



Quality ratings of wine bottles in e-commerce: the influence of time delays and spatial arrangement

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ABSTRACT

The present study, for the first time, investigated the influence of time delays and the spatial arrangement of products on the quality rating of wine bottles in an online wine shop. For this purpose, an online shop was simulated in which participants selected various wine bottles from an overview page. After participants had selected a wine bottle, an enlarged version was presented after a system response time of either 200 or 1400 ms. Participants then viewed and rated wine bottles from various locations on the website overview page. Results showed that the average quality ratings after the short and the long system response time did not differ. However, products presented on the left or the right side of the overview page received worse ratings than wine bottles presented in the centre. By explicitly comparing the influence of temporal delays and spatial arrangement of products on quality ratings in an online shop, we derived best practice suggestions for the interface design in online shopping environments.

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Have you ever ordered a product on the Internet? The answer is probably affirmative, as Internet retailers have become increasingly popular in the last decade. For instance, according to the Total Retail 2017 report (PricewaterhouseCoopers, 2017), more than 90% of the respondents from Germany, Japan, Italy, UK, and the US shop on Amazon. In the US, the growth rate of the e-commerce sector is 7% higher than that of the retail sector at large and almost all growth in the total retail revenue is due to online sales (PricewaterhouseCoopers, 2017).

Wine is among the most popular alcoholic beverages ordered online and although selling wine online is subject to many regulations, the number of online wine sales continues to grow (Cassar, 2018). Given this growing popularity of ordering wine online, most wineries now have an online presence that helps them advertise and sell their wines (Duarte Alonso, Bressan, O'Shea, & Krajsic, 2013). As online environments are highly customizable, e-commerce offers new possibilities for vendors and customers. Vendors must carefully consider how they present their business and information about their products on their websites in order to direct the decision-making process of their

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customers. For example, past research on winery websites indicated that factors such as the ease of navigation, the display of all relevant product information, or the overall website appearance are important factors that attract customers (Taylor, Parboteeah, & Snipes, 2010). Conversely, for customers, the Internet makes it easy to compare different products and draw on the experiences or opinions of other customers provided by online reviews and ratings. On wine.com, for example, customers can rate products with one to five stars to share their satisfaction with the wines they purchased.

Notably, while research on the website design of online wineries and other e-commerce websites has highlighted the importance of some general features, such as visual appeal (e.g. Parboteeah, Taylor, & Barber, 2016), research on the actual presentation of products in online shops is comparably scarce. This lack of research is surprising, as some studies showed that the order or spatial arrangement of several simultaneously presented products may have subtle influences on the products' evaluation (e.g. Cai & Xu, 2008; Scholtes, Dittrich, & Klauer, 2014). Expanding on the literature on product presentation on e-commerce websites, this paper explored the influence of the spatial arrangement of several simultaneously presented wine bottles on their evaluation.

Furthermore, every e-commerce website is affected by loading times. Previous research on website design agrees that loading times or time delays on websites are generally not desired and should be reduced to a minimum (e.g. Taylor et al., 2010). However, research in human–computer-interaction suggests that, under certain conditions, user performance can benefit from longer loading times (Weber, Haering, & Thomaschke, 2013). Thus, controlling website loading times may present itself as a powerful opportunity in shaping customers' evaluation of e-commerce products. As the influence of loading times has not been investigated in the context of e-commerce until now, this paper therefore also explored the effects of two different loading times on product evaluations. If loading times could be used to direct customer evaluations on e-commerce websites, manipulating loading times might not only present a new way of influencing product evaluations, but at the same time might also allow for optimizations in website construction.

Thus, by simulating an online wine shop, this study examined how the spatial arrangement and the loading times in the presentation of wine bottles influence spontaneous quality rating of wine bottles, when no further information about these wine bottles has been presented beforehand. Findings may provide suggestions for operators of e-commerce wine sites and other e-commerce websites on how to present their products and how to handle loading times with the aim to make their products and websites more appealing to their customers. Before introducing the methodology in detail, the paper first reviews the relevant literature on user-generated ratings and website design. After presenting the method and the results, the findings are discussed, and practical implications are drawn.

Literature review

Electronic word-of-mouth

As the present study explored influences on customers' evaluation of products, this section briefly reviews the importance of these evaluations. The Internet allows for new forms of consumer-to-consumer communication, so-called electronic word-of-mouth

(eWOM), commonly manifested in online product reviews or ratings (Schindler & Bickart, 2005). The eWOM manifests itself in the form of blogs, discussion forums, social media, consumer review sites, and reviews on e-commerce websites (Cheung & Thadani, 2012). Consumers can easily share their opinions about and experiences with products on the Internet, which provides other potential consumers with a diverse set of opinions that inform their decision making (Cheung & Thadani, 2012; Zhang & Benyoucef, 2016). Online reviews may help customers to avoid mistakes and disappointment in their product choice. As such, online reviews lead to an improved customer satisfaction and a higher revenue for the vendor (Haug & Küper, 2010). A case in point is the study by Lin (2014). Using a model based on actual sales data from a China-based online shop, Lin (2014) showed that when the number of user-generated online reviews for a product increased, the number of sales for this product increased as well, suggesting that online reviews may benefit customers and vendors equally.

