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Improving obesity prevention among university students through a tailored information design approach

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Abstract

University is a critical period for weight gain primarily due to unhealthy changes in eating behavior in students. This is the first study to focus on the impact of tailored information design approaches on the awareness and retention of obesity related information, specifically by university students. A motion graphics was developed through a comprehensive user-centered research and design process that involved a scoping study (observation, questionnaire and focus group), usability testing (five stages of iteration), and a performance test. The results show low previous knowledge and a statistical significant impact on understanding of information with a tailored user-centered motion graphics.

1 Introduction

One strategy to prevent obesity, according to Vella-Zarb and Elgar (2009), is to first identify and understand high-risk periods for weight gain, and second devise relevant interventions that are aimed specifically at these periods. As noted by the authors, one such period is the transition from late adolescence to early adulthood. People aged 18 to 29 with some university education appear to be at an even greater risk of weight gain (Mokdad et al. 1999; American College Health Association 2008). University is therefore a critical period for weight gain, due to unhealthy changes in eating behaviors in students. This is true across the world (Sparling 2007; Pliner and Saunders 2008; Lloyd-Richardson et al. 2009; Vella-Zarb and Elgar 2009 and 2010; Deliens et al. 2014 and 2015; Lofti 2015; Sofía et al. 2015; Vadeboncoeur et al. 2016). In the USA, such a phenomenon is known as the "Freshman 15", because students are thought to gain 15lbs (6.8 kg) on average during their university studies.

With the transition from structured secondary school to university, comes an increase in independency and exposure to different social circumstances of eating (Pliner and Saunders 2008). Several factors have been identified as influencing eating behavior in university students, as listed in Table 1.

Weight gain and obesity among university students is therefore a recognized health issue. Moreover, well documented studies have identified the need to intervene as early as possible to avoid long-term consequences, such as carrying poor health habits into adulthood that will lead to a series of health problems (Guo et al. 2002; Vadeboncoeur et al. 2016). The latter include type 2 diabetes, cardiovascular disease, hypertension, some types of cancers, musculoskeletal disorders, etc. (Visscher and Seidell 2001; Sparling 2007; Vella-Zarb and Elgar 2009 and 2010; Dixon 2010; Vadeboncoeur et al. 2016; World Health Organization 2016).

However, most strategies devised to tackle obesity have had a whole-population focus and, despite a change of attention from interventions such

FACTORS INFLUENCING EATING BEHAVIOUR	
A decrease in parental influence on diet.	• Pliner and Saunders 2008 • Deliens et al. 2014
Poor self-discipline, self-control and time management.	• Deliens et al. 2014
Lack of knowledge and skills to make healthy food choices and cook healthy foods.	• Cluskey and Grobe 2009
Other commitments being prioritized over healthy food choices, leading to the purchase of foods that are fast, convenient and inexpensive.	• Marquis 2005 • Nelson et al. 2009
Poor eating habits, stress and lower physical activity.	• Vadeboncoeur et al. 2016
Living away from home, having greater access to alcohol and being in an environment with many catering facilities.	• Vadeboncoeur et al. 2015
Food being everywhere and generally inexpensive, flavorful, large-portioned, and high-calorie	• Sparling 2007
The fact that students rely increasingly on energy-saving devices and technology throughout the day, and most of their waking hours are spent sitting.	• Sparling 2007

Table 1 Factors influencing eating behaviour among university students.

as surgery and drugs to community-based approaches and social marketing campaigns, there is very limited evidence on the success of such interventions (Walls et al. 2011). Moreover, no strategy to date seems to have explored the power that information design has to communicate and tackle obesity issues, as well as its ability to specifically reach university students. It is also important to take into account that determinants of obesity can be region or culture specific, and socio-cultural influences and lifestyle might vary in different countries, as shown by Deliens et al. (2014).

Providing information in a clear, attractive and digestible form makes it more accessible and likely to be noticed by the public in general and university students specifically. This is especially important in a society driven by information technology, where university students are exposed to large amounts of information on a daily basis. Moreover, their chosen platforms to learn and communicate are computers, tablets and smart phones. Therefore, after conducting a scoping study, examining the literature, discussing with the user and comparing with other information design approaches, motion graphics seemed highly accessible and with the potential to attract and provide information effectively to university students. However, these are only assumptions, since no empirical studies seem to have focused on the impact of motion graphics on information accessibility.

