Ithaca 2018 Abstract Submission

Title
How web design manipulations change customers' visual perception of a web shop:
an eye tracking study.

I want to submit an abstract for:
Conference Presentation

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Keywords
eye-tracking, webdesign, e-commerce, online marketing, implicit measurements, web shop, visual conception

Research Question
How do the individual Areas of Interest (AOI) differ between different website designs (light vs. dark) in the product detail view?

Methods
Implicit measurements via eye-tracking on a self hosted standardized wine selling webshop. A MANOVA was performed for the analysis.

Results
This evaluation emphasizes a significant impact of aesthetics on the attention and behavior of website users on wine selling websites. The analyzed AOIs needed significantly less time to be seen.

Abstract
Purpose

Many trends where forecasted in the last decades and for sure one of them became true: the increase of e-commerce in the wine selling industry. Customers become more digital since the spread of new technologies. These are good news for all market participants and online shop owners. E-commerce comes along with different issues compared to other distribution channels, because one of the biggest downfalls is the highly limited sensory perception: all impressions and information are solely gathered through the human eye, which is quite important for hedonic goods like wine. Thus, aesthetics is important for e-commerce. The challenge of measuring aesthetics is the unlimited variety of elements a website can be made of. Every single visual component is a part of a

website's general visual perception.
As our pre-studies showed, measuring aesthetics in a scientific way by manipulating a single element (as an independent variable) will fail, if the chance of the stimuli has not enough impact on the users' perception. Through the unlimited creativity of web designers, it is difficult to judge and categorize specific web designs solely by single components. This is why we used a more general approach for our study: light and dark designs.
For web shop owners it is essential to find out what kind of user experience the website offers and how it can be optimized. It can be questioned, which content the user will be confronted with at which time and how aesthetics influence users' attention. Explicit measurements via questionnaires deliver only limited answers, because they just ask for conscious impressions. The majority of human's visual perceptions happen in their unconscious minds and influence our behavior in the same way. In this context, measurements based on eye tracking can bring new insights through the implicit and accurate measurement technique. Eye tracking offers information, which might not even be known by the participant himself.
In this study, we observed N=120 participants in an experiment while shopping in a virtual web shop for wine. We investigated all elements (areas of interest) in the shop generating users attention during the shopping process.

Study design

The study took place in a laboratory at the University of Applied Sciences Ludwigshafen in Rhineland-Palatinate, Germany. The laboratory had no windows and only artificial illumination, which was being optimized for eye-tracking measurements. The participants were strongly isolated from each other during the experiment. They got all information via text screen messages on a computer. During the experiment, participants had the opportunity to ask questions. A wall to reduce disruptive factors separated the participant and the researcher. Every step, including the correct performing of the calibration of the eye-tracking device with a nine dot grid, was observed via two cameras. During the experiment, participants looked at a screen, which was mirrored to the investigator to see the subjects "live view" during the eye-tracking recording with the software Tobii Studio 3.3.2. The recording was conducted with the eye tracker Tobii X120 and with an optimal distance of 60 cm (23.62 inches) to the screen. The participants sat on a table and used a keyboard and a mouse. The eye-tracking device was below the screen with a resolution of 1280x1024 pixel. A 17'' monitor was fixed on a second table to remove micro vibrations caused by the user's hardware peripheries.
Subjects were divided into two test groups. As a criterion for exclusion, they had to be wine consumers and compatible with the eye tracking device (more than five failed calibration trials). The gender distribution was almost equal between the two groups.
The two groups got no information about the experiment. The primary task for each subject was to buy multiple bottles on a web shop, which was designed by the experiment team. The represented web shop and all wines were virtual and designed just for this study in order to exclude any former experiences with a web shop or brand preference. Therefore, the impression of the website and wines was for all participants new and unique. The virtual shop and all products had been tested and optimized for its plausibility in a pretest with wine experts and non-experts in order to create a high quality illusion of a 'real' web shop. The participants got no time or money limitations to create an almost natural shopping experience, which felt not too artificial. The language of the shop was German. Reds and whites were equally separated between the 50 wines with a wide variety of grapes. By hosting a realistic web shop on our own servers, it needed only little effort to control the look and feel of every single element and the general aesthetics.
From N=120 subjects in total, three subjects had to be excluded due to bad eye tracking data. Accordingly, n=117 participants took part within the two test groups: 'light website design' versus 'dark website design'.
For this study, the participants were free to choose what kind of wines they were looking at. This kind of freedom ensured to record realistic data. Subjects were only looking at wine bottles, which evoked their interests. When they clicked on a bottle in the product grid, they saw a more detailed view (in this study called 'detailed view') with further information about the selected wine and a larger picture of the bottle. The 'detailed view' on a wine bottle is the basement for the eye tracking analysis and shown in illustration 1. In this view, the users saw a big picture of the bottle and more information like a flavor text or product information and the 'put into cart' button. The structure of the 'detail view' followed always the same pattern and all elements had the same order. That allowed us to aggregate all views of the participants with all seen wine bottles, and to create means for AOIs, which were independent from missing or doubled data
This study set its focus on the following hypotheses:

