables.[6] All models were implemented in R using the mixed function in the afex package [63] using Likelihood Ratio Tests. Post hoc contrasts were calculated with the lsmeans package [64].

For younger adults we found a strong effect of product quality on their choices, $b = 1.58$, $SE = 0.459$, $\chi^2(1) = 26.92$, $p < 0.001$. In addition, we found a significant main effect of order, $b = 0.733$, $SE = 0.342$, $\chi^2(1) = 5.85$, $p = 0.016$, and an interaction of order by product quality, $\chi^2(1) = 5.07$, $p = 0.024$, but no effect of presentation type. Follow-up tests of the effect of product quality separately for the two order conditions showed a large effect of product quality when the higher rated product was second/on the right side, $b = 2.04$, $SE = 0.54$, $\chi^2(1) = 21.27$, $p < 0.001$. When the higher rated product was first/on the left side, the effect or product quality was smaller, but still significant, $b = 0.755$, $SE = 0.369$, $\chi^2(1) = 5.75$, $p = 0.0165$ (see also Fig. 2 and Fig. 3 in the supplementary online material).[7] No other effect or interaction was significant.

For older adults, the product quality index also emerged as a significant predictor of choice ($b = 0.381$, $SE = 0.186$, $\chi^2(1) = 4.76$, $p = 0.029$). Increasing product quality from visibly lower quality (quality index equal to −30) to comparable quality (quality index equal 0) and from comparable quality to visibly better quality (quality index equal to 30) both led to an increase in predicted probability of choosing the higher-rated product by roughly 15% (average marginal effect for the fixed part of the model). This shows that older participants paid attention to the product attributes and were more likely to choose a product that was clearly better on the attribute dimensions. Thus it indicates that they were not choosing randomly (see Fig. 2).

In addition, we found an effect of presentation order for older adults ($b = -0.411$, $SE = 0.173$, $\chi^2(1) = 5.94$, $p = 0.015$), suggesting that

[4] https://osf.io/3n8xw/.

[5] We abstain from reporting statistical comparisons between age groups to focus on the impact of the manipulated variables. However, we report additional analyses with age groups as a factor in the supplementary online materials and on OSF.

[6] We excluded the three-way interaction of presentation type × product quality × order from the analyses because the sample sizes within each cell were not sufficient to estimate the models. In addition, we had to exclude the interaction of presentation type with order in the analysis for the younger adults because the model did not converge. We did not include product type in this model because the model became unstable when product type and the product quality index were both included. Analyses without the quality index indicated that choices did not differ significantly between products.

[7] Tables reporting the choice proportions of older and younger adults by product and product quality can be found in the supplementary online materials and on OSF (folder Results): https://osf.io/3n8xw.

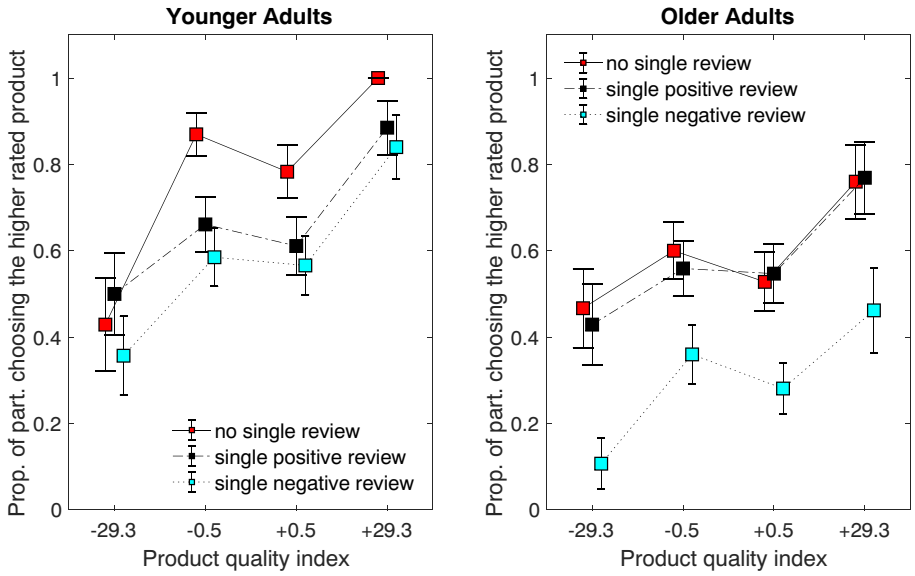

Fig. 2. Proportion of participants choosing the higher rated option by review condition and product quality for young adults (left panel) and older adults (right panel). The product quality index indicates the quality of the higher rated option. Error bars denote 1 SE.

older adults were more likely to choose the option with the higher rating when it was presented first or on the left-hand side of the screen. No further significant effects were found.