The study here presented is therefore the first to examine the impact of information design approaches (specifically motion graphics) developed using user-centered research methods, on the awareness and retention of obesity related information by university students, and its possible influence on student attitude towards healthy eating and lifestyle.

With this in mind, the first objective of this study was to find out what factors might contribute to an increase in weight in university students. The second objective of this study was to develop a motion graphics, taking into account principles and theories of information design in general and motion graphics specifically, as well as conduct several usability tests and involve the target audience at the various stages of the design process. The final objective of this study was to find out whether motion graphics can increase knowledge and communicate clearly and effectively to university students, as well as encourage them to live a healthy lifestyle.

2 Problem identification

A scoping study was conducted to help identify the problem and help determine the content for the motion graphics. The University of Leeds in the UK was chosen as an impact case study. The scoping study involved three stages: observation, a questionnaire-based survey, and a focus group.

2.1 Observation

Non-participant observation, where the observer is not involved in the activities and remains passive by only watching and taking notes to draw a conclusion, was conducted to get first-hand information about food habits and environmental influences at the University of Leeds and surrounding areas. Results show that, at the university students chose the counter serving food very high in calories, fat and sugar (e.g., burgers, hot dogs, french fries, etc.). Students were also particularly interested in Meal Deal options, which normally include a sandwich, sugary drink and crisps. What was also interesting is that most students observed did not check the nutrition label of the Meal Deal when one was available on the packaging. However, a Meal Deal can contain around 700 calories, around 30g of total fat (some meal deal combinations can have as much as 20g of saturated fat) and around 30g of sugar, which, when looking to guidelines from the NHS (National Health Service, UK) is too high (NHS Choices 2014).

Another outcome of the observation was the information provided by the Student Union, which has a great influence on students. In the academic year 2016-17 the University of Leeds had 33.2K students enrolled, with 33.1K of those following Leeds University Union (LUU) via their Twitter account. LUU's own labels on food products said "LUU is great value for money", which is a clever selling strategy, as one of the students' main concerns is price (e.g., Deliens et al. 2014;), but diminishes the importance of healthy options over cheap food. When checking the student union's twitter account, students were also

encouraged to participate in surveys by winning chocolate hampers or pizza. In relation to food places around the University, chicken shops sold deep-fry chicken, which is high in calories and fat. The Guardian's report – "The chicken shop mile and how Britain got fat" described similar results (The Guardian 2016). Observations were also conducted in nearby supermarkets. Their promotional food strategies included: buy 1 get 1 free, 2 for £1, save X amount when you spend Y amount, etc. All these discounts can entice students to buy unhealthy food because it is cheaper, or buy and eat more than they actually need.

2.2 Online questionnaire-based survey

An online questionnaire was created using Google forms, to collect general insights on university student food habits, lifestyle, and obesity awareness. The questionnaire was distributed to students at the University of Leeds, through social media and university email databases. A total of 77 responses were received from: 69 female, 8 male; 44 Undergraduate (UG) and 33 Postgraduate (PG) students. Respondents' average age was 22.5.

The results were as follows. In terms of food habits, the main reasons selected by students from a list of seven choices, as to why they eat unhealthy foods were: because they are too busy with their studies (selected 42 times); because they like to treat themselves (selected 41 times). Another revealing piece of data is that most students said they overeat: 28.6% always overeat and 57.1% overeat sometimes, because they are bored (selected 36 times) and because they are stressed (selected 32 times).

In terms of lifestyle, the majority of students said they stay up late: 49.4% always and 44.2% stay occasionally. As reported by the National Health Service (NHS) in England, lack of sleep can contribute to weight gain (NHS Choices 2015). Sedentary behavior is also a common problem among these university students: 62.3% said they sit down every day for 4-8 hours, and 23.4% sit down for more than 8 hours. As also reported by the NHS, sedentary behavior can lead to chronic diseases such as diabetes, obesity and heart disease (Buckley et al. 2015). When asked about their physical activity, around 90% of students said they engage with exercise, with walking being selected 65 times. However, only 18.2% do a physical activity four or more times a week. Reasons given were: because they are too busy with their studies (selected 50 times) because it is too expensive to go to the gym (selected 21 times).