H1: The mean TFF (Time to First Fixation) for different AOIs [bottle, product_text, award, price, info_text, product_recommendation, human_pic, navigation_bar, navigation_main] in the aggregated 'detail product view' will be significantly different between 'light design' and 'dark design'.

Findings

Table 1: Descriptives for Time to First Fixation (in Seconds) for All AOIs
The AOIs with the tag 'TFF' measured the time of first fixation on a specific area of interest in seconds, and with that the speed of attracted attention. The larger the TFF means were, the more time the participants needed to look at the AOIs for the first time. Table 1 represents the descriptive statistics for all groups in ascending order (measured in seconds). The AOIs 'human_pic', 'product_text' and 'bottle' were in average the first AOIs seen by the participants, which has been expected. 'product_recommendation', 'navigation_bar' and 'navigation_main' catch the participants' attention quite late.
The following MANOVA reveals how the individual areas of interest differ between the two test groups 'light design' and 'dark design'. The MANOVA already excluded no significant AOIs ($p>.05$) and shows the comparison between 'info_text', 'product_recommendation' and 'navigation_bar' (table 2).
Pictorial elements such as human pictures or the bottle were not affected by the manipulation of the independent variable 'visual design' and its aesthetic impact. Both areas were relatively quick seen in both groups. However, the less important AOIs, which were rather late or rarely viewed as 'info_text', 'product_recommendation', 'navigation_bar' showed some significant differences between the test groups, which confirms the hypotheses H3, H4 and H6. All other hypotheses could not be approved. The dark design helps the users to focus on the content that could be unseen by the light design, but has no impact for elements like bottle or product text, that are seen anyway. The effect sizes are η^2info_text = .084, η^2navigation_bar = .105, η^2product_recommendation = .153 and ranged therefore from under to upper medium effects.

Conclusion

This evaluation emphasizes a significant impact of aesthetics on the attention and behavior of website users on wine selling websites. The analyzed AOIs 'info_text', 'product_recommendation' and 'navigation_bar' needed significantly less time to be seen by users.
An explanation could be the effect of dark design on elements that were less important. For example, the AOI 'product_recommendation' was on the button of the screen and was likely to be overseen by many subjects (m=16.9, sd=6.21) like the 'navigation_bar' on the right edge (m=17.56, sd=6.99). For a reason, humans could be less distracted by the dark frame, so they were more willing to engage in text walls and spread their attention. The total shopping duration for all participants has not been affected by any aesthetic design.
This confirms our assumption, that dark designs generate a frame. This evokes higher attention and recognition for the websites content, hence even text elements were more likely to be seen. Moreover, the participants are more likely to take the effort and scroll down to the bottom of the website to see product recommendations. Eye tracking equipment records the eye fixation (foveal vision) but the human eye still recognizes shapes, colors and above all, contrast in the periphery. This could be the reason why the participants saw frames in the periphery and tended unconsciously to see only the items, which were in the brighter areas. Further, they tended to scroll down in an area, were the frame was unseen, because the frame was always visible on the left and right edge.
Another reason could be that users learned to ignore elements on the edges and areas beyond the white space, because they usually find advertisements and other irrelevant information there. This unconscious blindness works better on white space, because the majority of websites are designed in that way. Dark design could counteract that effect.
Nevertheless, dark design should not been seen as a general panacea. We did not use a completely dark design but still had white elements in it: the body color was white and the text was black. Whether an overall black theme with white letters on black background will have the same impact, has to be tested.
This study proves that a change between dark and light visual concepts has a significant impact on how users interact with the content. The analysis of the 'product detail view' shows, that a darker frame can help to increase the attention and therefore rise the visibility of elements who need more seconds on light design templates.

