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**The impact of delivering online information neglecting user-centered information design principles. Cyber security awareness websites as a case study.**

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## **Specifications**

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## **Abstract**

Information design principles are overlooked in cyber security awareness websites. An Information Design Process Model was devised to help frame and interpret how online information is processed and the role information design principles have in facilitating that processing. Two websites were then compared, and results show significant differences in terms of performance, behavior and perception. The results also show that in situations where serious information is at stake (such as cyber security), a more accessible design does not seem to be sufficient to project a sense of trust and security among users. All these findings led to original insights regarding the design of online information in terms of lasting impression and user-centered design approaches.

# 1 Introduction

## 1.1 Context

On 1st November 2016, the UK government released its new National Cyber Security Strategy 2016-2021, along with £1.9 billion in investment over five years. The new cyber security strategy will be implemented by the newly established National Cyber Security Centre, which, under the authority of GCHQ, will centralize and rationalize the UK's cyber security activities. In the United States, annual government spending on cyber security has risen to \$19 billion, and Cyber Command has been elevated to the status of a full, unified combatant command. This reflects the emphasis afforded to the subject in the 2015 *The DoD Cyber Strategy* and the 2017 *National Security Strategy*.

Despite these developments in funding and organizational structure, both the UK and US identify further room for improvement. In particular, it is acknowledged in the UK National Cyber Security Strategy (2016), "the majority of businesses and individuals are still not properly managing cyber risk". Since all Internet users play a role in cyber security, this is a serious failing. Indeed, although cyber security is often discussed in technical terms, it is primarily a people problem. As reported in IBM's *Cyber Security Intelligence Index*, the vast majority (95%) of security breaches are due to human error (Howarth, 2014). Moreover, much of this is down to deficiencies in education and understanding about basic cyber security matters (Olmstead and Smith, 2017). As noted by GCHQ Director, Robert Hannigan, 'the baseline of understanding across society and across government is still very low' (Ashford, 2017). In response, one of the three pillars of the UK strategy, 'Develop', has the objective of increasing cyber security awareness and skills. The *US National Security Strategy* addresses this problem via 'Building a Culture of Preparedness' and 'Information Sharing'.

It is in such areas where information and awareness campaigns come to the fore. However, worryingly significant deficiencies currently exist in cyber security awareness campaigns. For example, the UK cross-government

awareness and behavior change campaign *Cyber Aware* has been criticized for being an 'expensive flop'. The campaign cost more than £12 million, but has only had 1.9 million visits across 2 years and 10 months, meaning that each visit to the site cost £6.37 (Martin, 2017). This problem of cyber ignorance is well illustrated by the 2017 WannaCry attack, which exploited a known deficiency in older forms of the Windows operating system. Many of the systems affected by the attack had simply not been updated or downloaded the available security patch. This clearly speaks to a lack of awareness of security risks and remedies.

Part of these identified deficiencies are design problems that are simply overlooked, but that according to the literature can significantly hinder users in their attempts to locate, understand and recall/retain information that is vital for cyber security. In this sense, information design is essential when seeking to develop cyber skills and awareness amongst the public.

Information design is vital to the construction of websites where the primary aim is to inform, instruct and educate. However, there is a lack of research and literature focusing on the integration of information and web design and its relevance to the delivery of information and instructions online. This is even more so in the area of cyber security, despite the obvious need to keep the public well informed on how to be cyber secure and avoid falling foul of the many problems encountered online (fraud, identity theft, viruses, etc.).

The first challenge that any information designer and any platform providing information face, is to gain the attention of the user and then continue to hold their attention and interest thereafter (Pettersen, 2010). As claimed by Nielsen (2011), users do not stay on a web page for very long before leaving. Users usually leave in 10-20 seconds, with the average page visit lasting a little less than a minute. Scanning and skimming are the most common reading strategies used (Nielsen, 2008; Schriver, 2016) and, on an average visit, users read a maximum of 28% of the words (with 20% being more likely).

Cardello (2013) brings to the discussion the theory that when users feel uneasy, uncertain and sense a problem (e.g., when reading complicated instructions, when viewing text that is in small font or has poor contrast) they switch from a state of 'cognitive ease' to 'cognitive strain'. When this switch happens and users are required to spend more energy to find a piece of information, they become more vigilant and suspicious and may start to question the credibility of the information provided and even the reputation of the company/organization. Such lack of confidence can lead to users not taking 'desirable actions' (as defined by Cardello, 2013), i.e., the actions we want them to take.

Getting the public to take 'desirable actions' regarding cyber security is crucial to any informative and educational website. Therefore, in order to: 1) attract the

user to a website, 2) hold users' attention for as long as possible, and 3) get them to take desirable actions, it is imperative to deliver information as clearly, quickly and focused as possible.

## 1.2 Aim and hypothesis

The aim of this paper is to identify how successfully cyber security websites are at informing and instructing the public on how to adopt secure online behaviors and be protected online.

The researchers' hypothesis is that neglecting user-centered design principles compromises cyber awareness by impairing users' ability to locate, understand and recall/retain information that is vital for cyber security. To test the researchers' hypothesis, a study was devised to ascertain the effectiveness of two existing UK websites that provide practical advice on cyber security: *Cyber Aware* and *Get Safe Online*.

The need to focus on user-centered design principles stems from the fact that information design solutions that are merely driven by opinion and intuition, without having involved the target user (testing and feedback), nor having been tested and gone through several stages of iteration and re-design, lack validity and reliability and are prone to failure.

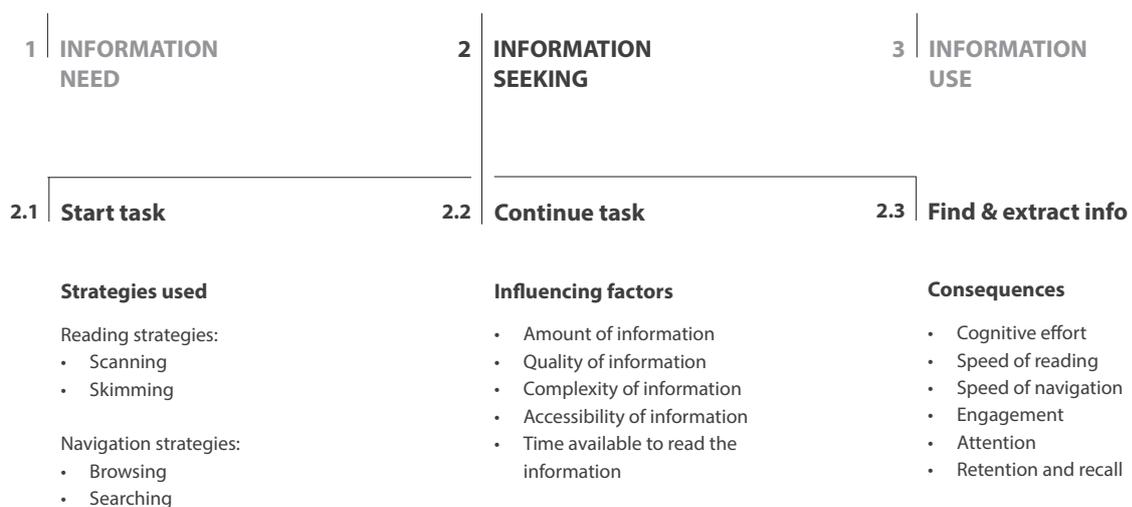
## 2 | Information processing: A theoretical model

Building on the literature, we propose a theoretical 'Online Information Process Model' (Figure 1) that illustrates the process of looking for information online, and identifies at the 'Information seeking' stage: the strategies used when looking for information; the factors influencing the information seeking process; and the consequences of poor online information design on user performance. Such a model is important to help frame and interpret how online information is processed and the role information design principles have in facilitating that processing.

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### ONLINE INFORMATION PROCESS MODEL

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**Figure 1** Online Information Process Model.

The three stages of information processing, based on Choo (1999) and Loeber and Cristea (2003), are defined as: 1) Information need – why do users visit a website? 2) Information seeking – how do users perform?; 3) Information use – do users apply what they have learnt? Although all three stages are identified, since they are equally important and closely inter-related, the model here proposed focuses on Stage 2 – Information seeking, as this is the stage at which design has a direct effect on performance when trying to find online information. For a comprehensive understanding of the process of finding information online, Stage 2 is broken down into three sub-stages. Each sub-stage includes a list of factors that ought to be considered in the information process.

2.1) START TASK – At this first sub-stage, users select a reading and navigation strategy. As discussed by several authors, online reading involves mainly scanning and skimming (e.g., Nielsen, 2008; Schriver, 2016), and online navigation involves mainly browsing and searching (e.g., Loeber and Cristea, 2003). The importance of identifying these strategies in Stage 2 of the model is because, as shown by Lonsdale (2007, 2014b and 2016), design principles can improve performance when using 'search reading' strategies to locate information, which is the case when visiting websites. However, for navigation on websites, the most suitable term would be 'browsing' strategies, which Loeber and Cristea (2003, p.45) define as the process of following links to get to the information needed (while 'searching' strategies on websites is defined by the same authors as typing keywords in order to find information).

2.2) CONTINUE TASK – At this second sub-stage, users continue the task of finding information, which is influenced by several factors. The influencing factors listed in the model were adapted and extended from Hoyer and McInnis' (2001) Motivation, Ability and Opportunity (MAO) model. All relate to the information itself, with the exception of the last influencing factor, which relates to time. As discussed by Nielsen (2011) users do not spend much time on a website. In addition, as shown by Lonsdale et al. (2006), the implementation of design principles can improve performance in situations of searching for information under time pressure, i.e. when finding information quickly or under a limited time.