In sum, both younger and older adults were more likely to chose the better rated product when it also had better attributes. Yet, the influence of product quality on the choices of older adults was less pronounced than in the case of younger adults. This can clearly be seen when focusing on the drills, for which by design one option was clearly better than the other one in terms of the product's attributes. When the better drill was also recommended by average consumer ratings, (i.e., it dominated the other product on all relevant dimensions), younger adults chose the better drill in 100% of the cases, showing that they clearly recognized this dominance relationship. In contrast, older adults chose the better drill in 76% of the cases.

5.2. Influence of single affect-rich consumer reviews on choice

In the next step, we investigated our second research question, i.e. whether the single affect-rich consumer reviews influenced how frequently the higher rated product was chosen (see Fig. 2). To this goal we once again ran a multilevel mixed effects logistic model predicting how often the higher rated product was chosen, now analyzing the full data set. In addition to the predictors in the analyses above, we included review condition and its interactions with the other predictors in the model.[8]

The analysis for younger adults revealed a significant effect of review condition on choices, $\chi^2(2) = 16.79$, $p < 0.001$ and an effect of product quality, $b = 0.978$, $SE = 0.170$, $\chi^2(1) = 48.07$, $p < 0.001$. No other main effect or interactions reached significance. Post-hoc contrasts using the Tukey method to adjust p-values indicated that the odds of students choosing the higher-rated product were 5.43 times smaller when it was presented with a single, affect-rich, negative review than when no reviews were included ($b = 1.691$, $SE = 0.451$, $z = 3.75$, $p < 0.001$). Similarly, presenting the lower rated product with a single, affect-rich, positive review reduced the odds that the option with higher average rating would be chosen by a factor of 3.56 ($b = 1.271$, $SE = 0.448$, $z = 2.84$, $p = 0.013$). The influence of single positive and negative consumer reviews on choices did not differ significantly, $z = 1.228$, $p = 0.437$ (see Fig. 2, left panel).

For older adults, the analyses also showed significant main effects of review condition, $\chi^2(2) = 30.44$, $p < 0.001$, product quality, $b = 0.448$, $SE = 0.110$, $\chi^2(1) = 18.44$, $p < 0.001$, and presentation order, $b = -0.204$, $SE = 0.101$, $\chi^2(1) = 4.11$, $p = 0.0427$, but no significant interactions. Post-hoc contrasts adjusted with the Tukey method, indicated that a single, negative, affect-rich review significantly reduced the probability of choosing the higher rated product by a factor of 3.5 compared to the no review condition, $b = 1.256$, $SE = 0.260$, $z = 4.83$, $p < 0.001$. However, in contrast to the younger adults, a single, affect-rich, positive review of the lower rated product did not change the likelihood of choosing the higher rated product compared to the no review condition for older adults, $b = 0.094$, $SE = 0.242$, $z = 0.387$, $p = 0.921$ (see Fig. 2, right panel).

5.3. Perception of the affect-rich reviews

The analyses of choices had shown that for younger adults a single affect-rich review that was inconsistent with the average rating reliably reduced how often the option with higher rating was chosen. This was the case for positive and negative affect-rich reviews. For older adults, however, we only found an influence for negative affect-rich reviews. One reason could be that older and younger adults differed in how well they understood the affect-rich reviews and as how positively/negatively they perceived them compared to the baseline review presented with the other product. To investigate this question we tested whether participants reported that they understood the reviews and whether participants really perceived the affect-rich reviews as more positive/negative than the baseline review.

Overall, younger and older adults reported high levels of understanding of the consumer reviews. Average ratings were above or close to 5 on a seven-point scale, suggesting that both age groups understood the reviews well (see Table 1 for an overview of participants' ratings).