In terms of obesity awareness, and as supported by the observation results, many students do not check their food intake and nutritional information when purchasing food: 41.6% of students do not watch their calorie intake (in contrast to 28.6% who say they do), and 55.6% do not watch their sugar intake (in

contrast to 27.8% students who say they do). Moreover, although most students are aware that high calorie foods and sugary drinks lead to obesity (79.2% and 89.6% respectively), a much lower percentage of students, 55.8%, believed that alcohol leads to obesity.

2.3 Focus group

A focus group was conducted at the University of Leeds with 6 participants who had completed the questionnaire previously: 4 female, 2 male; 5 International, 1 British; 2 UG and 4 PG; and one of the participants had a Health and Nutrition background. Their average age was 24 years. The aim of conducting the focus group was to discuss eating habits and lifestyle in more depth. Comments made by participants reinforced the findings from the observation study and online questionnaire-based study.

When asked about bad food habits some comments were: "Staying up late and drinking sugary drinks."; "Cheap and easy to get unhealthy foods."; "Unbalanced nutritional intake."; "Refectory offers healthy food, but not delicious." They all felt that their lifestyle, in terms of diet and exercise, had changed since they came to University: "Have become lazy gradually."; "Go to bed late."; "No exercise, just sitting."; "Sometimes suffer from sleep deprivation."; "Bad skin."

This focus group was also an opportunity to help decide which information tool would be most appropriate to educate and raise awareness on obesity among university students, as discussed next.

3 Solution to the problem

Once the problem had been identified and analyzed, the next step was to identify a new and innovative solution to communicate obesity prevention effectively to university students in the UK.

3.1 Rationale for motion graphics

The first factor influencing the choice to use a motion graphics as the communication tool was students' easy access to the Internet and portable digital media, and the associated requirement to find and share information in seconds. This was also identified in the observation stage, where it was common practice for students to check their mobile phone when queuing to buy their food, and to eat while using their phone or working on their laptop/tablet. This was further confirmed in the focus group. When asked where they eat their lunch, participants' responses included eating in front of the computer. In terms of sharing information, participants in the focus group reported that they get most information through the Internet, social media and video sharing.
The second factor taken into account was that university students are exposed to a vast amount of information on a daily basis, and it was extremely important to find a means of communication that had the true potential to stand out, grab attention, inform and be retained in students' memory for long term impact. Moreover, according to Strizver (2014), younger audiences such as university students are more used to motion, are more attracted to it, and perceive it more easily and naturally. With these two factors in mind, and based on good design practice and research, motion graphics was selected as an alternative and innovative communication tool, capable of delivering information to university students quickly, clearly, efficiently and effectively.

3.2 Relevant literature

In essence, motion graphics can be defined as "the choreography of graphical elements over time to convey information" (Crook and Beare 2015). This choreography, complemented with sound, can build an extra layer of communication that has a stronger ability than static infographics to inform, educate, persuade and influence behavior.

Literature on the principles and theories of motion graphics, however, is scarcely available, with only a few referenced books on the matter (e.g., Finke et al. 2012; Landa 2016), a few books on the design and practice of motion graphics (e.g., Krasner 2013; Crook and Beare 2015; Shaw 2016), a few academic papers (e.g., Lasseter 1987; Babic et al. 2008; Shir and Asadollahi 2014; Hsueh et al. 2016) and some recent student theses (e.g., Musselman 2013). Moreover, these principles come mostly from practical knowledge, as very little empirical research has been conducted on how motion graphics should be designed and presented to maximize understanding, retention, impact, and behavior change, as well as targeted to specific audiences. Furthermore, while motion graphics has become more prevalent in advertising, its use to inform and educate is still in its infancy.

In learning, there exists some evidence that instructional animation is superior to static pictures regarding learning outcomes (as shown by Höffler and Leutner 2007). Brigas and Ramos (2015) also discuss how, in an educational context, static or dynamic infographics can be a powerful tool capable of holding students' attention, as well as facilitating understanding by reducing complexity of information and instruction. Other authors and researchers have addressed and discussed the importance of infographics in learning and teaching, but only static and not motion graphics (e.g., Bellato 2013; Ozdaml et al. 2016; Shafipoor et al. 2016; Yıldırım 2016).