2.3) FIND & EXTRACT INFORMATION – At this third sub-stage, users locate the information and retain what fulfils their need. Here we identify the consequences of online information design. For example, the consequences of poor design, i.e. when neglecting design principles that have been identified in the literature, could be: cognitive overload and strain, poor speed of reading and of navigation, as well as poor engagement, attention, retention and recall. Beyond this, Tetlan and Marschalek's (2016) article on 'How humans process visual information' gives a very good account regarding:

- *Cognitive effort* – the brain can process only a certain amount of information at one time (3-7 items), and when exposed to too much information at one time the user will feel overwhelmed and disengage from the material. Tetlan and Marschalek (2016) point out that information designers have the responsibility to reduce information in order to limit cognitive overload by, for example, grouping units of thought, limiting the number of fonts and colors, balancing words with image, etc.
- *Attention* – humans also have a limited attention span that changes according to the type of activity required. Tetlan and Marschalek (2016) recommend that in an effort to encourage readers to stay engaged with the material, information designers should use elements that can be interpreted more quickly than text, as is the case of images and symbols, which can prolong engagement.
- *Recall* – information designers can facilitate information recall by grouping and/or chunking information (incorporating two or more elements into one), as this improves the reader's ability to store information accurately and retrieve it in long-term retrieval.

### 3 | Evaluation: Design principles

To further understand which design principles might have a negative effect on cognitive load and strain, speed of reading and navigation, engagement and attention, retention and recall, a framework was developed which includes a total of 82 design principles. These principles were extracted from the fields of Information and Web Design under the content areas of 'Page layout' and 'Navigation' (see Table 1 in Appendix 1 for a full list of principles). The sources used were limited to articles and books that already provide principles of Information and Web Design. Our approach was to then analyze whether these principles were user-centered, and consequently merge them to create single principles that apply to the design of information on the Web.

Both websites (Figure 2 and Figure 3 below) were analyzed based on this framework. The findings from this initial evaluation on the design features of the websites provide evidence that simple design principles are being neglected when it comes to cyber security websites (as listed in Table 2 below). The *Cyber Aware* website, although with a clearer and more accessible design, still fails in some design aspects that if improved would enhance user performance even further. The *Get Safe Online* website shows far more design problems that can significantly impair (or at least not support) user performance.

Based on these initial findings, the researchers went on to test the hypothesis of whether neglecting information and web design principles that are user-centered, compromises cyber awareness by impairing users' ability to locate, understand and retain information that is vital for cyber security.

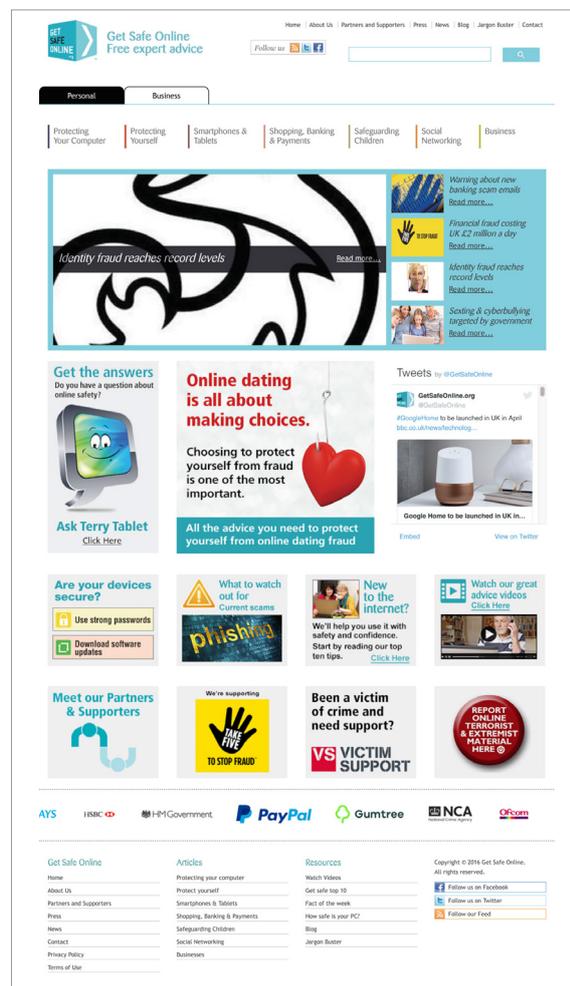
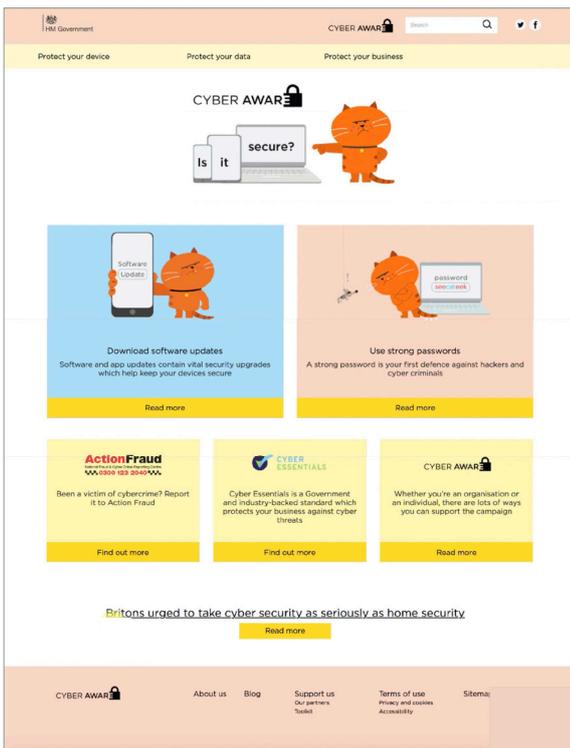


Figure 2 Homepage for Cyber Aware website (left) and Get Safe Online website (right).

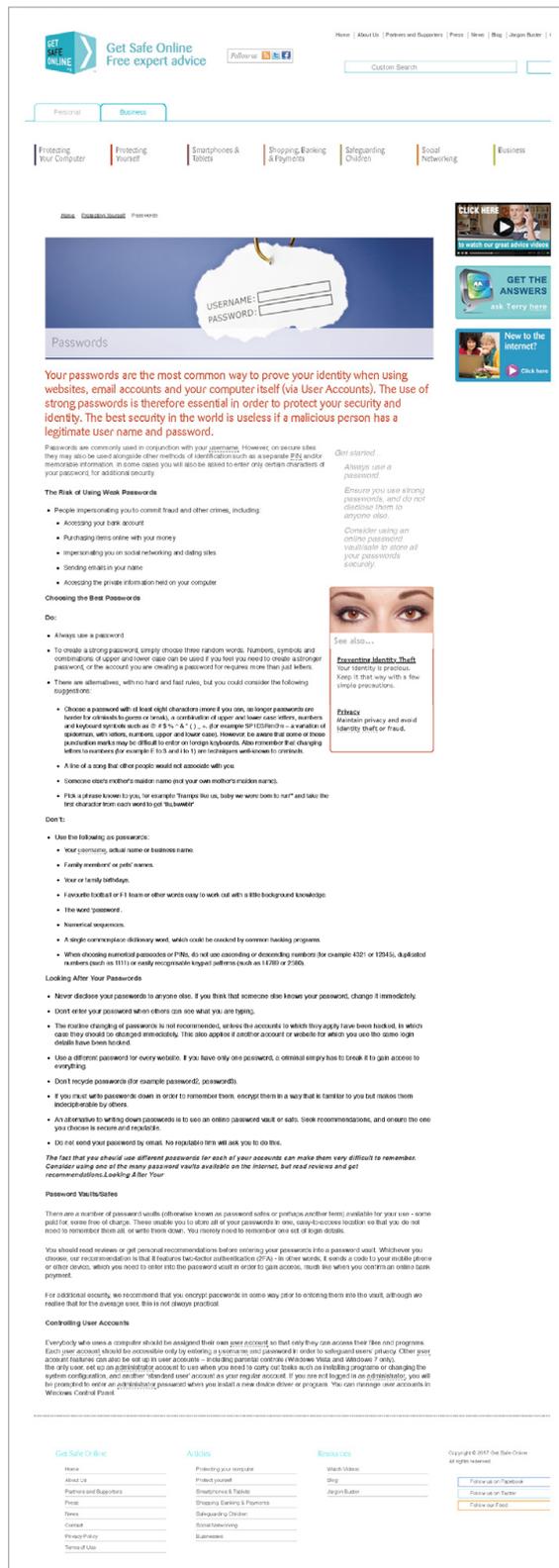
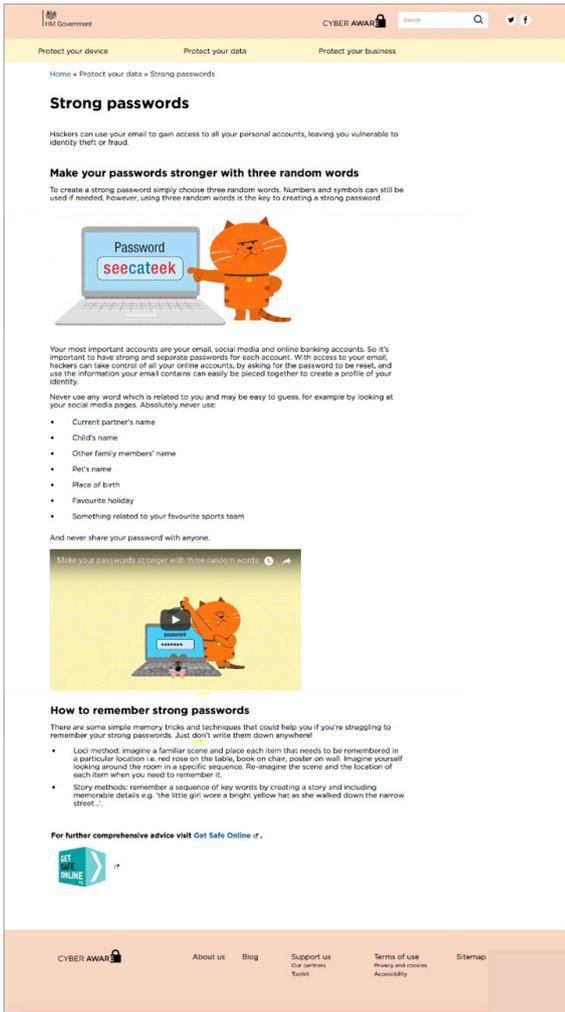


Figure 3 Example of one of the web pages for Cyber Aware website (left) and Get Safe Online website (right) used as the testing material in the study (in this case the web page containing information on 'Passwords').