eWOM may be especially important in the purchase of wine, as selecting wines requires some knowledge, making product recommendations particularly helpful. Thach, Lease, and Barton (2016), for instance, surveyed 375 wineries in the US about their social media usage and found that social media was an important tool for wineries to acquire new customers and to promote their wines. Eighteen percent of the surveyed wineries attributed an increase of 30 percent or more in their wine sales to their social media usage. This finding is consistent with the Total Retail 2017 report, in which 39% of the surveyed shoppers reported that they used social media as inspiration for their purchases (PricewaterhouseCoopers, 2017). Apart from social media, Thach (2009) suggested that wineries can increase their sales by including features on their website that enable dialogue between vendor and customer or customer and customer, such as message boards, blogs, vlogs, or podcasts about wine.

Website design

Offering products online is becoming increasingly important for the financial success of wineries (Velikova, Wilcox, & Dodd, 2011). However, as mentioned before, the online presence of wineries goes beyond the mere selling of wine, as it also serves as a tool to communicate with customers and to provide them with information about the winery and its products (Nowak & Newton, 2008; Taylor et al., 2010; Velikova et al., 2011). As winery websites may be the first and only point of contact with the customer, it is imperative to ensure a high website quality, as customers may associate website quality with product quality (Nowak & Newton, 2008).

A high-quality website should include all relevant information for the customer and should be efficiently designed. Velikova et al. (2011) suggested that a financially successful website includes information about the winery, the wine, the wine club if one exists, up-to-date information about tastings, and contact information. Apart from the available information, an overall efficient website design is crucial to the financial success of every winery website (Nowak & Newton, 2008). Efficient website design includes features such as the ease of navigation, website security (e.g. sensitive data is not shared with third parties), download delay (e.g. short system response times after entering a command, i.e. website loads quickly), and website appearance (e.g. visual appeal, coherent design;

Parboteeah et al., 2016; Taylor et al., 2010). When building a website, wineries should take these features into account.

System response time

When using an online shopping environment, loading times are a common experience for customers. Computing systems need time to process and complete a command. The time elapsed from the entry until the completion of a command is termed the system response time (SRT; for a review, see Weber et al., 2013). High SRTs were generally assumed to imply a negative and frustrating experience for the user and the goal for interface designers was to make SRTs progressively smaller, as they cannot be completely prevented (Weber et al., 2013). As mentioned previously, research on website design also considers high SRTs as inefficient (e.g. Parboteeah et al., 2016). However, recent research challenges this finding and shows that, in complex tasks, for instance, when classifying e-mails as relevant or as spam, user performance can benefit from longer SRTs, especially when there are only few different SRTs, as this low variability of SRTs makes the occurrence of a stimulus more predictable. This temporal predictability allows users to anticipate the occurrence of the stimulus, making their responses faster (Weber et al., 2013). Hence, user performance can benefit from longer absolute SRTs when they are predictive of the stimulus occurrence.

With regards to e-commerce websites, the influence of SRTs on customer behaviour has barely been scientifically investigated. Long SRTs may decrease customer satisfaction and may incline customers to leave the site and to not make a purchase (Cao, Zhang, & Seydel, 2005). So far, only one study by Sonntag (2015) has explored the effect of SRTs on product choice behaviours. In this study, product attributes were presented after different SRTs (330, 660, or 1000 ms) when the mouse cursor was moved over them. Sonntag (2015) found that shorter SRTs resulted in more viewed attributes, but not in better product choices (choice of participants vs. best possible choice), suggesting that participants who experienced shorter SRTs engaged in inefficient over-searching, as they looked up more attributes than necessary (Sonntag, 2015). This finding demonstrated that reducing SRTs to a minimum is not necessarily beneficial for the user, as it did not lead to better choices. Controlling SRTs on e-commerce sites may influence further aspects of the customers' assessment of products, for instance, how they rate products on a rating scale. To elaborate on this idea, the following section provides the theoretical background on how SRTs may influence product evaluations.

Mental time line

Rating scales on e-commerce websites are a simple form of eWOM that visually summarize the opinions of the customers. These scales, such as the rating scales on wine.com or Amazon ranging from one star to five stars, can be conceived of as a spatial scale running from left to right, similar to an extending line. Research on mental representation of time suggests strong interactions between time (i.e. SRTs) and space (i.e. rating scales). A vast body of research suggests that time is represented on a mental time line (MTL), where time is represented in space, for instance, from brief to long or from past to future in left-right order in Western cultures (for a review, see Bonato, Zorzi, & Umiltà, 2012). For example, various studies that support an MTL showed faster reaction times when participants were instructed to classify short time intervals with the left response button and

long time intervals with the right response button compared to the opposite response-button mapping (Bonato et al., 2012).