To test whether the review type (affect-rich positive, affect-rich negative, and baseline reviews) differed in how their valence was rated (i.e. how positive/negative they were perceived) we run a repeated measurement analyses of variance (ANOVA) with the valence rating as

[8] We did not include the four-way interaction including all predictors in the analyses because the within-cell sample sizes were not sufficient to estimate the models. For younger adults we also had to exclude the three-way interactions of presentation type × product quality × order and review condition × order × product quality because otherwise the model did not converge. Reducing the model further does not change the conclusions.

Table 1
Overview of rating responses in both studies. Rating scale = 1 (not at all) to 7 (very much). Since each participant made multiple evaluations (after each choice and for each review) we use robust standard errors clustered on participants. The question regarding the importance of the single consumer review was only asked in the conditions including a consumer review (the positive and negative review conditions). For the ratings of the valence and understanding of the affect-rich consumer reviews data from N = 41 older participants is missing.

	Young adults		Older adults	
Variables	Mean	SE	Mean	SE
Online experience	5.29	0.11	1.96	0.12
Product knowledge	3.19	0.10	3.57	0.10
Importance: product features	5.70	0.08	5.37	0.11
Importance: average rating	4.90	0.11	4.09	0.12
Importance: consumer review	3.51	0.15	4.00	0.15
Understandings: negative review	5.54	0.09	5.10	0.16
Understandings: baseline review	4.93	0.12	5.19	0.14
Understandings: positive review	5.53	0.09	5.68	0.12
Valence: negative review	1.76	0.10	2.52	0.16
Valence: baseline review	5.46	0.09	5.19	0.13
Valence: positive review	6.20	0.08	5.66	0.13

dependent variable and the type of the review as predictor.

For younger adults we found a large effect of the type of review on valence ratings ($F(2,922) = 1235$, $p < 0.001$, $\eta^2 = 0.73$). Contrasts confirmed that the positive reviews were perceived as more positive than the baseline reviews ($F(1,461) = 134$, $p < 0.001$, $\eta^2 = 0.23$) and the negative reviews as more negative than the baseline reviews ($F(1,461) = 1136$, $p < 0.001$, $\eta^2 = 0.71$). Accordingly, participants perceived the reviews as differently positive/negative but the difference in perception was larger for the negative-baseline comparison than the positive-baseline comparison.

Similar to the younger adults, how positively older adults perceived the reviews depended strongly on the type of the consumer review ($F(2,736) = 349.5$, $p < 0.001$, $\eta^2 = 0.49$). They perceived the positive consumer reviews as more positive than the baseline reviews ($F(1,369) = 21.79$, $p < 0.001$, $\eta^2 = 0.06$) and the negative reviews as more negative than the baseline reviews ($F(1,368) = 373.5$, $p < 0.001$, $\eta^2 = 0.50$). However, overall and in particular for the comparison between positive and baseline reviews, the effect size was much smaller than for younger adults. The same pattern of results was found for all products, although for the drills the rating of the positive review did not differ significantly from the rating of the baseline review ($p = 0.19$).

6. Discussion

We found that younger and older adults were influenced by product attributes and affect-rich negative reviews. However, whereas younger adults strongly relied on average consumer ratings and also on affect-rich positive reviews, older adults did not take them into account. These results suggests that older adults differ in how they perceive the reviews written by other consumers and how much value they assign to this information, which has important implications for marketing directed at older adults. In the following we discuss the results in more details and outline implications for designing e-commerce platforms for older adults.

6.1. Influence of product attributes

For both younger and older participants, the quality index of products' attributes strongly influenced choices when no review was presented, but also when single reviews were provided. This may not be very surprising in itself, but the results are important for two reasons. First of all, it shows that although average consumer ratings are quite important for younger adults, product attributes were more important for most of them and were not overruled when they were clearly in conflict with the consumer ratings. Secondly, it shows that older adults understood the task, but struggled more with identifying a better product just from the attributes. This is most clearly seen when considering choices for the drills. When in the no-review condition the better drill was also recommended by average consumer ratings, (i.e., it dominated the other product in all relevant dimensions), older adults chose the better drill in 76% of the cases. This demonstrates that older adults clearly paid attention to the product attributes and were not choosing randomly. But it also suggests that older adults had problems identifying a better product based on its attributes. These results resonate with research showing declines in decision-making abilities in new and complex tasks in older adults [31-33]. The results are also in line with research on consumer choice finding choice deficits in older adults (e.g., [38]).