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## NEGLECTED DESIGN PRINCIPLES

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### **Cyber Aware**

- Some important information is not kept above the fold and requires scrolling
- The hierarchy could be clearer.
- The menu is not distinct enough.
- Adequate cueing techniques are not being used to distinguish more relevant information.
- Visuals could be better used to create a more aesthetically pleasing website that complements the organization (project a more serious and corporate feel).
- The search box is not long enough (only fits 10 visible characters at a time).
- The website content is not rich enough for automated searches (less than the required 100 pages).

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### **Get Safe Online**

- The layout is not easy to navigate.
- The homepage and menu are too cluttered.
- The font size is too small.
- The line length is too long.
- Some important information is not kept above the fold and requires scrolling.
- The hierarchy needs to be clearer (confusing to have two bullet points levels within one another, that look similar).
- Repetition and redundancies need to be deleted.
- A limited number of information items should be displayed at the same time.
- Where applicable, units of thought should be grouped so that the user can visually see and register as a single unit of information.
- Adequate cueing techniques are not used to distinguish more relevant information.
- The graphics are not kept simple and distinct enough from advertisements.
- Visuals should be used to complement and/or replace some text.
- White space should be used to reflect the relationship between items of information.
- Horizontal, roll-over activated submenus should not be used.
- A-Z listings should be avoided.
- If alphabetizing information needs to be used for "scannability", then it should be in rows rather than columns.
- Some links do not work.
- The link for the videos is badly located and is not different enough from other elements on the homepage.

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**Table 2** Neglected design principles on the respective websites.

## 4 | User testing

### 4.1 Participants

A total of 61 participants were tested, belonging to social grades A and B (higher & intermediate managerial, administrative, professional occupations), since these are the two groups who use the Internet the most in the UK – 94-95% of internet usage, respectively (Cabinet Office, 2012).

The participants were admin, teaching and research staff at university level. Such individuals are considered medium-high risk because they are responsible for personal details, private and financial information relating to students, staff, applicants and research participants. Overall, there were 34.4% males and 65.6% females; 41% of participants were aged 30-39 years old and 24.6% were aged 20-29 years old.

In terms of 'internet usage', 91.8 % of participants said that they used the internet 'very often'. When asked about their cyber security awareness, only 29% of participants said they were aware of cyber security.

### 4.2 Stimuli

The reasons for selecting the two websites in question were as follows: 1) both websites provide practical advice on how to be protected online, with the aim of driving behavior change amongst businesses and individuals, so that they adopt simple secure online behaviors; 2) both websites are closely linked to the same government, i.e., HM Government in the UK (*Cyber Aware* is sponsored by HM Government and *Get Safe Online* is a private/public sector partnership with HM Government); 3) despite their similar scope and aim, they adopt contrasting approaches in the way information is designed and delivered, which makes them ideal to fulfil the aim of this study.

### 4.3 Procedure

Participants were asked to find specific information on both *Cyber Aware* and *Get Safe Online* websites. The two websites were presented to participants in a random order to prevent biasing and learning effects. Participants were required to complete 4 tasks as follows:

- T<sub>1</sub> – Find information and tell us briefly how to create 'strong passwords'.
- T<sub>2</sub> – Find information and tell us briefly how to keep your 'software secure'.
- T<sub>3</sub> – Find information and tell us briefly how to 'shop online' safely.
- T<sub>4</sub> – Watch the video 'Shopping Online' and tell us briefly what you learnt.

The rationale for choosing the tasks was as follows. For comparison, tasks had to be chosen that featured on both websites. Therefore, as the *Cyber Aware* website had far fewer menu choices, the first step was to select the first choice under each menu tab that related to the public: T<sub>1</sub> – passwords and T<sub>2</sub> – Software. T<sub>3</sub> – Shopping was then selected because of its popularity among the British public. The latest figures show that 86% of internet users in the UK shopped online in 2017. Moreover, people aged 25-34 are more active e-shoppers (77 % of internet users), as well as people with high education (82%) and employed (73%), which matches the group of participants we tested in our study (Eurostat, 2018). T<sub>4</sub> – Video was also selected because of it being an additional means of communicating the information on both websites. For all 4 tasks, the information could be found with 2 clicks/steps (e.g. click on the menu, then click on the specific tab).

Participants were given some instructions before starting the test to maximize the reliability of the findings: 1) You should NOT copy the text from the web page; 2) You should NOT go back to check the answer again. Just write what you remember; 3) You should NOT change the answer afterwards; 4) You should NOT write down an answer based on your knowledge. ONLY information from the respective website will be accepted; 5) If you cannot find or remember the information, just write 'CANNOT FIND'.

Participants' behavior was recorded using 'Movavi Screen Capture' software, which records the computer screen, mouse movements and participants' facial expression.

## 5 Results

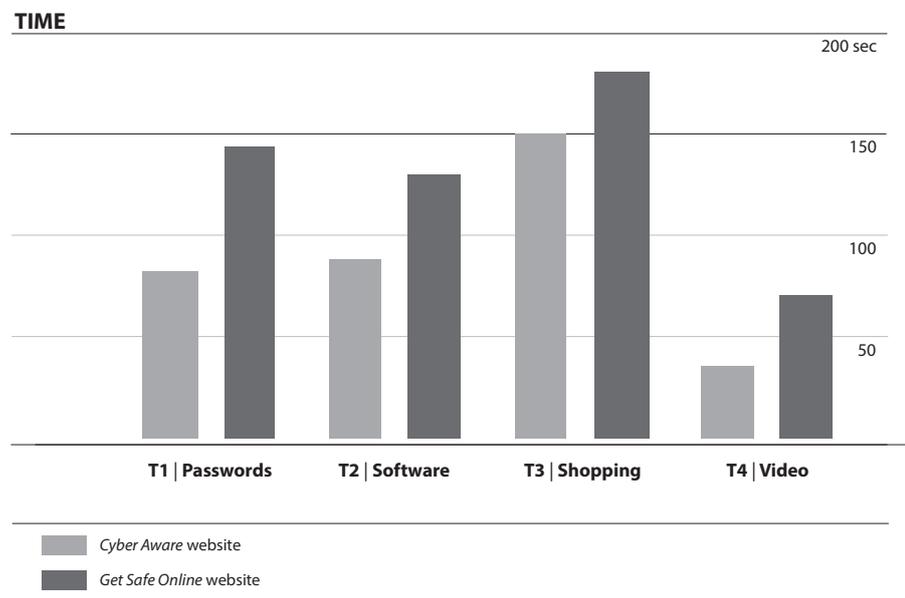
### 5.1 Time

A paired samples t-test was used to compare the time for conducting four given tasks on the *Cyber Aware* and *Get Safe Online* websites. Results show that there were significant differences between the two websites. As shown in Table 3, there were significant differences for tasks Password [T1], Software [T2], and Video [T4]. However, a significant difference between the two websites was not found for the task Shopping [T3] ( $p=.131$ ).

		Time spent to find information						
		n	M	SD	t	p		
<b>T1</b>	<i>Cyber Aware</i>	61	81.3	39.4	-8.287	p = .000	<b>p &lt; .001</b>	
	<i>Get Safe Online</i>		137.8	61.7				
<b>T2</b>	<i>Cyber Aware</i>	61	87.1	50	-3.729	p = .000	<b>p &lt; .001</b>	
	<i>Get Safe Online</i>		128.1	87.3				
<b>T3</b>	<i>Cyber Aware</i>	61	150.0	108.5	-1.530	p = .131	NS	
	<i>Get Safe Online</i>		179.1	111.7				
<b>T4</b>	<i>Cyber Aware</i>	61	33.1	28.0	-5.505	p = .000	<b>p &lt; .001</b>	
	<i>Get Safe Online</i>		66.0	33.8				

**T1** – Passwords | **T2** – Software | **T3** – Shopping | **T4** – Video

As illustrated in Table 3 and Figure 4, participants took significantly more time to find information on the *Get Safe Online* website ( $M=137.8$ ,  $SD=61.7$ ) than on the *Cyber Aware* website ( $M=81.3$ ,  $SD=39.4$ ) ( $p < .001$ ) for the task Password [T1]. Participants also took significantly more time to find information on the *Get Safe Online* website ( $M=128.1$ ,  $SD=87.3$ ) than on the *Cyber Aware* website ( $M=87.1$ ,  $SD=50$ ) ( $p < .001$ ) for the task Software [T2]. The same was true for the task Video [T4], where participants also took significantly more time to find information on the *Get Safe Online* website ( $M=66.0$ ,  $SD=33.8$ ) than on the *Cyber Aware* website ( $M=33.1$ ,  $SD=28.0$ ) ( $p < .001$ ).



**Figure 4** Mean task time in seconds.

5.1.1. *Summary and discussion.* Overall, participants took significantly more time to find information on the *Get Safe Online* website than on the *Cyber Aware* website on three tasks: Passwords [T1], Software [T2] and Video [T4]. This provides evidence that the way the information is designed (organized and structured) on the *Get Safe Online* website is less accessible and less clear to users than on the *Cyber Aware* website.

Moreover, although participants were told not to go back to check the answer again and had to answer each question before going on to the next, they still did it in situations when they struggled to find the information and when they were overwhelmed with the amount of information available on the *Get Safe Online* website (for example, when they wanted to give detailed information but had difficulty in remembering all of it).

Another important point to make, as noted above, is that users do not stay very long on web pages, with an average visit lasting around 60 seconds (Nielsen, 2011). Thus, to gain users' attention, valuable information needs to be communicated ideally within the first 10 seconds. In our study, when asked to find information, participants took on average more than the 60 seconds barrier. Only one task out of four, and only on the *Cyber Aware* website, took less than 60 seconds. In a normal situation, where users are not completing a performance test, they might not stay long enough on either website, nor consider returning to the websites again in the future.