In a study by Casasanto and Boroditsky (2008), participants were instructed to estimate the duration of an interval during which a line growing from left to right was presented on a screen in front of them. Even though the actual duration of the presented line was kept constant, participants judged a line that travelled a shorter distance to take a shorter time than a line that travelled a longer distance (Casasanto & Boroditsky, 2008). Hence, the spatial information provided by the expansion of the line influenced participant's temporal estimations. The relationship between time and space in the MTL has frequently been interpreted as asymmetrical with space having a larger effect on time than vice versa (for a review of MTL and other models, see Winter, Marghetis, & Matlock, 2015). In fact, the study by Casasanto and Boroditsky (2008) revealed that spatial information influenced time estimations, but temporal manipulations did not influence spatial estimations, suggesting a unidirectional influence of space on time. However, the authors retained the possibility of a bidirectional influence.

To sum up, the reviewed research demonstrated that smaller spatial extensions are associated with short time spans and larger spatial extensions are associated with longer time spans. Presuming a bidirectional influence of time and space, it is conceivable that SRTs may influence user-generated ratings that are given on a unidimensional rating scale on which a larger spatial extension usually corresponds to a better rating. Relating back to the star rating scales before, one star on this scale represents a bad rating and a small spatial extension and five stars represent a good rating a larger spatial extension. Hence, in accordance with the notion of an MTL, short SRTs may be associated with less spatial extension on the rating scale (corresponding to a bad rating) and long SRTs may be associated with more spatial extension on the rating scale (corresponding to a better rating). Therefore, the present study exploratively investigated the influence of SRTs on product evaluations and the first hypothesis was:

H1: Participants associate the short SRT with lower ratings (i.e. less spatial extension on the rating scale) and the long SRT with higher ratings (i.e. more spatial extension on the rating scale).

Product arrangement

While the reviewed studies on website design presented various suggestions on what features influence website evaluations, they neglected considerations on how the actual products should be presented in order to be positively evaluated. Past research, although scarce, has shown that specific presentations of products influence the decision-making process of the customer. Cai and Xu (2008), for instance, found that the sorting of a product list influences the product choice of participants. They sorted the product list by product quality (as determined by judges in a pretest) in ascending or descending order. When the list was sorted by quality in a descending order, quality was weighted more important than price by participants. When sorted by quality in ascending order, participants rated the price to be more important than the quality, suggesting that expensive, high-quality products are more likely to be sold if sorted by quality in descending order.

Additional research has indicated that the spatial position of a product on an e-commerce website influences its evaluation. Scholtes et al. (2014), for instance, reported

that when presenting three cosmetic products in a row, the lateral stimuli (left and right) were devaluated compared to the central stimuli in a subsequent evaluation task asking for purchase intention. The authors referred to this effect as spatial stimulus devaluation (Scholtes et al., 2014). Similarly, in a study by Valenzuela and Raghurir (2009), participants showed a preference for products presented in the screen centre compared to laterally presented products. Overall, these studies showed that simple features of product presentation, in an online shop, namely the spatial arrangement, may have considerable effects on customer decision making. Based on the spatial stimulus devaluation that demonstrated an influence of spatial arrangement of a product on its rating, the second hypothesis was:

H2: Participants rate stimuli presented on lateral positions of the overview page worse than stimuli presented on central positions of the overview page.

Paradigm

We developed a novel paradigm that allowed us to investigate the influence of SRTs (H1) and the influence of the spatial position of products (H2) on the products' rating. We simulated an online wine shop in which participants selected, viewed, and rated wine bottles. The online shop was designed to be realistic and thereby differed from the study by Scholtes et al. (2014). Instead of presenting only three products simultaneously, our wine shop displayed 100 wine bottles at the same time on one overview page. We investigated whether the duration (200 or 1400 ms) of the loading time for a selected product (i.e. the time it took the website to present an enlarged view of the selected wine bottle once it had been selected via a mouse click; SRT) influenced the quality rating of wine bottles. In line with research on the mental time line (e.g. Casasanto & Boroditsky, 2008), we expected that bottles presented after a short SRT received worse ratings and than bottles presented after a long SRT (H1). Furthermore, we investigated whether wine bottles presented on lateral positions of the overview page received worse ratings than wine bottles presented on central positions (H2; e.g. Scholtes et al., 2014).

Participants gave quality ratings ranging from one star (=poor quality) to four stars (=good quality) to wine bottles. The quality ratings were given on a unidirectional scale running from left to right similar to the rating scale on wine.com. The experiment consisted of an exploration phase that familiarized participants with the experimental environment and a test phase during which participants intuitively rated 100 wine bottles after the mentioned SRTs.

Method

Participants

Forty-two participants were recruited either via the subject acquisition system SONA of the University of Freiburg or by word-of-mouth advertising. Two participants were excluded from analyses because they reported having based their rating on systematic strategies rather than their intuitive evaluations of the presented stimuli. Thus, 40 participants (31 female, 9 male, 5 left-handed) were included in the analysis. Participants' age ranged between 18 and 28 years ($Mean[M] = 22.0$, $Standard\ Deviation [SD] = 2.0$). Participants were native German speakers and had normal or corrected-to-normal vision. They were

treated according to the ethical standards of the American Psychological Association (2010) and were compensated with course credit and cookies. All participants provided written informed consent prior to their participation.