In health information, positive increases in breast cancer awareness, diagnosis, breast self-exam, and intention to screen for breast cancer, were found for both static infographics and video (Occa and Suggs 2016). Although the video was not what we would consider a motion graphics format, it is reasonable to assume from the results that if both static infographics and video produced an increase when shown separately, when combined the results could be even more successful. As concluded by the researchers themselves (Occa and Suggs 2016), further research should be conducted to understand how to maximize communication strategies so that they are the most effective in influencing behavior.

Other studies have also shown that pictures/cartoon illustrations can improve health information. Delp and Jones (1996) showed that patients given cartoon instructions were more likely to have read the instructions, to answer all

questions correctly, and were more compliant with the task. In their review on the effects of pictures/cartoons/pictographs on health communications in terms of attention, comprehension, recall, and adherence, Houts et al. (2006) also found that "pictures closely linked to written or spoken text can, when compared to text alone, markedly increase attention to and recall of health education information" (Houts et al. 2006: 173). Leiner et al. (2004) add to this the finding that an animated cartoon (videotape) is more effective in delivering a message than the same information in written printed instructional materials. The animated cartoon was produced using advertising strategies focusing on the message to first capture the attention, interest and desire of the patient.

Specifically in terms of health communication strategies for obesity control, Adefemi and Awasthi (2016) highlight the fact that considerable resources have been expended to design and implement health communication campaigns for obesity control. However, there is very little evidence showing that these campaigns are effective, with most achieving minimal population behavioral change (between 5-10%). In fact, some interventions are not even evaluated at all. Adefemi and Awasthi (2016) also list the negative portrayal of obesity as another factor hampering a change in behavior regarding obesity. Furthermore, Sparling (2007) argues that all students should be educated about obesity and how to combat it, and notes that resources to help students can be provided in a sensitive, nonjudgmental, and professional manner.

Based on the literature reviewed, the guidelines shown in Table 2 regarding message and content, design development, and testing, were taken into account for the development of effective, accessible and attractive motion graphics, as discussed next.

	GUIDELINES FROM THE LITERATURE	
Message & Content	• Provide information in a sensitive, non-judgmental and professional manner. • Give an account of specific region and culture specific factors. • Communicate facts on obesity and unhealthy lifestyle (diet and exercise) of relevance to university students. • Offer obesity prevention solutions and healthy lifestyle changes specific and accessible to university students. • Discourage consumption of sugar-dense soft drinks, fatty snacks and fast food, but promote healthier and accessible alternatives to university students. • Attempt to persuade university students to follow a healthy diet and lifestyle.	• Sparling 2007 • Wengreen and Moncur 2009 • Walls et al. 2011 • Deliens et al. 2014 • Adefemi and Awasthi 2016
Motion graphics	• Avoid excess movement, high speed, motion effects for type in motion. • Avoid too much text in the same frame. • Use sans serif typefaces to maximize legibility. • Consider the conceptual interplay between typography, voice over and images. • Carefully select colors for type and graphic elements in order to create sufficient contrast between elements, and between elements and background. • Use color to differentiate levels of meaning and significance. • Emphasize information by manipulating time (slowing or speeding it up). • Illustrate the relationships amongst different pieces of information. • Direct viewers to selected pieces of information in order to help minimize misunderstanding. • Use language and sound to support or emphasize the graphic elements, as well as establish a personal connection with the viewer. • The viewer has a limited amount of time available to perceive the content, and different viewers perceive information at different rates. • Sequences that are too long will tire the viewers. • Consider established principles of motion design (e.g. timing, anticipation, staging, exaggeration, secondary action, squash & stretch, etc.) • Use motion as a design tool to support usability.	• Lasseter 1987 • Tufte 2004 • Finke et al. 2012 • Strizver 2014 • Lodigiani 2014 • Pannafino 2015 • Stones and Gent 2015 • Landa 2016 • Willenskomer 2017
Usability Testing	• Conduct several iterations and at the various stages of the design process to find and fix problems along the way. • Low-fidelity prototypes (e.g. story boards) can be used at earlier stages of the design process, gradually moving to high fidelity prototypes (e.g. computer prototypes) at later stages. • Test approximately 5 participants in each iteration (3 to 7 should be acceptable). • Test a mix of former and new participants to get both validation and new insights. • Use open-ended questions as they allow more discovery than was anticipated, and even provide problem-solving strategies • Make design changes based on user feedback, as well as usability guidelines and design principles from published research and design practice. • Test the motion graphics after implementation because subtle problems always appear even during implementation.	• Nielsen 2012 • Mou et al. 2013 • Ross 2015 • Farrell 2016 • Pernice 2016

Table 2 Guidelines from the literature to inform the content of the motion graphics, its design and usability testing.