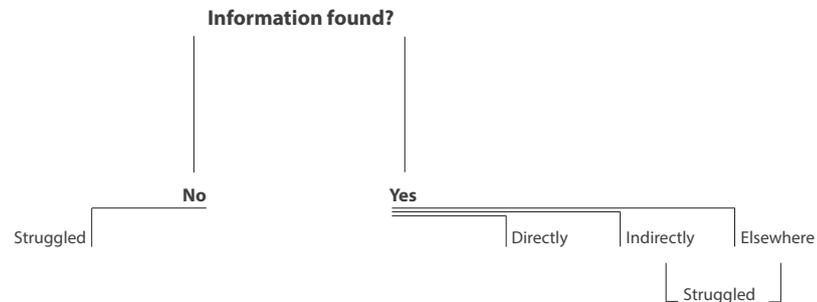
Although no statistically significant difference was found for speed of finding information on Shopping [T3] between the two websites, this was the task in which participants spent more time in total on both websites. Participants struggled to find the information (taking more time to complete the task) and 56% of participants on the *Cyber Aware* website did not find the information at all. This may be due to the fact that information on how to shop online safely is difficult to access on the *Get Safe Online* website, and on the *Cyber Aware* website there is no dedicated page for such information (information is less focused and is dispersed across different web pages). This is worrying because of the high percentage of people who shop online, as mentioned above – 86% of internet users in the UK shopped online in 2017. To gather more evidence on this matter, an analysis of participants' behavior, as well as their preferences and opinions, is described next.

## 5.2 Behavior

A chi-square was used to compare frequency of behavior when finding information on the various web pages available between the two websites *Cyber Aware* and *Get Safe Online* for the same four tasks. In case of the expected values being less than 20%, the Fisher Exact Test was conducted. The same four tasks on each website were given and the measurement points of behavior were as follows and as illustrated in Figure 5:

- 'Found information' [BP1] – Did participants find the accurate information?
- 'Directly to the page' [BP2] – Did participants go directly to the correct page where the information was available and find the accurate information?
- 'Indirectly to the page' [BP3] – Did participants go elsewhere on the website before finding the accurate information on the correct page?
- 'Found information elsewhere' [BP4] – Did participants find similar information elsewhere on the website?
- 'Struggled' [BP5] – Did participants struggle to find the information (going back and forth) and/or could not find the information?

## PATTERNS OF BEHAVIOR



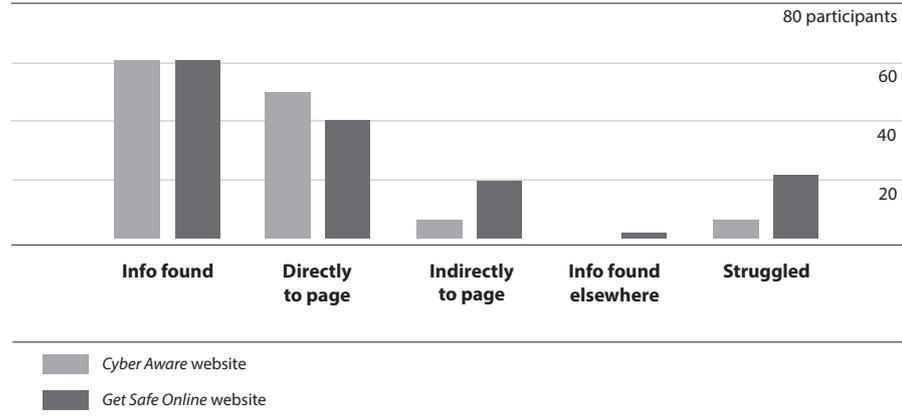
**Figure 5** Patterns of behavior when finding the information on the websites

5.2.1. *Passwords*. According to the results for Passwords (T1), significant differences were found for three behaviors as shown in Table 4.1 and Figure 6.1. Significantly more participants went 'directly to the page' [BP2] on the *Cyber Aware* website (n=55) than on the *Get Safe Online* website (n=40) ( $X^2=10.702, p < .01$ ). Significantly more participants went 'indirectly to the page' [BP3] on the *Get Safe Online* website (n=20) than on the *Cyber Aware* website (n=6) ( $X^2=9.580, p < .01$ ). Significantly more participants 'struggled' [BP5] to find the information on the *Get Safe Online* website (n=21) than on the *Cyber Aware* website (n=6) ( $X^2=10.702, p < .01$ ).

			Behavior when finding information						
			n	Yes	No	$X^2$	p		
T1	Directly to the page	<i>Cyber Aware</i>	61	55	6	10.702	p = .002		p < .01
		<i>Get Safe Online</i>		40	21				
	Indirectly to the page	<i>Cyber Aware</i>	61	6	55	9.580	p = .003		p < .01
		<i>Get Safe Online</i>		20	41				
	Info found elsewhere	<i>Cyber Aware</i>	61	0	61	1.008	p = 1.000		NS
		<i>Get Safe Online</i>		1	60				
	Struggled	<i>Cyber Aware</i>	61	6	55	10.702	p = .002		p < .01
		<i>Get Safe Online</i>		21	40				

T1 – Passwords

## PASSWORDS



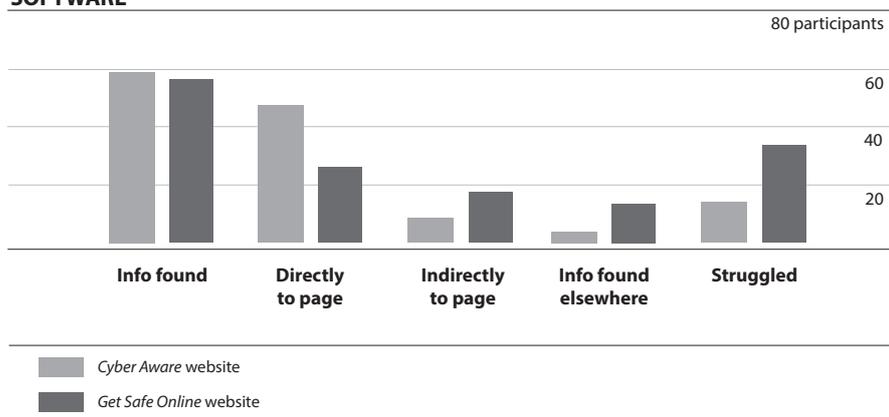
**Figure 6.1** Frequency of behavior when finding information for task T1 – Passwords.

5.2.2. *Software*. According to the results for Software (T2) significant differences were found for three behaviors as shown in Table 4.2 and Figure 6.2. Significantly more participants went 'directly to the page [BP2] on the *Cyber Aware* website (n=47) than on the *Get Safe Online* website (n=27) ( $X^2=3.739$ ,  $p < .001$ ). Significantly more participants 'found information elsewhere' [BP4] on the *Get Safe Online* website (n=13) than on the *Cyber Aware* website (n=4) ( $X^2=5.536$ ,  $p < .05$ ). Significantly more people 'struggled' [BP5] on the *Get Safe Online* (n=34) than on the *Cyber Aware* website (n=14) ( $X^2=13.739$ ,  $p < .001$ ).

				Behavior when finding information				
			n	Yes	No	$X^2$	p	
<b>T2</b>	<b>Info found</b>	<i>Cyber Aware</i>	61	59	2	.701	p = .680	NS
		<i>Get Safe Online</i>		57	4			
	<b>Directly to the page</b>	<i>Cyber Aware</i>	61	47	14	13.739	p = .000	<b>p &lt; .001</b>
		<i>Get Safe Online</i>		27	34			
	<b>Indirectly to the page</b>	<i>Cyber Aware</i>	61	8	53	4.075	p = .071	NS
		<i>Get Safe Online</i>		17	44			
	<b>Info found elsewhere</b>	<i>Cyber Aware</i>	61	4	57	5.536	p = .034	<b>p &lt; .05</b>
		<i>Get Safe Online</i>		13	48			
	<b>Struggled</b>	<i>Cyber Aware</i>	61	14	47	13.739	p = .000	<b>p &lt; .001</b>
		<i>Get Safe Online</i>		34	27			

T2 – Software

## SOFTWARE



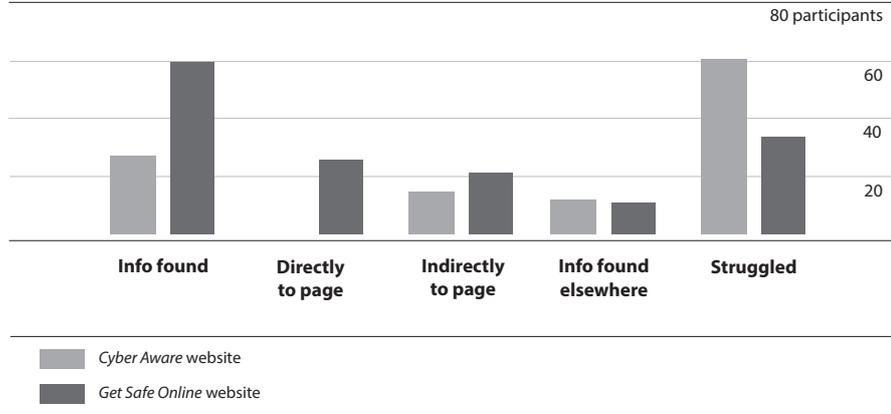
**Figure 6.2** Behavior when finding information for task T2 – Software.

5.2.3. *Shopping*. The results for Shopping (T3) show significant differences for three behaviors as illustrated in Table 4.3 and Figure 6.3. Significantly more participants ‘found the information’ [BP1] on the *Get Safe Online* website (n=59) than on the *Cyber Aware* website (n=27) ( $X^2=40.351, p < .001$ ). Significantly more participants went ‘directly to the page’ [BP2] on the *Get Safe Online* website (n=27) than on the *Cyber Aware* website (n=0) ( $X^2=36.674, p < .001$ ). Significantly more participants ‘struggled’ [BP5] to find the information on the *Cyber Aware* website (n=61) than on the *Get Safe Online* website (n=34) ( $X^2=34.674, p < .001$ ).