Materials

The experiment was programmed using the software E-prime (Psychology Software Tools, Pittsburgh, PA). Participants sat approximately 60 cm in front of a 24" iiyama Prolite GB2488HSU computer screen (1920 × 1080 pixels, 144 Hz) in a dimly lit room. Room lighting was low to increase screen contrast and provide an ideal viewing situation.

Images (172 × 575 pixels) of 400 unique, but similar-looking Bordeaux wine bottles on a white background (see [Figure 1](#)) taken from an online wine shop served as stimuli in the experiment. Two independent testers pre-examined the wine bottles and eliminated duplicates or bottles that could barely be differentiated.

In order to present the remaining materials of this experiment in a structured manner, we distinguish between two different presentation modes of the experiment: the overview page and the product view. On the overview pages, 100 images of wine bottles were presented in five rows of 20 bottles and participants were instructed to randomly select and intuitively rate these wine bottles. Once a wine bottle had been selected, it was presented in the product view. An enlarged image of the selected wine bottle with an empty rating scale was presented and the other wine bottles in the background were greyed out.

Overview page

On the overview page, the images of 100 wine bottles scaled to fit the screen were presented on a grey background. Additionally, the numbers 1 or 2, preceded by the word 'Seite' (German for 'page'), a waiting cursor in the video container format Audio Video Interleave (see [Figure 2](#)), and a grey-shaded wine bottle on a white background (see [Figure 3](#)) were used.

Product view

For the product view (see [Figure 4](#)), an enlarged and centred image of the selected wine bottle framed in grey was used. The enlarged image was presented at a visual angle of $4.53^\circ \times 11.61^\circ$. Furthermore, four grey stars (representing the quality rating) were located below the image of the wine bottle. Some of these stars were coloured yellow in the first part of the experiment (representing a wine bottle that had already been



Figure 1. Sample of three exemplary wine bottles that were used in the experiment.

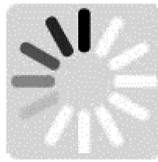


Figure 2. Waiting cursor.



Figure 3. Grey shaded bottle.



Figure 4. Product view of an exemplary wine bottle with corresponding rating scale and an *ok*-button.

rated). An *ok*-button, a grey square containing the word *Ok* in white font, was shown centred below the stars.

Following the recommendation of Moosbrugger and Kelava (2012), the quality ratings of the bottles depicted by one to four yellow coloured stars did not have a neutral middle category. Especially when participants believe that they lack sufficient knowledge to make a judgement, which was the case in this experiment since participants ideally did not have any knowledge about the wines and their quality, participants tend towards the central

category (Moosbrugger & Kelava, 2012). To counteract this tendency that makes the procedure less sensitive, a middle category was not used in this experiment.

Procedure

The experiment consisted of two different phases, an exploration phase and a test phase. Wine bottles were drawn from a pool of 400 wine bottles. Each wine bottle only appeared in the exploration or test phase and its position, quality rating (exploration phase), and SRT were randomly allocated anew for each participant. The following parts describe the trial and block procedure for each phase in detail before they are presented in the context of the entire procedure.

Exploration phase

The exploration phase served to familiarize participants with the experiment. In this phase, participants were instructed to view different wine bottles that had already been rated according to their quality. The instructions were displayed on the computer screen. At the beginning of the exploration phase, the experimenter was still present to verbally provide the key parts of the instructions and to answer potential questions.

Trial procedure. A trial started with a click on a wine bottle on the overview page, which prompted the waiting cursor to appear at the centre of the screen for either 200 or 1400 ms. After that, an enlarged image of the bottle with its corresponding quality rating was displayed in the centre of the screen. These SRTs are typically not experienced as intentional delays as such time ranges are common in e-commerce applications (cf. Sonntag, 2015). In the background of the product view of a selected product, every wine bottle of the overview page was replaced by the above described grey-shaded bottle. The four stars represented the quality rating of the wine bottle, with one yellow coloured star indicating a poor rating and four yellow coloured stars indicating the best rating. To return to the overview page, participants had to click on the ok-button which was displayed under the rating scale in the product view.

Block procedure. Participants were presented with 200 different wine bottles distributed over two pages (see Figure 5). One page of the product overview contained five rows with 20 bottles each. Participants could switch back and forth between both overview pages by clicking on the numbers 1 or 2 in the bottom right corner. The numbers were framed in either a white or a grey square. The white square indicated the current page; hence, when a participant was on the first page and clicked on the number 2, both squares swapped colours and the wine bottles from the second page were shown. Participants could take as much time as they liked to view the overview pages and to select wine bottles in any order. After a wine bottle had been viewed, it appeared shaded in grey on the overview page and could not be selected again.

One of the SRTs and one of the ratings was randomly allocated to each bottle and each combination of SRT and rating was equally frequent in the exploration phase. Furthermore, the order of presented wine bottles was randomized, but held constant during the experiment for one participant and the 200 wine bottles were randomly drawn from the pool of 400 wine bottles. After the participants had called the product view of



Figure 5. One of two overview pages in the exploration phase (here: page 2).