4 Design development and testing

With the aim of creating effective motion graphics with the viewer at the heart of design development, usability testing was chosen for this study. Although usability testing has been primarily associated with web and mobile design, it is a key factor in the design and testing of all design outputs in the field of information design. The reason being that, for information to have impact, it must be easy to find, simple to use, instantly understandable (as defined by the Information Design Association, IDA), relevant, clear and memorable (as defined by informationdesign.org). Moreover, usability testing primarily explores usability features such as task completion, task time and errors, but can also explore other features that are part of the user experience such as participants' feelings about a design output, the problems that users encounter, and whether the design meets user needs (Ross 2015).

The various steps of development, testing and iteration are explained below. Participant information for each usability test is shown in Table 3. Problems raised by participants were always addressed before moving on to the next iteration stage.

Iteration 1 – Initial storyboard. At the start of the design process, a storyboard was developed based on the literature review and primary research conducted during the scoping study. The initial storyboard was then tested and feedback was obtained individually. Participants agreed that the first facts on obesity should be general and extracted from organizations such as WHO (World Health Organization). They further thought that it was important to include scenes that directly relate to students' university lifestyle.

Iteration 2 – Final storyboard. The revised and final storyboard was developed and tested. Participants' main feedback was that the solution to tackle obesity was too general. Instead, it should be tailored to university students and focus on how to help them change their lifestyle.

		N	Nationality	Gender	Age	Level	Weight
DEVELOPMENT & TESTING	**Storyboard 1**	5	0 British 5 International	4 F 1 M	23-30	1 UG 4 PG	3 Normal 2 Overweight
	Storyboard 2	6	1 British 5 International	4 F 2 M	20-30	2 UG 4 PG	3 Normal 3 Overweight
	Static frames	3	1 British 2 International	2 F 1 M	23-30	0 UG 3 PG	2 Normal 1 Overweight
	Motion graphics 1	7	1 British 6 International	5 F 2 M	20-30	1 UG 6 PG	5 Normal 2 Overweight
	Motion graphics 2	22	3 British 19 International	16 F 6 M	22-43	0 UG 22 PG	17 Normal 5 Overweight

Table 3. Participant details for all usability tests.

Iteration 3 – Static frames. Static frames were developed and tested consisting of six main sections. The first section was a light introduction to obesity, showing a fictional future where society is highly developed but people have become very obese. The second section introduced the context of obesity around the world and then specifically in the UK. The third section presented facts on how university students are exposed to an unhealthy food environment and lifestyle. The fourth section presented the questionnaire-based survey results. The fifth section visualized four bad habits. The sixth section presented solutions for university students to deal with or prevent obesity – healthy diet and free exercise activities. Feedback was obtained individually and problems identified by participants were mainly related to inadequate color combinations and inadequate font size.

Iteration 4 – Motion graphics. Usability is defined by the International Organization for Standardization (ISO, 2013) as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (ISO, 2013, Introduction).

The fully developed and finished motion graphics was tested to evaluate four categories through a series of set questions following ISO's (2013) guidelines: (1) Effectiveness – Is the motion graphics successful in producing the intended result? Questions asked enquired about the theme, target audience and purpose

of the motion graphics, and initial reaction to the motion graphics (including whether sound and visual effects were delivered effectively); (2) Efficiency – Is the motion graphics successful in achieving maximum understanding with minimum wasted effort? Questions asked enquired about speed of reading and understanding the information, calling attention to typography, font size and color scheme, as well as the identification of any confusing sections; (3) Satisfaction – Is the motion graphics successful in fulfilling user expectations and needs. This was ascertained through an Appraisal Words Chart, based on Travis (2009); (4) Emotion – How do users feel after watching the motion graphics? This was ascertained through an Emotional Words Chart based on the "wheel of emotional words" devised by Onesimusix (2015). The wheel contains a bigger number of negative than positive emotions/experiences because, according to Onesimusix (2015), people have limited emotional vocabulary and cannot describe their feelings, especially their negative feelings.