			Behavior when finding information																																																				
			n	Yes	No	$X^2$	p																																																
<b>T3</b>	<b>Info found</b>	<i>Cyber Aware</i>	61	27	34	40.351	p = .000	<b>p &lt; .001</b>																																															
		<i>Get Safe Online</i>		59	2					<b>Directly to the page</b>	<i>Cyber Aware</i>	61	0	61	36.674	p = .000	<b>p &lt; .001</b>	<i>Get Safe Online</i>		27	34		<b>Indirectly to the page</b>	<i>Cyber Aware</i>	61	15	46	1.419	p = .321	NS	<i>Get Safe Online</i>		21	40		<b>Info found elsewhere</b>	<i>Cyber Aware</i>	61	12	49	.054	p = 1.000	NS	<i>Get Safe Online</i>		11	50		<b>Struggled</b>	<i>Cyber Aware</i>	61	61	0	34.674	p = .000
	<b>Directly to the page</b>	<i>Cyber Aware</i>	61	0	61	36.674	p = .000	<b>p &lt; .001</b>																																															
		<i>Get Safe Online</i>		27	34					<b>Indirectly to the page</b>	<i>Cyber Aware</i>	61	15	46	1.419	p = .321	NS	<i>Get Safe Online</i>		21	40		<b>Info found elsewhere</b>	<i>Cyber Aware</i>	61	12	49	.054	p = 1.000	NS	<i>Get Safe Online</i>		11	50		<b>Struggled</b>	<i>Cyber Aware</i>	61	61	0	34.674	p = .000	<b>p &lt; .001</b>	<i>Get Safe Online</i>		34	27								
	<b>Indirectly to the page</b>	<i>Cyber Aware</i>	61	15	46	1.419	p = .321	NS																																															
		<i>Get Safe Online</i>		21	40					<b>Info found elsewhere</b>	<i>Cyber Aware</i>	61	12	49	.054	p = 1.000	NS	<i>Get Safe Online</i>		11	50		<b>Struggled</b>	<i>Cyber Aware</i>	61	61	0	34.674	p = .000	<b>p &lt; .001</b>	<i>Get Safe Online</i>		34	27																					
	<b>Info found elsewhere</b>	<i>Cyber Aware</i>	61	12	49	.054	p = 1.000	NS																																															
		<i>Get Safe Online</i>		11	50					<b>Struggled</b>	<i>Cyber Aware</i>	61	61	0	34.674	p = .000	<b>p &lt; .001</b>	<i>Get Safe Online</i>		34	27																																		
	<b>Struggled</b>	<i>Cyber Aware</i>	61	61	0	34.674	p = .000	<b>p &lt; .001</b>																																															
		<i>Get Safe Online</i>		34	27																																																		

T3 – Shopping

## SHOPPING



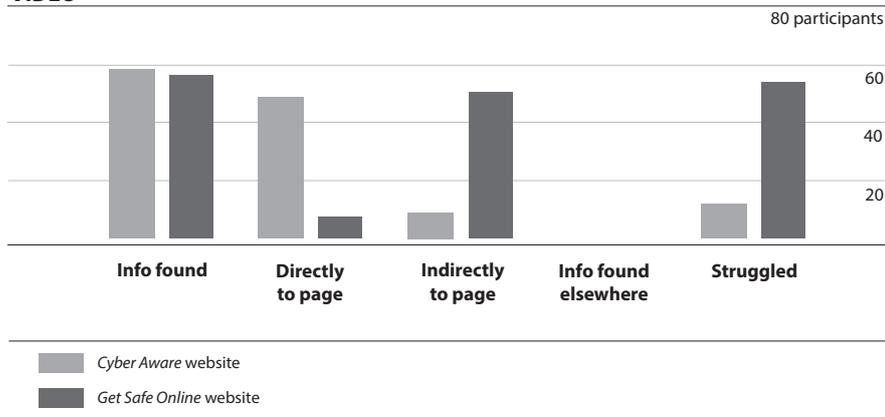
**Figure 6.3** Behavior when finding information for task T3 – Shopping.

5.2.4. *Video*. In relation to the results for Video (T<sub>4</sub>), significant differences were found for three behaviors as shown in Table 4.4 and Figure 6.4. Significantly more participants went 'directly to the page' [BP<sub>2</sub>] on the *Cyber Aware* website (n=49) than on the *Get Safe Online* website (n=7) ( $X^2=58.227, p < .001$ ). Significantly more participants went 'indirectly to the page' [BP<sub>3</sub>] on the *Get Safe Online* website (n=50) than on the *Cyber Aware* website (n=9) ( $X^2=55.174, p < .001$ ). Significantly more participants 'struggled' [BP<sub>5</sub>] on the *Get Safe Online* website (n=54) than on the *Cyber Aware* website (n=12) ( $X^2=58.227, p < .001$ ).

			Behavior when finding information						
			n	Yes	No	X <sup>2</sup>	p		
<b>T4</b>	<b>Info found</b>	<i>Cyber Aware</i>	61	58	3	.152	p = 1.000	NS	
		<i>Get Safe Online</i>		57	4				
	<b>Directly to the page</b>	<i>Cyber Aware</i>	61	49	12	58.227	p = .000	<b>p &lt; .001</b>	
		<i>Get Safe Online</i>		7	54				
	<b>Indirectly to the page</b>	<i>Cyber Aware</i>	61	9	52	55.174	p = .000	<b>p &lt; .001</b>	
		<i>Get Safe Online</i>		50	11				
	<b>Struggled</b>	<i>Cyber Aware</i>	61	12	49	58.227	p = .000	<b>p &lt; .001</b>	
		<i>Get Safe Online</i>		54	7				

T4 – Video

## VIDEO



**Figure 6.4** Behavior when finding information for task T4 – Video.

5.2.5. *Summary and discussion.* Overall, the vast majority of participants found the accurate information on both websites, with the exception of the website *Cyber Aware* for information on 'shopping online'. The latter may be due to the fact that there was no dedicated page for this category. As many as 56% of participants failed to find the information, 52% wrote "cannot find" and 4% wrote information that was inaccurate (possibly a guess). From the video recording we can see that the remaining 44% who managed to find information on shopping online safely, found bits of information on less formal pages i.e. on the *Cyber Aware* blog and on articles dating back to 2014 and 2015. With blogs being considered more subjective and less accurate, it is reasonable to surmise that users will have lower levels of trust in such information even if they find it.

In terms of how information was found and accessed, overall significantly more participants found the information more easily, i.e., went directly to the page and struggled less, on the *Cyber Aware* website than on the *Get Safe Online* website (with the exception of information on shopping).

For the *Get Safe Online* website, overall participants struggled more to find the information: 34% struggled to find information on Passwords (compared to 10% on the *Cyber Aware* website); 56% struggled to find information on Software (compared to 23% on the *Cyber Aware* website); 56% also struggled to find information on Shopping (compared to 23% on the *Cyber Aware* website); and as many as 89% struggled to find the video on 'Shopping online' (compared to 20% on the *Cyber Aware* website). The reasons for this high percentage regarding access to the video in terms of design are that: 1) a link to the video was not available on the page dedicated to Shopping; 2) on the homepage there were two links to the video but both were difficult to see and were below the 'page fold' (the first looked like an advert and the second was right at the bottom of the page in a smaller font size). In contrast, the *Cyber Aware* website had the video on the page dedicated to the corresponding category/content.

### 5.3 User perception

At the end of completing all four tasks for each website respectively, participants were asked to choose three words to describe the website and their feelings after using the website, for which they were given a list of sixteen words (8 positive and 8 negative adjectives/feelings) based on the 'Microsoft Desirability Toolkit to Test Visual Appeal' (Meyer, 2016). This was followed by an interview to gather participants' general opinion about the design of the two websites. Participants were not asked to choose one website over the other, but to list what they liked and disliked.

5.3.1. *Description of the website.* The choice of three words to describe the website is illustrated in Table 5.1 and Figure 7.1 (please see p. 26).

<b>Website description</b>			
<b>Cyber Aware</b>		<b>Get Safe Online</b>	
Accessible	38 (31.1%)	Complex	28 (23.0%)
Friendly	27 (22.1%)	Relevant	25 (20.5%)
Straightforward	25 (20.5%)	Effective	22 (18.0%)
Understandable	21 (17.2%)	Trustworthy	21 (17.2%)
Fun	16 (13.1%)	Overwhelming	20 (16.4%)
Effective	12 (9.8%)	Time consuming	17 (13.9%)
Ineffective	11 (9.0%)	Understandable	13 (10.7%)
Trustworthy	10 (8.2%)	Accessible	9 (7.4%)
Relevant	6 (4.9%)	Straightforward	9 (7.4%)
Time consuming	5 (4.1%)	Difficult	7 (5.7%)
Confusing	4 (3.3%)	Confusing	6 (4.9%)
Frustrating	3 (2.5%)	Frustrating	3 (2.5%)
Difficult	2 (1.6%)	Friendly	2 (1.6%)
Complex	1 (0.8%)	Stressful	1 (0.8%)
Overwhelming	1 (0.8%)	Fun	0 (0.0%)
Stressful	1 (0.8%)	Ineffective	0 (0.0%)

**Task** – Choose 3 words to describe the website

**Table 5.1** User description of the website.

The highest choice was the word 'Accessible' (31.1%), selected for the *Cyber Aware* website, and the word 'Complex' (23.0%) for the *Get Safe Online* website. The second highest choice was the word 'Friendly' (22.1%) selected for the *Cyber Aware* website, and the word 'Relevant' (20.5%) for the *Get Safe Online* website.

5.3.2. *Feelings after using the website.* The choice of three words to describe participants' feelings after using the website is illustrated in Table 5.2 and Figure 7.2 (please see p. 26). The highest choice was the word 'Satisfied' (22.1%) for the *Cyber Aware* website, and both 'Overwhelmed' and 'Secure' (22.1%) for the *Get Safe Online* website. The second highest choice was the word 'Calm' (19.7%) for the *Cyber Aware* website, and the word 'Confident' (20.5%) for the *Get Safe Online* website.