96 wine bottles (i.e. after 96 trials), which was deemed sufficient to familiarize them with the procedure, the experiment automatically proceeded to the test phase.

Test phase

In the test phase, the participants actively rated wine bottles themselves that had not been shown before instead of viewing already rated bottles. A new set of instructions appeared on the screen that instructed participants to ignore the design of the wine bottles and labels, to rate the bottles intuitively, and to evenly distribute the different ratings (from one to four stars) among all bottles. These instructions specifically served to reduce the influence of other factors that might have had an influence on the rating of products presented in an online shopping environment, such as the design of the wine bottle. Before the test phase started, participants were instructed to call the experimenter. The experimenter entered the room and repeated the instructions and ensured that participants had understood them before proceeding.

Trial procedure. Identical to the exploration phase, a click on a bottle on the overview page prompted the waiting cursor to appear for either 200 or 1400 ms at the centre of the screen. Then, the product view with an empty rating scale depicted by four grey stars appeared. The wine bottles on the overview page were again replaced by the grey-shaded wine bottle. Participants could rate the bottle by clicking on the corresponding star. The stars were coloured in yellow to visualize the given ratings, for instance, if participants intended to give a three star rating, they had to click on the third star and the first three stars were coloured in yellow. Participant could return to the overview page by clicking on the ok-button, which was displayed under the ratings scales. There were no temporal restrictions to complete a trial. [Figure 6](#) illustrates a trial in the test phase.

Block procedure. In the test phase, participants were presented with 100 new randomly drawn wine bottles that had not yet been shown in the exploration phase on one page. The 100 bottles were presented on one single page in five rows with 20 bottles each. For each wine bottle, the duration of the waiting cursor was randomly chosen with the restriction that the short and long duration was overall equally frequent. Also, the order of the wine bottles was randomized, but was held constant during the whole experiment for one participant. Participants were free to take as much time as desired in selecting the bottles. Already rated wine bottles appeared shaded in grey and could not be selected again. The experiments ended when all 100 bottles had been rated (i.e. after 100 trials).

Entire procedure

Participants were welcomed and told that the experiment required a relaxed state of mind and no cognitive effort. After obtaining informed consent by a signature, participants were seated in front of the computer screen and demographic data was recorded. Subsequently, the above described exploration phase started, which was followed by the test phase. The test phase was followed by a short interview. Participants were asked if specific rating strategies had been used during the test phase (recorded qualitatively) and if the design of the bottles had been taken into account (recorded on a 4-point scale ranging from *rarely* to *always*). Lastly, participants were debriefed, compensated, and left. The whole experiment took approximately 30 minutes.

Results

The star ratings were converted into the corresponding values ranging from 1 (=poor quality) to 4 (=good quality). To test whether SRTs influenced the rating of the wine bottles (H1), the mean quality rating of wine bottles in trials with a SRT of 200 ms ($M =$

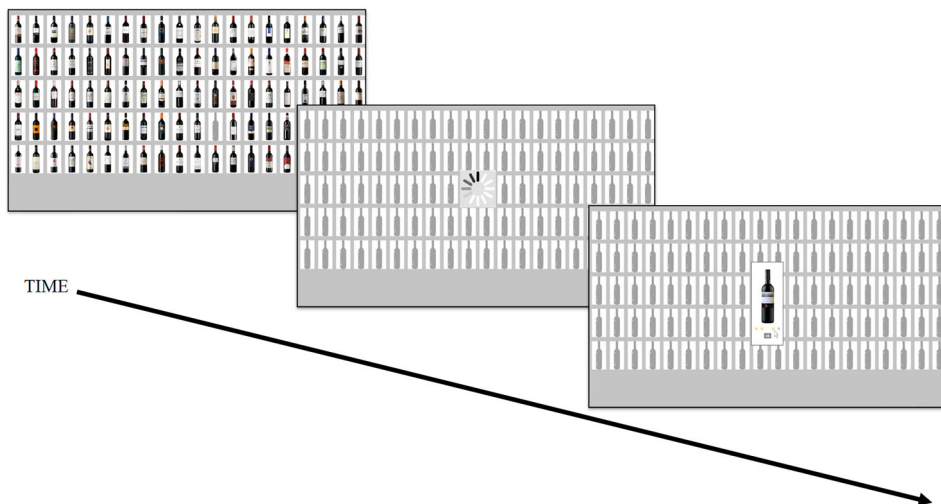


Figure 6. Exemplary trial procedure of the test phase. Participants select a wine bottle from the overview page, wait for either a long or short duration, and can then rate the wine bottle in the product view.