6.2. Influence of average consumer ratings

Younger adults were strongly influenced by aggregated consumer ratings. In particular, when the two products they could choose from were similar in quality and no single positive or negative review was presented, younger adults overwhelmingly chose the higher rated product. The majority of younger adults chose the lower rated product only when it had clearly better attributes than the higher rated product, although even then a sizable minority (43%) still preferred the higher rated product. These results dovetail with previous research reporting the importance of consumer ratings for online purchasing decisions of younger adults [5–7] and also resonate with younger adults reporting average ratings as quite important, with a score of 4.9 on a scale from 1 to 7.

In contrast, we did not find any evidence that older adults considered average consumer ratings in their decisions. This finding is surprising given the prevalence of consumer reports in an online context and high importance assigned to them by younger adults, but it corresponds to findings by Ma et al. [3] suggesting that older adults perceive consumer ratings as less relevant and helpful than younger adults.

Why older adults did not use average ratings is less clear. One reason could be that older adults just do not value the opinion of other consumers as much as younger adults, which suggests that they may not be aware of how valuable this information can be. Alternatively, the presentation of the consumer ratings may be confusing for older adults. Older adults have worse visual acuity making it more difficult to discern small differences on the screen [27,65]. Most consumer ratings tend to be positive, making differences in average ratings relatively small. Thus it is possible that older adults had problems in realizing that a difference in average ratings of 0.5 points carries relevant information. Future research into this is necessary to determine the factors underlying older adults' neglect of consumer ratings and potential ways of making this information more accessible to them.

6.3. Influence of single affect-rich reviews

Both younger and older adults' choices were strongly influenced if the higher-rated product was accompanied by a single, vivid, negative review. Only a minority of participants picked the option with the negative review, even though they were told that the review was selected randomly (and thus was not necessarily representative of the reviews the product had received). These results correspond with studies reporting that people are more easily influenced by anecdotal or narrative information than by statistical information when making decisions in medical or consumer contexts [18–20].

For younger adults affect-rich negative and positive single reviews that conflicted with the average ratings reduced how often the higher-rated product was chosen. The effect size was somewhat larger for the affect-rich negative than for the affect-rich positive reviews, but the

difference was not significant. At first sight, the somewhat larger effect of negative reviews is consistent with a negativity bias. However, when evaluating the effect of the affect-rich reviews one must also take into account how the affect-rich reviews were perceived compared to the baseline review shown with the other option. Due to the nature of the baseline reviews we chose — short but in general positive statements selected to reflect typical reviews found online – the affect-rich negative reviews differed more strongly in their perceived valence from the baseline reviews than the affect-rich positive reviews. Nevertheless, younger adults' choices were influenced by the affect-rich positive reviews. Indeed, the positive affect-rich reviews affected their choices in a similar way as the negative affect-rich reviews in spite of the smaller difference in perceived valence. A finding that is in contradiction to research showing a negativity bias [11,13]. However, it is in line with research suggesting that negativity bias may be limited to hedonic goods [12] as the products we used were more of a utilitarian nature. In addition, although we can't distinguish between the features that made the affect-rich reviews more convincing than the baseline reviews in the current study, it suggests that beside valence other features such as the affective nature and the level of detail of a review may affect how much weight participants give them in their decisions.

In contrast, older adults were strongly influenced by the affect-rich negative reviews, but not at all by the affect-rich positive reviews. At first glance, these results seem to be at odds with research proposing a focus on positive information in older adults [49,50]. However, according to socio-emotional selectivity theory older adults focus on positive information stems from a shift to emotional meaningful goals [49]. With emotional goals in mind, avoiding products with negative reviews, and thus potential losses, seems a rational strategy as it minimizes negative emotions that could be caused by choosing the wrong product [51]. This suggests that in decision making tasks older adults may be more likely to exhibit a negativity than a positivity bias.

Why older adults did not consider the affect-rich positive reviews at all is an interesting question. One possibility is that older adults did not differentiate between the affect-rich positive and the baseline reviews as much as younger adults did. Although older adults on average rated the affect-rich positive reviews as significantly more positive than the baseline reviews, the difference was smaller than for the younger adults and the difference between the affect-rich negative reviews and the baseline reviews. Accordingly, it is possible that for older adults the perceived differences in valence was not strong enough to affect their choices. This suggests that, although in old age the understanding of emotions in written texts and of narrative texts seems to be largely unaffected [45,46], older adults may still have more difficulty in perceiving nuances in emotional intensity [66].