Practical implications.

Dark and white colors have an impact on users' perception and their willingness to pay attention to specific AOIs. Web side owners in the wine industry should consider how important the AOIs like 'product_recommendation', 'info_text' or 'navigation_bar' are. A higher involvement to sidebars may help to increase the interaction with other websites due to their faster recognition. Light aesthetics is more common and could increase the readability and set a focus on AOIs that are more important.

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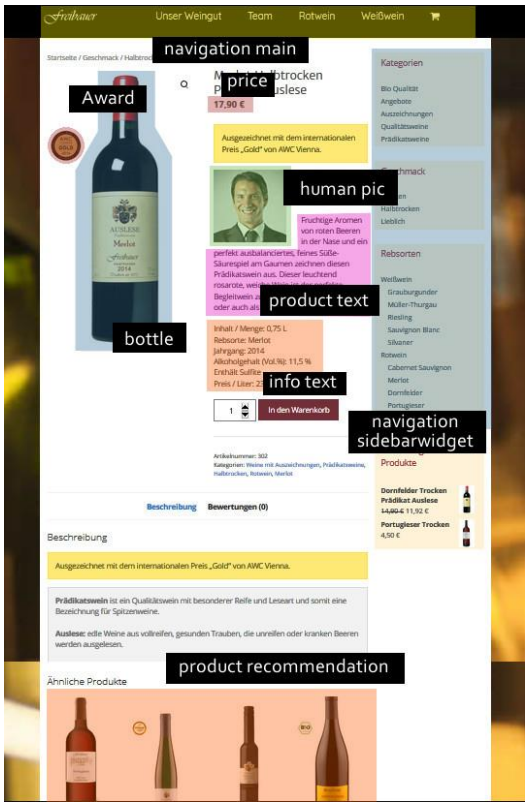

Illustration 1: AOIs Overview at the Detail View in the 'dark template'. Areas Were Colored Afterwards For this Picture)

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Findings

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
AOI_human_pic_TFF	113	,20	9,01	1,8680	1,79112
AOI_product_text_TFF	113	,74	26,76	3,3406	2,73267
AOI_bottle_TFF	113	,20	19,06	4,6770	3,96931
AOI_price_TFF	99	,20	28,51	9,5570	6,80643
AOI_info_text_TFF	113	,81	21,65	9,9480	4,89643
AOI_award_TFF	62	,20	70,45	14,3542	13,40969
AOI_product_recommendation_TFF	104	4,99	33,07	16,9270	6,20684
AOI_navigation_bar_TFF	111	3,22	36,98	17,5759	6,99058
AOI_navigation_main_TFF	91	,20	50,17	20,1576	10,75807
Valid N (listwise)	47				

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which has been expected. '*product_recommendation'*, '*navigation_bar'* and '*navigation_main'* catch the participants' attention quite late.

The following MANOVA reveals how the individual areas of interest differ between the two test groups 'light design' and 'dark design'. The MANOVA already excluded no significant AOIs (p>.05) and shows the comparison between '*info_text'*, '*product_recommendation'* and '*navigation_bar'* (table 2).

Descriptive Statistics

	Testgruppe	Mean	Std. Deviation	N
AOI_navigation_bar_TFF	light design	20,3292	7,61873	49
	dark design	15,8151	5,57496	53
	Total	17,9836	6,98028	102
AOI_info_text_TFF	light design	11,5139	4,93383	49
	dark design	8,7426	4,33546	53
	Total	10,0739	4,81477	102
AOI_product_recommendation_TFF	light design	19,5224	6,12140	49
	dark design	14,6602	5,41684	53
	Total	16,9960	6,23497	102

Table 2: Descriptives for Significant AOIs for Both Test Groups

Estimates

				95% Confidence Interval	
Dependent Variable	Testgruppe	Mean	Std. Error	Lower Bound	Upper Bound
AOI_navigation_bar_TFF	light design	20,329	,948	18,449	22,210
	dark design	15,815	,911	14,007	17,623
AOI_info_text_TFF	light design	11,514	,662	10,201	12,827
	dark design	8,743	,636	7,480	10,005
AOI_product_recommendation_TFF	light design	19,522	,824	17,888	21,157
	dark design	14,660	,792	13,089	16,231