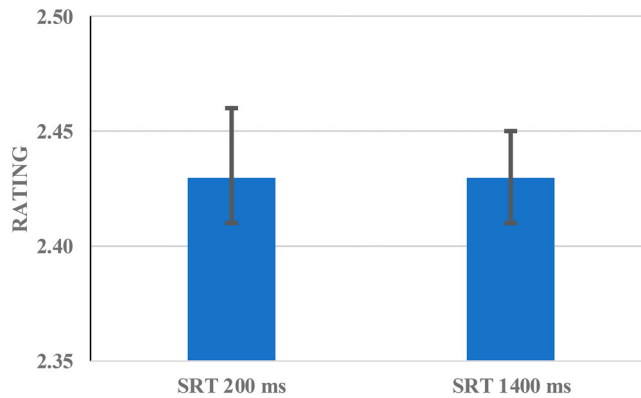


Figure 7. Mean quality ratings depending on the duration of a preceding system response time (SRT). Error bars represent one standard error of the mean.

2.43, $SD = .19$) was compared to the mean quality rating of bottles in trials with a SRT of 1400 ms ($M = 2.43$, $SD = .15$; see Figure 7) by conducting a t -test. This t -test did not reach significance, $t(39) = .025$, $p = .980$ (see Table 1).

To examine whether the spatial arrangement of the wine bottles had an influence on the quality ratings, the wine bottles in the first seven columns (from left to right) were classified with the position left, the wine bottles in the six following columns were classified as centre, and the last seven columns were classified as right (see Figure 8). Figure 9 illustrates the mean ratings of bottles on the left, right, and middle side.

To test whether the spatial position (left vs. middle vs. right) influenced the rating of the wine bottles (H2), a one-way ANOVA was conducted on the quality ratings. This one-way ANOVA yielded a significant main effect of position, $F(2, 78) = 5.92$, $p = .006$, $\eta_p^2 = .24$. A post-hoc comparison (see Table 2) revealed that both wine bottles on the left, $t(39) = 3.49$, $p = .001$, and wine bottles on the right, $t(39) = 2.03$, $p = .05$, were rated significantly worse than wine bottles in the centre.

In the post-experiment interview (see Table 3), 18 (45.0%) participants stated that they followed the instructions and rated the wine bottles intuitively without taking the design of the bottles into account. The remaining 22 (55.0%) participants stated either that they based their rating on the design of the wine bottles or that they had tried to remember the ratings and designs from the exploration phase and rated the new bottles accordingly. Note that this strategy was based on false memory, because no bottle from the exploration phase was presented again in the test phase. Eleven participants (27.5%) indicated that they had always taken the design of the wine bottles into account for their rating, 18 (45.0%) participants indicated to have taken it into account often, ten participants (25.0%) stated to have taken it into account at least occasionally, and one participant (2.5%) stated to have taken the design of the bottles rarely into account.

Table 1. T -test comparing quality ratings for the two different system response times (H1).

	SRT 200 ms			SRT 1400 ms			$t(39)$	p
	n	M	SD	n	M	SD		
Rating	40	2.43	.19	40	2.43	.15	.025	.980

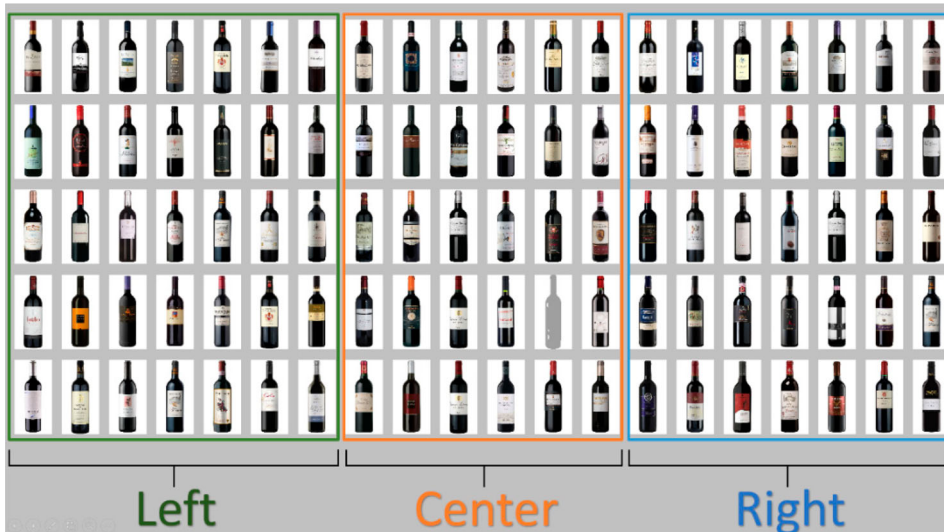


Figure 8. Classification of the spatial arrangement of products on the overview page in *left*, *centre*, and *right*.

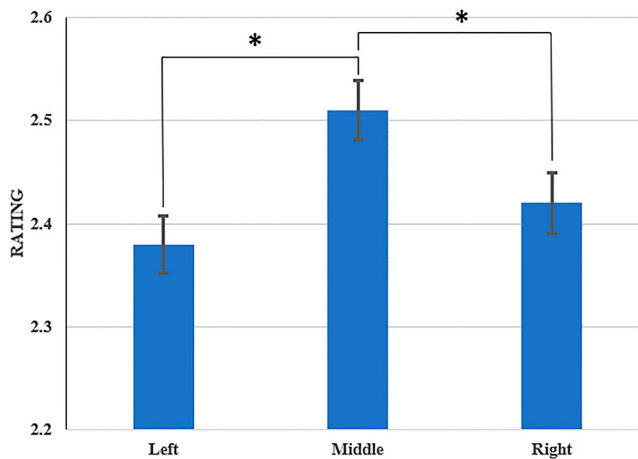


Figure 9. Mean quality ratings depending on the spatial arrangement of the products. Error bars represent one standard error of the mean. Asterisks denote significance in a *t*-test with a significance level of .05.