6.4. Implications for a design of rating systems

We found clear indications that older adults were strongly influenced by affect-rich negative consumer reviews, but not by better average consumer ratings or affect-rich positive reviews. This suggests that social media and WOM communication directed at older adults do not require enthusiastic and vivid descriptions whereas younger adults can be convinced by strongly positive reviews.

The finding that older adults did not consider average ratings in our study is intriguing. The strong effect of the negative reviews suggests that they are not completely insensitive to consumer recommendations. Alternatively, it is possible that the differences in ratings were too small to carry meaning for older adults. Here, it would be important to choose designs that make it easier for older adults to recognize differences in ratings that otherwise they may not be able to discriminate.

Our results show not only that ratings and reviews play different roles in the purchasing decision process (see [67]), but also that the importance of reviews and ratings varies between younger and older adults. Therefore, to ensure the same level of comfort for both groups while making decisions about purchases, the user interface should be adapted accordingly (better visibility of negative reviews and less stress on average ratings for older adults).

The observed differences between younger and older adults, however, have more far-reaching consequences than just regarding the personalization of the way ratings and reviews are displayed and force researchers to re-examine existing methods of mitigating attacks on e-commerce ratings systems. To assure the same level of protection for both groups of users ratings, systems should be resistant not only to attacks on average ratings (malicious increasing or decreasing) but also to the injection of single, fake, vivid, negative reviews.

6.5. Limitations

In this study we found strong age differences in the influence of aggregated and single consumer reviews on choices. However, it is important to take into account several limitations of our study.

For one, we used a cross-sectional design. Thus, it is impossible to separate age differences from cohort effects. Although we did not find any evidence that experience with online shopping influenced older participants' choices (for details see supplementary online materials), it is possible that current older adults are just less accustomed to consumer ratings and reviews in general, and thus give this information less weight. However, this may change when a new generation of more internet-savvy individuals approaches old age.

In addition, our two samples are from a single country and differed not only in age but also in the gender composition, with younger adults being mostly male and older adults mostly female. Gender partly influenced product knowledge, but otherwise we did not find an effect of gender on choices, suggesting that the results are not dependent on gender (for details see supplementary online materials). In addition, although we did not find difference on education on choices, the younger adults sample consisted of students, whereas older adults were recruited from the community. In sum, we cannot exclude that sample differences could have played some role and that generalizability may be limited.

In the studies we used a set of utilitarian products with hypothetical choices. Products were selected to be typical domestic equipment that most people own at one point in their life, but buy only rarely, to decrease differences in product knowledge between participants. However, decision processes may depend on the type of products selected. For instance, the negativity bias has been shown to be limited to hedonic goods [12]. Thus, it is possible that older adults may take average consumer ratings more into account while making real choices or while choosing between other types of products such as experiential services.

To measure the influence of product attributes on choice, we used an index of relative product quality that assumed all attributes to be equally important. Given that subjective importance of attributes will differ between individuals, our measure of product quality most likely underestimates the influence of product attributes on choices.

Lastly, the consumer reviews we used as a baseline comparison were not at the (valence) midpoint between negative and positive reviews but had a positive valence. We chose these short but positive statements as baseline reviews because they are more typical than neutral reviews [4,61,62] but still differ in their valence from the strongly positive reviews.

7. Conclusions

Our results show not only that ratings and reviews play different roles in purchasing decisions (see [67]), but also that the importance of reviews and ratings varies between younger and older adults. Whereas students were strongly influenced by average consumer ratings and positive affect-rich reviews, the older adults in our sample gave little importance to these types of consumer information. However, younger and older adults were quite strongly influenced by affect-rich negative

reviews — even if these were unrepresentative of the product reviews. These results highlight important age difference in consumer behavior, raising questions about the utility of consumer reviews for older adults, as well as how consumer reviews should be presented. To ensure the same level of comfort for both groups when making decisions about purchases, at the very least the user interface must be adapted accordingly (better visibility of negative reviews and less stress on average ratings for older adults).

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Appendix A. Supplementary materials: analyses and stimulus materials

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dss.2018.05.006.

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