Table 3: Descriptives for Significant AOIs

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	,915	349,591[b]	3,000	98,000	,000	,915
	Wilks' Lambda	,085	349,591[b]	3,000	98,000	,000	,915
	Hotelling's Trace	10,702	349,591[b]	3,000	98,000	,000	,915
	Roy's Largest Root	10,702	349,591[b]	3,000	98,000	,000	,915
test_group_website_desing	Pillai's Trace	,166	6,489[b]	3,000	98,000	,000	,166
	Wilks' Lambda	,834	6,489[b]	3,000	98,000	,000	,166
	Hotelling's Trace	,199	6,489[b]	3,000	98,000	,000	,166
	Roy's Largest Root	,199	6,489[b]	3,000	98,000	,000	,166

a. Design: Intercept + test_group_website_desing

b. Exact statistic

Table 4: Multivariate Tests

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
AOI_navigation_bar_TFF	4,987	1	100	,028
AOI_info_text_TFF	1,073	1	100	,303
AOI_product_recommendation_TFF	1,218	1	100	,272

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + test_group_website_desing

Table 5: Levene´s Test of Equality

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	AOI_navigation_bar_TFF	518,814[a]	1	518,814	11,785	,001	,105
	AOI_info_text_TFF	195,532[b]	1	195,532	9,112	,003	,084
	AOI_product_recommendation_TFF	601,933[c]	1	601,933	18,106	,000	,153
Intercept	AOI_navigation_bar_TFF	33262,194	1	33262,194	755,558	,000	,883
	AOI_info_text_TFF	10447,236	1	10447,236	486,857	,000	,830
	AOI_product_recommendation_TFF	29749,723	1	29749,723	894,883	,000	,899
test_group_website_desing	AOI_navigation_bar_TFF	518,814	1	518,814	11,785	,001	,105
	AOI_info_text_TFF	195,532	1	195,532	9,112	,003	,084
	AOI_product_recommendation_TFF	601,933	1	601,933	18,106	,000	,153
Error	AOI_navigation_bar_TFF	4402,335	100	44,023			
	AOI_info_text_TFF	2145,853	100	21,459			
	AOI_product_recommendation_TFF	3324,427	100	33,244			
Total	AOI_navigation_bar_TFF	37909,057	102				
	AOI_info_text_TFF	12692,743	102				
	AOI_product_recommendation_TFF	33390,422	102				
Corrected Total	AOI_navigation_bar_TFF	4921,150	101				
	AOI_info_text_TFF	2341,386	101				
	AOI_product_recommendation_TFF	3926,360	101				

a. R Squared = ,105 (Adjusted R Squared = ,096)

b. R Squared = ,084 (Adjusted R Squared = ,074)

c. R Squared = ,153 (Adjusted R Squared = ,145)

Table 6: Test of Between-Subjects Effects

Pictorial elements such as human pictures or the bottle were not affected by the manipulation of the independent variable 'visual design' and its aesthetic impact. Both areas were relatively quick seen in both groups. However, the less important AOIs, which were rather late or rarely viewed as '*info_text*', '*product_recommendation*', '*navigation_bar*' showed some significant differences between the test groups, which confirms the hypotheses H_3, H_4 and H_6. All other hypotheses could not be approved. The dark design helps the users to focus on the content that could be unseen by the light design, but has no impact for elements like bottle or product text, that are seen anyway. The effect sizes are $\eta^2_{info\_text} = .084$, $\eta^2_{navigation\_bar} = .105$, $\eta^2_{product\_recommendation} = .153$ and ranged therefore from under to upper medium effects.

Conclusion

This evaluation emphasizes a significant impact of aesthetics on the attention and behavior of website users on wine selling websites. The analyzed AOIs '*info_text*', '*product_recommendation*' and '*navigation_bar*' needed significantly less time to be seen by users.

Illustration 2: The Differences of Time to First Fixation Between Test Groups for Significant AOIs

An explanation could be the effect of dark design on elements that were less important. For example, the AOI '*product_recommendation*' was on the button of the screen and was likely to be overseen by many subjects (m=16.9, sd=6.21) like the '*navigation_bar*' on the right edge (m=17.56, sd=6.99). For a reason, humans could be less distracted by the dark frame, so they were more willing to engage in text walls and spread their attention. The total shopping duration for all participants has not been affected by any aesthetic design.

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Practical implications.

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