<b>Feelings about website</b>			
<b>Cyber Aware</b>		<b>Get Safe Online</b>	
Satisfied	27 (22.1%)	Overwhelmed	27 (22.1%)
Calm	24 (19.7%)	Secure	27 (22.1%)
Confident	19 (15.6%)	Confident	25 (20.5%)
Frustrated	19 (15.6%)	Satisfied	17 (13.9%)
Annoyed	17 (13.9%)	Calm	15 (12.3%)
Engaged	15 (12.3%)	Confused	11 (9.0%)
Disconnected	14 (11.5%)	Engaged	10 (8.2%)
Secure	14 (11.5%)	Frustrated	10 (8.2%)
Confused	11 (9.0%)	Impressed	9 (7.4%)
Inspired	8 (6.6%)	Empowered	8 (6.6%)
Stressed	4 (3.3%)	Valued	8 (6.6%)
Valued	4 (3.3%)	Annoyed	4 (3.3%)
Overwhelmed	3 (2.5%)	Inspired	4 (3.3%)
Empowered	2 (1.6%)	Intimidated	3 (2.5%)
Impressed	1 (0.8%)	Stressed	3 (2.5%)
Intimidated	1 (0.8%)	Disconnected	2 (1.6%)

**Task** – Choose 3 words to describe your feelings after using the website

**Table 5.2** User feelings after using the website.

## WEBSITE DESCRIPTION

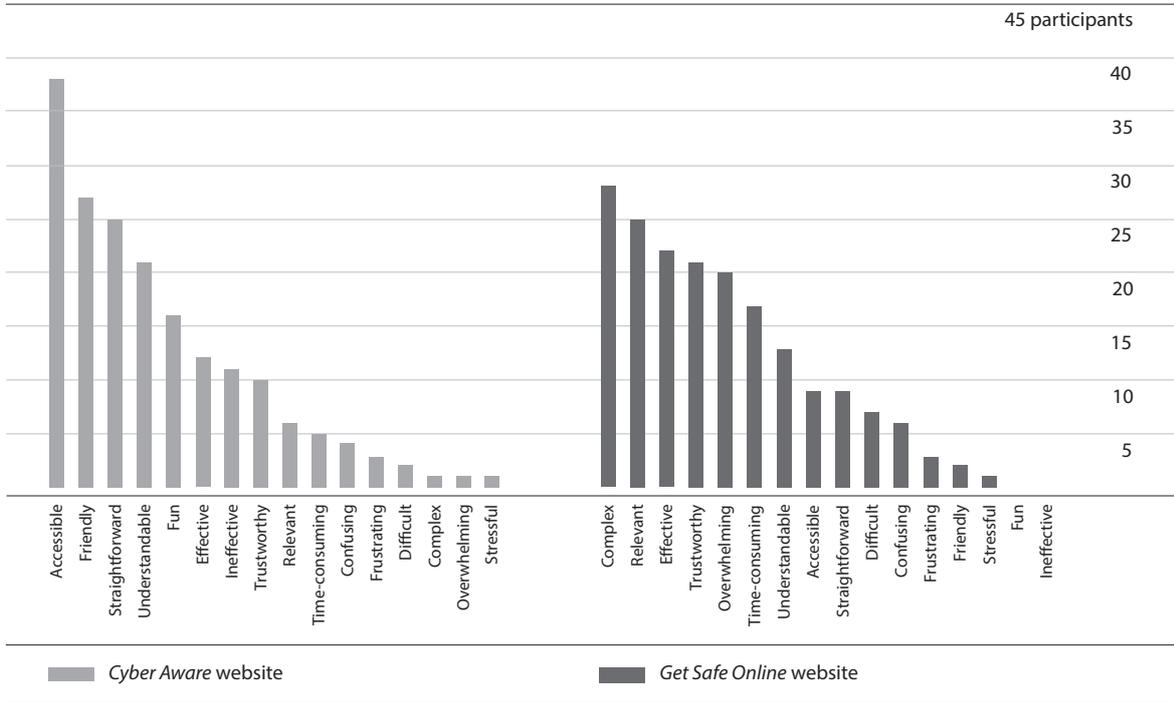


Figure 7.1 User description of the website.

## FEELINGS ABOUT WEBSITE

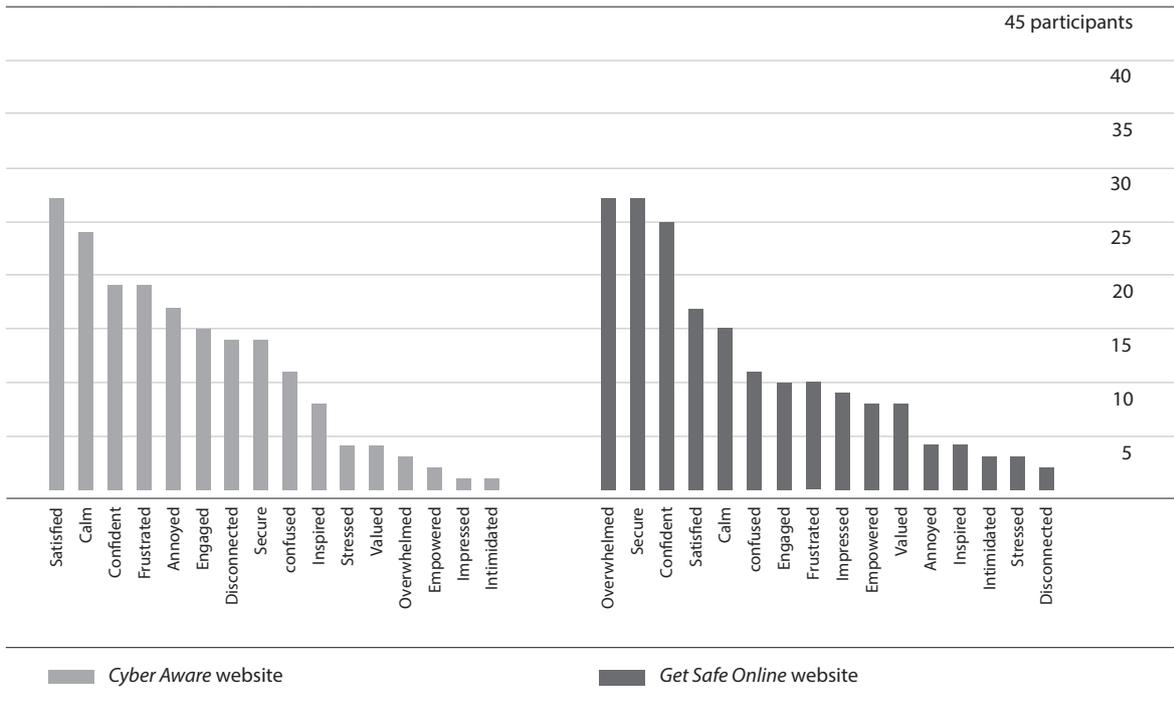


Figure 7.2 User feelings after using the website.

5.3.3. *Design preferences.* Features that participants **liked** for the *Cyber Aware* website were: simple interface; user-friendly; cleaner look; calm; tidy and clear organization of information; colorful; fun; with more visualization; good layout; big headings; short paragraphs; bigger font size; more memorable video; easy to look at on a mobile phone; more interactive with the information. Features that participants **disliked**: “childish” look due to the cartoon cat (aimed more at children and teenagers); basic video; menu with very few options (only 3 tabs); design a little plain and simple; website looks like it was produced quickly and cheaply. Some participants went further and made some design **suggestions** for the *Cyber Aware* website: might be a good idea to combine both websites (use the format of the *Cyber Aware* website and the content of the *Get Safe Online* website); the color palette is warm but red might be better for a cyber security subject.

Features that participants **liked** for the *Get Safe Online* website were: professional; serious; detailed; looks more trustworthy; more corporate; more formal; headings with a different color; well separated information; good use of color to separate the different menu options; good to separate personal from business; more contemporary design; the logos of companies at the bottom are good as it gives reassurance of being a trustworthy website. Features that participants **disliked**: dense text; unclear layout; too many sub-categories in the menu; menu difficult to follow; unclear how information is organized in the mega menu (alphabetical?); when menu is open it does not always fit on one page; looks old and tired; not visually engaging; too many boxes on the right hand-side; too many and unrelated things on one page; too many pictures on the homepage (look like adverts); too busy at the bottom of the homepage. Design **suggestions** made by some participants for the *Get Safe Online* website included: more hierarchy overall and fewer options to choose from in the menu; show more common and sought-after content first in the menu, and then have separate sections for other content; use pictograms instead of photos.

5.3.4. *Summary and discussion.* Overall, participants considered the *Get Safe Online* website to be more useful and trustworthy because of the specific and in-depth content, as well as the more corporate and formal design. However, they also considered the information to be too dense and the design to be unclear, too crowded and with too many options, which they felt had affected their performance. The feature that they seem to have struggled with most was the mega menu. The latter had far too many options (with some options actually repeated across the different menu categories), and the options were sorted alphabetically in rows (horizontally) rather than columns, which goes against the natural way of looking at menus/lists, as discussed by Nielsen (2010b).

Participants considered the *Cyber Aware* website to be easier to use overall because the design was simpler and clearer, making it easier to navigate and

find the information. Participants chose the words 'Accessible' (38 times), 'Friendly' (27 times) and 'Straightforward' (25 times) to describe the *Cyber Aware* website, and the words 'Satisfied' (27 times) and 'Calm' (24 times) to describe their feelings after using the *Cyber Aware* website. This evidence is in tune with the performance findings and also favors the design of the *Cyber Aware* website as being more accessible and easier to use, and leaving a lasting impression of satisfaction and calmness. However, they also considered the information to be too thin at times (e.g., the menu had very few options; when using the search box, participants were directed to blog pages, as opposed to dedicated pages), and the design a bit childish due to the cartoon cat, which did not make them feel very secure.