Discussion

The present study explored two hypotheses in a simulated online wine shop: First, we investigated whether the duration of SRTs before the presentation of wine bottles influenced their evaluation (H1). Second, we investigated whether the spatial arrangement of wine bottles on an overview page influenced the evaluation (i.e. quality ratings) of these wine bottles (H2). In the online wine shop, participants viewed and rated wine bottles. After participants selected a

Table 2. Post-hoc test of quality ratings from wine bottles on the left and right side compared to the centre of the screen (H2).

	Position	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i> (39)	<i>p</i>
Rating	Left	40	2.38	.18	3.49	.001
	Centre	40	2.51	.18		
	Right	40	2.42	.19	2.03	.050

Table 3. Results overview of the post-experiment interview.

	<i>N</i> (%)
What was your overall rating strategy?	
Rated intuitively (as instructed)	18 (45.0)
Rated based on the design of bottle	17 (42.5)
Rated based on exploration phase (false memory)	5 (12.5)
How frequently did you take the design of the bottles into account?	
Always	11 (27.5)
Often	18 (45.0)
Occasionally	10 (25.0)
Rarely	1 (2.5)

wine bottle from an overview page containing 100 different wine bottles, they were presented with an enlarged version of the selected wine bottle after an SRT of either 200 or 1400 ms. In the exploration phase that served to familiarize participants with the experiment, participants viewed wine bottles that had already been rated. In the test phase, participants rated selected bottles with regards to their assumed quality after the respective SRTs.

Spatial stimulus devaluation

It was expected that wine bottles presented on the left and right side of the overview page would receive worse ratings than wine bottles displayed in the middle of the screen (H2). Results revealed a significant influence of the spatial arrangement of the products on their corresponding quality rating and showed that participants gave a better rating to wine bottles presented in the middle of the overview page compared to wine bottles presented on the left and right side of the overview page. This finding supports the second hypothesis.

The finding of the present study that laterally presented wine bottles were devaluated compared to centrally presented bottles supports previous studies on the spatial arrangement of products which reported a spatial stimulus devaluation effect (e.g. Scholtes et al., 2014). In her doctoral dissertation, Scholtes (2015) contrasted two different explanations to account for the effect: cognitive inhibition and emotional coding.

According to the cognitive inhibition account, participants may have inadvertently focused their attention on the centre of the screen, passively inhibiting laterally presented wine bottles. Possibly, the fact that the product view was also presented centrally on the screen may have increased their attentional focus on the centre. When selecting laterally presented wine bottles, participants may have stored the passive inhibition with the mental representation of these bottles, which led to a devaluation of these bottles compared to centrally presented bottles.

Contrarily, according to the emotional coding account, participants may have coded the lateral wine bottles negatively and the central wine bottles positively, because they

may have believed that centrally presented products are more popular or of higher quality, as the participants of Valenzuela and Raghubir (2009) reported. This issue was, however, not assessed in the present study. When rating the wine bottles, this negative emotional code may have led to worse ratings for laterally presented products and the positive emotional code to better ratings for central bottles. As no additional measures (e.g. whether participants' attention focussed on the central products suggesting cognitive inhibition) were assessed in this study, these two accounts cannot be distinguished, subjecting the underlying mechanism of the spatial stimulus devaluation effect to further investigation.

The present study can be viewed as similar to previous experiments examining spatial devaluation, since participants were presented with various wine bottles that could be assigned to a central, left, and right spatial positions and had to be evaluated after they were selected. However, previous work, such as the study by Scholtes et al. (2014), clearly separated the presentation of stimuli and their evaluation. Participants were first presented with three products in a row and subsequently were presented with each individual product again and asked for an evaluation (cf. Scholtes et al., 2014). In contrast, the present study did not have a separate evaluation task after the stimuli had been presented and could thus show the spatial stimulus devaluation effect in a more flexible and realistic paradigm, where stimulus presentation and evaluation had smooth transitions, as participants were free to select the to-be-evaluated stimuli from any spatial position and without time constraints. Then, participants proceeded to the next stimuli they desired to evaluate until all stimuli were evaluated. In a series of experiments, Scholtes (2015) has shown the spatial stimulus devaluation with only the same cosmetics products. Thus, this study makes an important contribution to the literature on the spatial stimulus devaluation effect, as it, firstly, extends the effect to different products, namely wine bottles, and, secondly, because it could show that participants also classify wine bottles on a large overview page with 100 wine bottles into left, central, and right positions, further generalizing the effect.

System response times

Based on the literature review, we expected that participants would associate the short SRT with worse quality ratings and the long SRT with better quality ratings (H1). The statistical analysis revealed that the average ratings in trials with a long SRT and the average ratings in trials with a short SRT did not significantly differ; hence, the first hypothesis was not supported.