## 6 Discussion and conclusion

The present study compared two cyber security websites that are equivalent in terms of focus and target audience, to ascertain how successful they are at informing and instructing the public on how to adopt secure online behaviors and be protected online. The websites were compared in terms of: time to search and locate information; whether information was found; user behavior when finding information; and user perception.

The findings confirm the researchers' hypothesis. Participants performed better (located, understood and recalled information better) with the website that displayed a higher number of user-centered design principles (as defined in the literature). Our study shows that even when information is considered important (such as cyber security information) if too dense, complex and badly designed, it will overwhelm users and they will struggle to find and understand the information they need. Therefore, neglecting the target users' needs and expectations comes at a price.

Previous studies have shown a significant impact of design aesthetics and perceived ease of use on trust (Li and Yeh, 2010), and have validated the relationship of perceived interactivity (user control, connectedness, and responsiveness) to trust of a website (Cyr et al., 2009). However, our study unexpectedly showed that a design which is clearer, more accessible and that facilitates performance, is not sufficient to project a sense of trust among cybersecurity users. The tone of the design (e.g., more corporate if dealing with more serious information) and the depth of the information (e.g., more detailed information when communicating more serious material that needs to be acted upon), are equally important.

Our findings therefore allow us to provide an original insight: that one design principle that seems to have been somewhat neglected in the field of online information design (and Web design), especially when the aim is to access, understand, retain and act upon information, is a 'lasting impression'. Much has

been discussed and researched regarding how to create a good first impression that grabs the users' attention. But, if the aim is for users to implement what they have found and learnt, then a 'lasting impression' counts as much as the 'first impression'. What our study shows is that, if users do not trust the information, even if they accessed it and understood it easily, they might not act upon it, nor return to the website.

Proposing a redesign of these websites is outside the scope of our research. However, our findings allow us to fill in a few gaps in the research and recommend further principles for information design in general, and online information specifically.

*Lasting impression* – The first principle is to aim for a lasting impression and avoid setting in motion negative bias and/or attitudes (such as lack of trust). As shown by our results and supported by previous research (discussed by, for example, Loranger, 2016b), users give more weight to the negative than the positive. Therefore, in order to provide a good user experience, legibility and usability should take priority in information and Web design. However, to ensure a lasting positive impression, information design outputs should go beyond that. Designers must mitigate as many design flaws as possible, and this should include the visual tone of the message and the output's overall visual impression. In sum, information design outputs should take into account, and fulfil, all three stages of our Information Design Process Model, with legibility and usability having the highest impact on 'Information Seeking', and lasting impression having the highest impact on 'Information Use'. That is, a good lasting impression will be key to persuading users to act upon the information, but users will struggle to act upon the information if they cannot locate it, understand it and retain/recall it. It is therefore imperative for such inter-dependence between the different stages of the Information Design Process to be considered in the design development.

*User-centered design approaches* – for the lasting impression principle to work, it should be orchestrated with a second principle: to identify user needs through user-centered design approaches during the various stages of design development. This principle has the highest impact on the 'Information Need' stage of our Information Design Process Model. As claimed by Loranger (2016c) regarding UX design, but which also applies to information design, "one of the biggest traps... is focusing on outputs over outcomes — that is, discussing what to build before clearly defining its purpose" (to clarify, an output is here interpreted as the design solution, and an outcome as the problem that is solved with that design output/solution). Therefore, before deciding on the design of a website, for example, based on intuition and practical experience, designers should identify the needs of the target user and the problems that are to be addressed; otherwise they run the risk of designing the wrong entity,

as indicated by our results. We therefore suggest that the 'Information Need' stage should involve a mixed-methods approach by including both quantitative and qualitative user-centered research methods. Moreover, this information design processing stage should be checked at different times during the design development: a) at the beginning, by conducting primary research and involving target users in co-/participatory design sessions; b) in the middle, by designing, testing, iterating and redesigning the information as many times as necessary; c) and at the end, when implementing and evaluating the final design output (which can resonate with what we have done in our study).

With these two further principles in place, in addition to all the other principles listed in Table 1 blending the fields of Information and Web design, the theory emerging from this study is as follows. Information design principles benefit websites whose primary goal is to inform and instruct the public on important and serious matters. According to this theory, at the 'Information Need' stage of the Information Design Process, websites designed taking into account user needs and expectations collected through user-centered research methods: 1) deliver more valid and reliable design outputs and outcomes. At the 'Information Seeking' stage of the Information Design Process, websites displaying user-centered design principles and reflecting user preferences (within reason, i.e., that do not compromise accessibility of information): 2) grab and hold user interests and attention; 3) facilitate user access and understanding of information; 4) facilitate user retention and recall of information; 5) create a sense of trust among users in the information provided. Consequently, at the 'Information Use' stage, such websites are likely to: 6) help and persuade users to implement the information learnt in their daily lives.

In sum, and in full agreement with Schriver (2016), "design on the Web matters". Information design developed through user-centered approaches is crucial in shaping experience and enabling organizations to accomplish their goals (e.g., keep the public safe) and users to fulfil their needs. Moreover, user-centered design is desperately needed across both public and private sectors when planning web content intended to benefit users, to engender trust in the information that they are fed by the organization, and to increase the likelihood that they will act upon it. In regards to the private sector, it has also been concluded that the private sector has failed to deliver the necessary developments in cyber security, leaving the government to take the lead in protecting both the Critical National Infrastructure and individuals from nefarious activities in cyberspace (HM Government 2016: 13)

## Table 1 – Appendix 1

PAGE LAYOUT		
<b>Aesthetics</b>	<ul style="list-style-type: none"> <li>Find balance between all design elements.</li> <li>Design documents that are attractive, uncluttered, but informative.</li> </ul>	<ul style="list-style-type: none"> <li>Lindgaard et al., 2006;</li> <li>Karlsson, 2007;</li> <li>Pettersson, 2010;</li> <li>Waller, 2011</li> </ul>
<b>Attention (improve)</b>	<ul style="list-style-type: none"> <li>TEXT: set headings in different type versions (e.g. bold, italics, color) and size; use cueing techniques, but conservatively to avoid compromising legibility.</li> <li>COLOR: use bold and bright colors to cue the user to new information; use color coding in a consistent and logical manner.</li> <li>VISUALS: use pictures with interesting content and different types of visuals; use arrows, bullets, lines, and symbols in various colors.</li> <li>OTHER: use margin notes, repetition, and space to highlight relevant information.</li> </ul>	<ul style="list-style-type: none"> <li>Lee &amp; Bolling, 1999;</li> <li>Hartley, 2004;</li> <li>Leavitt &amp; Shneiderman, 2006;</li> <li>Pettersson, 2010;</li> <li>Beukes et al. 2016;</li> <li>Travis, 2016</li> </ul>
<b>Consistency</b>	<ul style="list-style-type: none"> <li>Use visual consistency to allow users to anticipate where items will be, such as consistent use of color, of size and spacing of text, of size and location of labels, of fonts and backgrounds, of location and function of items.</li> <li>Visually align page items consistently (e.g. blocks of text, rows, columns, checkboxes, buttons, data entry fields, etc.).</li> </ul>	<ul style="list-style-type: none"> <li>Hornof &amp; Halverson, 2003;</li> <li>Leavitt &amp; Shneiderman, 2006;</li> <li>Lipton, 2007;</li> <li>Pettersson, 2010;</li> <li>Beukes et al. 2016;</li> <li>Travis, 2016.</li> </ul>
<b>Color</b>	<ul style="list-style-type: none"> <li>Use color as an information design tool (not as decoration).</li> <li>Use color sparingly.</li> <li>Use a background color appropriate to the content.</li> <li>Use a color with good contrast for the text and/or image.</li> <li>Use colors that are clearly different, but avoid complementary colors.</li> <li>Use color coding that is quick and easy to understand and with no more than five colors.</li> <li>Do not use color on its own to communicate information.</li> </ul>	<ul style="list-style-type: none"> <li>Hartley, 2004;</li> <li>Leavitt &amp; Shneiderman, 2006;</li> <li>Lipton, 2007;</li> <li>Pettersson, 2010;</li> <li>Travis, 2016.</li> </ul>
<b>Density</b>	<ul style="list-style-type: none"> <li>Avoid pages that are too cluttered with items of information.</li> </ul>	<ul style="list-style-type: none"> <li>Hornof &amp; Halverson, 2003;</li> <li>Leavitt &amp; Shneiderman, 2006;</li> <li>Pettersson, 2010;</li> <li>Beukes et al., 2016;</li> <li>Travis, 2016.</li> </ul>