As previously discussed, some studies supporting the concept of an MTL showed that spatial extension influenced duration estimations, but the duration of an interval seemed to have no influence on spatial estimations (Casasanto & Boroditsky, 2008). According to the authors, these findings suggest an asymmetric, unidirectional relationship between time and space. In the present study, this asymmetric relationship might be an explanation for the missing influence of the SRT manipulation on the quality ratings. However, the present study cannot unequivocally support the idea of a unidirectional asymmetry between time and space, as the opposite effect of spatial information on duration estimations was not tested.

An additional explanation for the missing influence of the SRT manipulation on quality ratings was provided by the post-experiment questionnaire. More than half of the

participants did not rate the bottles intuitively, but indicated that they were, to varying degrees, influenced by the visual appearance of the bottles, although they were instructed by both the written instructions and the experimenter to ignore the design of the bottles. The dual coding theory (DCT) by Paivio (1990) might offer an explanation for why participants could not ignore the design of the bottles, although being instructed to do so. According to the DCT, there are two independent, but interconnected cognitive subsystems. One of them encodes verbal information and the other one encodes non-verbal information. The verbal system encodes language-related information and the non-verbal system encodes objects and events. Furthermore, the DCT posits that the verbal system is constrained by sequential processing, whereas the non-verbal system can process information synchronously and thus faster. The visual stimuli in this experiment were predominantly processed by the non-verbal system, resulting in a fast and synchronous processing. Participants may thus have partly based their first impression of the presumed quality of the wine bottles on this fast visual information processing. Consequently, the quality ratings may partly reflect a visual bias of the participants, for example, whether the colour or etiquette of the wine bottle appealed to them or not.

Lastly, the spatial position of the wine bottles and the resulting devaluations of the laterally presented wine bottles (cf. spatial stimulus devaluation) may have overshadowed the effect of the SRTs. Presumably, the spatial position of the products may have exerted a decisive influence on the ratings, obliterating any effect of the SRTs.

Practical implications

The present study has practical implications for the design of winery websites and more generally of e-commerce websites. Online vendors should consider spatial arrangement when presenting several products at once, as this arrangement might lead to assumptions of product quality. Specifically, customers might evaluate centrally presented products more favourably compared to products that are presented laterally. Previous research (cf. Scholtes et al., 2014) demonstrated that this effect is present when asking for purchase intention after three products in a horizontal alignment were presented. Extending these findings, the present study could demonstrate the presence of this effect when products are intuitively evaluated without detailed information after they have been selected from a large overview page containing 100 products. Since Scholtes et al. (2014) observed this devaluation effect when asking for purchase intention, it is conceivable that vendors may use the devaluation of laterally presented products to increase their sales, for example, they may present expensive, profitable products in the centre of a website's spatial arrangement. Online vendors that sell both a store brand and competing brands could, for instance, also present their own brands centrally and competing brands laterally to promote the store brand.

Limitations and future directions

The present study should be viewed as explorative and thus has several limitations that reduce its generalizability and urge for further investigations. Firstly, this study relied on a convenience sample that was very homogenous, as only native German university students, predominantly female, with a limited age range participated. A sample with

different characteristics, for instance gender, ethnicity, age, profession, or income, would most likely affect the results. Secondly, even though the study aimed at presenting a real-world online shop experience, the standardized, artificial, and unfamiliar setting in a laboratory may not translate to real-world settings. Thirdly, other characteristics of products, such as price, were not considered in this experiment, although they may play a strong role in assessing the product quality, possibly interacting with spatial devaluation. Further studies could investigate whether the spatial stimulus devaluation effect is still present within the experimental paradigm of the present study when additional product information, such as the price, are provided. Lastly, as indicated before, this study did not ask for participants' purchase intention, leaving it open if the observed lateral devaluation affects the actual product choice. However, past research showed that positive evaluations make a purchase more likely (e.g. Zhang, Zhao, Cheung, & Lee, 2014). To sum up, future research should further uncover the effects of spatial product arrangement by extending the stimuli and paradigms.

Conclusion

E-commerce is growing steadily, offering new ways to interact with and influence customers. Wineries and other vendors have to pay attention to manifold considerations in constructing their websites, ranging from design choices to the inclusion of user-generated reviews and ratings. The present study investigated whether SRTs before product presentation and the spatial arrangement of products influence the quality ratings of the presented products. While no effect of SRTs on quality ratings was observed, a spatial stimulus devaluation was found, in the sense that participants devaluated the products that were presented on the left and right side compared to centrally presented products. Notably, this effect occurred in a paradigm that was more ecologically valid than previous work and was independent of the design of the products. It can thus be concluded that spatial product arrangement has a decisive influence on the assumed quality of presented products, whereas temporal delays seem to be rather unrelated to the quality rating of products. Thus, winery websites should take spatial arrangements into account when designing their websites to guide their customers' decision-making process.

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Data availability

Raw data were generated at the University of Freiburg. All data are available from the corresponding author RT on request.

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