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## PAGE LAYOUT

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<b>Graphics</b>	<ul style="list-style-type: none"><li>• Keep graphics simple and different from banner advertisements.</li><li>• Use background images sparingly and make sure they are simple.</li><li>• Make sure the text over images is legible and has sufficient contrast.</li><li>• Label graphics and photos when their meaning or relationship to the main text is not clear.</li><li>• The organisation's logo should be a reasonable size and in the same position on every page (usually on the top left corner).</li><li>• Use images/graphics to support and improve learning.</li><li>• Make animations optional and user-controlled.</li><li>• Do not use animations without a clear reason, and when you do provide an introductory text for animations/videos.</li></ul>	<ul style="list-style-type: none"><li>• Nielsen, 2001;</li><li>• Leavitt &amp; Shneiderman, 2006;</li><li>• Waller, 2011;</li><li>• Beukes et al. 2016;</li><li>• Travis, 2016;</li><li>• Loranger, 2017</li></ul>
<b>Hierarchy</b>	<ul style="list-style-type: none"><li>• Show the hierarchy, sequencing and structure of the content in the graphic design by establishing a high-to-low level of importance.</li><li>• Do this throughout each page and in the order that is most useful to users (e.g. important information higher on the page to be quickly located; least used information toward the bottom of the page).</li></ul>	<ul style="list-style-type: none"><li>• Farkas &amp; Farkas, 2000;</li><li>• Hartley, 2004;</li><li>• Leavitt &amp; Shneiderman, 2006;</li><li>• Pettersson, 2010;</li><li>• Beukes et al. 2016</li></ul>
<b>Homepage</b>	<ul style="list-style-type: none"><li>• Ensure that the homepage is perceived as a homepage and projects the quality of the website.</li><li>• Limit the homepage length and the amount of prose text available.</li><li>• Show all main options on the homepage.</li></ul>	<ul style="list-style-type: none"><li>• Nielsen, 2001;</li><li>• Leavitt &amp; Shneiderman, 2006;</li><li>• Lindgaard et al., 2006;</li><li>• Karlsson, 2007;</li><li>• Nielsen, 2010c;</li><li>• Travis, 2016</li></ul>
<b>Legibility of text</b>	<ul style="list-style-type: none"><li>• Use simple and clean typefaces designed for screen display.</li><li>• Use no more than two fonts, taking advantage of different weights and sizes.</li><li>• Use a 10- to 12-point size font. Do not use less than 9-point and for older adults 14-point might be better.</li><li>• Use a black text on a white or yellow background.</li><li>• Avoid the use of all capital letters.</li><li>• Justify text to the left.</li><li>• Avoid too short and too long lines (e.g. for reading speed use 75-100 characters per line).</li></ul>	<ul style="list-style-type: none"><li>• Lee &amp; Boiling, 1999;</li><li>• Nielsen, 2001;</li><li>• Bernard et al., 2002;</li><li>• Hartley 2004;</li><li>• Leavitt &amp; Shneiderman, 2006;</li><li>• Lipton, 2007;</li><li>• Pettersson, 2010;</li><li>• Waller, 2011;</li><li>• Beukes et al. 2016;</li><li>• Travis, 2016.</li></ul>

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## PAGE LAYOUT

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<b>Memory &amp; recall</b>	<ul style="list-style-type: none"><li>• Organize information carefully.</li><li>• Use visuals.</li><li>• Display a limited number of information items at the same time.</li><li>• Connect text and illustrations closely.</li></ul>	<ul style="list-style-type: none"><li>• Leavitt &amp; Shneiderman, 2006;</li><li>• Pettersson, 2010</li></ul>
<b>Page length</b>	<ul style="list-style-type: none"><li>• Use shorter pages when they need to be quickly browsed (e.g. homepages, navigation pages).</li><li>• Use longer pages when the aim is comprehension (e.g. content pages with more detailed information).</li></ul>	<ul style="list-style-type: none"><li>• Leavitt &amp; Shneiderman, 2006;</li><li>• Waller, 2011</li></ul>
<b>Structure &amp; layout</b>	<ul style="list-style-type: none"><li>• Use a clear and simple layout and structure for the content, limiting the number of levels in the structure.</li><li>• Create a layout that is easy to navigate, i.e. that clearly shows where to start, in what order, and where to end.</li><li>• Put most important items and navigation options at the top centre of the page with minimum scrolling.</li></ul>	<ul style="list-style-type: none"><li>• Farkas and Farkas, 2000;</li><li>• Nielsen, 2001;</li><li>• Hornof &amp; Halverson, 2003;</li><li>• Leavitt &amp; Shneiderman, 2006;</li><li>• Lipton, 2007;</li><li>• Pettersson, 2010;</li><li>• Beukes et al. 2016;</li><li>• Silvennoinen &amp; Jokinen, 2016</li></ul>
<b>Unity</b>	<ul style="list-style-type: none"><li>• Position closely related items next to each other and use similar characteristics (e.g. color, orientation, pattern, shape, size, texture, value) to show that they belong together.</li><li>• Use vertical lists instead of horizontal lists.</li><li>• Use amounts of space between items of information that reflect their relationships.</li></ul>	<ul style="list-style-type: none"><li>• Nielsen, 2001;</li><li>• Hornof &amp; Halverson, 2003;</li><li>• Leavitt &amp; Shneiderman, 2006;</li><li>• Pettersson, 2010;</li><li>• Travis, 2016</li></ul>
<b>White space</b>	<ul style="list-style-type: none"><li>• Use moderate amounts of white space (horizontal and vertical) consistently to organize visual layouts (e.g. to separate paragraphs, subsections, etc.).</li><li>• Aim for a good balance between information density and white space.</li></ul>	<ul style="list-style-type: none"><li>• Hornof &amp; Halverson, 2003;</li><li>• Hartley, 2004;</li><li>• Leavitt &amp; Shneiderman, 2006;</li><li>• Lipton, 2007;</li><li>• Travis, 2016</li></ul>

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## NAVIGATION

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<b>Feedback</b>	<ul style="list-style-type: none"><li>• Provide feedback to the user about their path and location on the website by: using breadcrumbs (to give the current location and the next step); matching link text to the destination page's heading; changing the color of a link that has been clicked, etc.</li></ul>	<ul style="list-style-type: none"><li>• Leavitt &amp; Shneiderman, 2006;</li><li>• Beukes et al. 2016;</li><li>• Travis, 2016</li></ul>
<b>Homepage</b>	<ul style="list-style-type: none"><li>• Allow users to access the homepage from any other page (e.g. a logo is not always recognized as clickable, but a link named "home" is).</li><li>• Do not cover format navigation areas on the home page.</li><li>• Be very careful with minimalist and hidden navigation.</li></ul>	<ul style="list-style-type: none"><li>• Farkas &amp; Farkas, 2000;</li><li>• Leavitt &amp; Shneiderman, 2006;</li><li>• Sherwin, 2014;</li><li>• Beukes et al. 2016;</li><li>• Travis, 2016;</li><li>• Loranger, 2017</li></ul>
<b>Menu &amp; listings</b>	<ul style="list-style-type: none"><li>• Do not use thin, horizontal, roll-over activated submenus.</li><li>• Avoid too many menu levels.</li><li>• Use mega menus for accommodating a large number of options.</li><li>• Avoid A-Z listings. Instead, present information in ordinal sequences, logical structuring, timeline, or prioritization by importance.</li><li>• If alphabetizing information do it in columns, not rows.</li></ul>	<ul style="list-style-type: none"><li>• Leavitt &amp; Shneiderman, 2006;</li><li>• Nielsen, 2010a and 2010b;</li><li>• Cardello, 2013;</li><li>• Whitenton, 2015;</li><li>• Travis, 2016;</li><li>• Nielsen and Li, 2017.</li></ul>
<b>Navigation links</b>	<ul style="list-style-type: none"><li>• Use text for links (e.g. links that match the headings on the destination page).</li><li>• Use links with meaningful and descriptive text/labels (e.g. general descriptions such "click here" and "learn more" have poor information scent).</li><li>• Use an appropriate text length (more than one word and less than a line of text).</li><li>• Use consistent clickable cues that are clear to the user (non-clickable items should not be graphically similar to clickable ones).</li><li>• Change the appearance of links when clicked.</li><li>• Create 'anchor links' (a short list of contents) if pages are too long and have different sections.</li><li>• Avoid duplicate and redundant links.</li></ul>	<ul style="list-style-type: none"><li>• Farkas &amp; Farkas, 2000;</li><li>• Nielsen, 2001;</li><li>• Leavitt &amp; Shneiderman, 2006;</li><li>• Cardello, 2013;</li><li>• Sherwin, 2015;</li><li>• Beukes et al. 2016;</li><li>• Loranger, 2016a;</li><li>• Travis, 2016</li></ul>
<b>Navigation elements</b>	<ul style="list-style-type: none"><li>• Locate, group and differentiate navigation elements consistently across pages: menus, tabs, headings, lists, search box, site map, etc.</li></ul>	<ul style="list-style-type: none"><li>• Leavitt &amp; Shneiderman, 2006;</li><li>• Travis, 2016</li></ul>

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## NAVIGATION

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<b>Paging</b>	<ul style="list-style-type: none"><li>Use paging when finding specific information – what Loranger (2014) calls “goal-oriented” finding tasks.</li></ul>	<ul style="list-style-type: none"><li>Leavitt &amp; Shneiderman, 2006;</li><li>Loranger, 2016a</li></ul>
<b>Scrolling</b>	<ul style="list-style-type: none"><li>Use longer, scrolling pages when reading for comprehension (not for navigation-only pages such as the homepage).</li><li>Use a page layout that does not require horizontal scrolling.</li><li>Keep the most important information “above the fold”, i.e. within the first viewable area of the page.</li></ul>	<ul style="list-style-type: none"><li>Nielsen, 2001 and 2010c;</li><li>Leavitt &amp; Shneiderman, 2006;</li><li>Travis, 2016</li></ul>
<b>Scroll stoppers</b>	<ul style="list-style-type: none"><li>Make sure that page elements do not give the false impression to users that they have reached the top or bottom of the page (e.g. headings, block of text in small font, horizontal lines, a block of color that finishes).</li></ul>	<ul style="list-style-type: none"><li>Leavitt &amp; Shneiderman, 2006;</li><li>Travis, 2016</li></ul>
<b>Search</b>	<ul style="list-style-type: none"><li>If using a search option, provide one on each page, but do not to rely on search engines when the website’s content is not rich enough for automated searches (i.e. with no more than 100 web pages).</li><li>The search box should be long enough (at least 30 characters), and located where users expect it.</li></ul>	<ul style="list-style-type: none"><li>Nielsen, 1999 and 2001;</li><li>Farkas&amp; Farkas, 2000;</li><li>Leavitt &amp; Shneiderman, 2006;</li><li>Beukes et al. 2016;</li><li>Travis, 2016</li></ul>
<b>Tabs</b>	<ul style="list-style-type: none"><li>Use tabs to alternate between views that relate to the same context.</li><li>Locate tabs at the top of the page.</li><li>Design tabs to look like real clickable tabs.</li><li>Highlight tabs in current use, but make unselected tabs also clearly visible.</li><li>Write short labels (1-2 words), avoiding all capitals.</li><li>Use one row of tabs only and locate them at the top.</li></ul>	<ul style="list-style-type: none"><li>Leavitt &amp; Shneiderman, 2006;</li><li>Nielsen, 2016;</li><li>Travis, 2016</li></ul>

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