Feedback from participants helped with further improvements, both in design and message. Useful comments from participants helped improve weaknesses with some transitions that were thought to be too quick, some color contrasts that were thought to be a bit too weak, some motion effects that were thought not to be sharp and evident enough, the suggestion that a palette with a few less colors could be used, and some slight changes in the wording and quantities relating to fat content in food.

Beyond these occasional changes, the feedback was positive overall with comments including: the information in the motion graphics was easily and quickly understood; there were no offensive graphics and words; the color and cartoon design were adequate to help understand the message clearly (e.g., the brighter color used when introducing the data on obesity); the sound, visual, and motion effects helped the viewer to understand the data and facts; the style was friendly; overall the color choices were suitable and the text was readable.

Participants were also asked to choose 3 words from the Appraisal Word Chart to describe the motion graphics – Satisfaction, and three words from the Emotional Word Chart to describe how they felt after watching the motion graphics – Emotion. Words chosen for Satisfaction and Emotion can be seen in Figure 1 in the shape of a word cloud, where biggest font size corresponds to the most selected words. Overall, the feedback was very positive despite the "wheel of emotional words" containing more negative than positive words. Moreover, participants were clearly surprised by the facts given in the motion graphics. When asked whether they were willing to share the motion graphics with their friends and family, participants were all unanimous in saying yes.

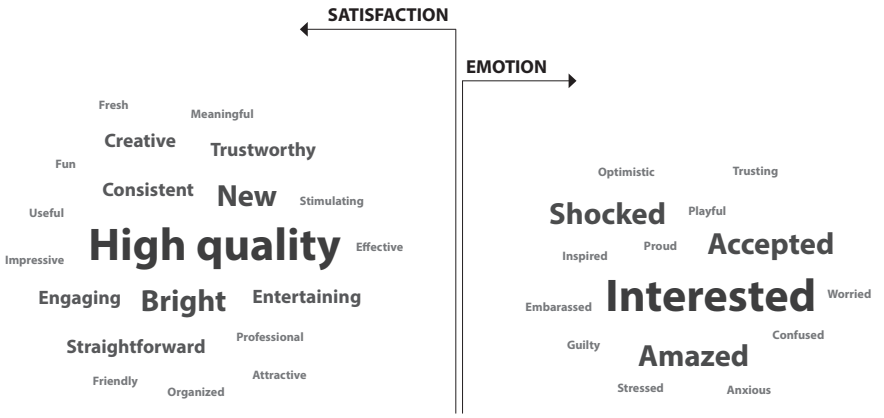

Figure 1 Word cloud – results from Iteration 4.

Iteration 5 – Implemented motion graphics. As advised by Nielsen (2012), the final stage of the usability testing was to implement the motion graphics by uploading it to Vimeo, a global video-sharing website in which users can upload, share and view videos. The motion graphics "Your weight matters" was then shown to a group of 22 new participants who had arrived at the University of Leeds approximately 3 to 5 months earlier to do their degree, and had just been exposed to environmental influences regarding diet and lifestyle. The same four categories – Effectiveness, Efficiency, Satisfaction and Emotion were ascertained. The video was shown to all participants at the same time and then each participant filled in the questionnaire individually, which contained a similar set of open questions as in Iteration 4.

Feedback from participants showed that there were still some minor improvements needed. In terms of Effectiveness, overall participants understood that the purpose of the motion graphics was to raise awareness and prevent obesity by eating healthily and changing lifestyle. In terms of reaction to the motion graphics, comments included: "Easy to understand with relaxing and joyful feeling."; "Wow, I didn't expect the data from Leeds University."; "It's cute and easy to attract people's attention."; There is a lot of useful information on the video."; "Clear on how to eat healthy food.".

In terms of Efficiency, all participants said they could understand the motion graphics and almost all said they could understand the information very quickly. Comments were: "I can follow the voiceover with the moving animation simultaneously."; "It's ok for me as an international student." All participants also said that the audio and visual effects helped them to understand the information and both font style and size were easy to read. Although two thirds of participants said there were no problems with the color scheme, one third of

participants were of the opinion that in a few places the color combination was still inadequate. As found by Stones and Gent (2015) in their health infographics studies, color was always the design feature most mentioned and the one that needed more stages of refinement. Regarding Satisfaction and Emotion, the feedback was once again overall very positive. Words chosen for Satisfaction and Emotion can be seen in Figure 2 in the shape of a word cloud.

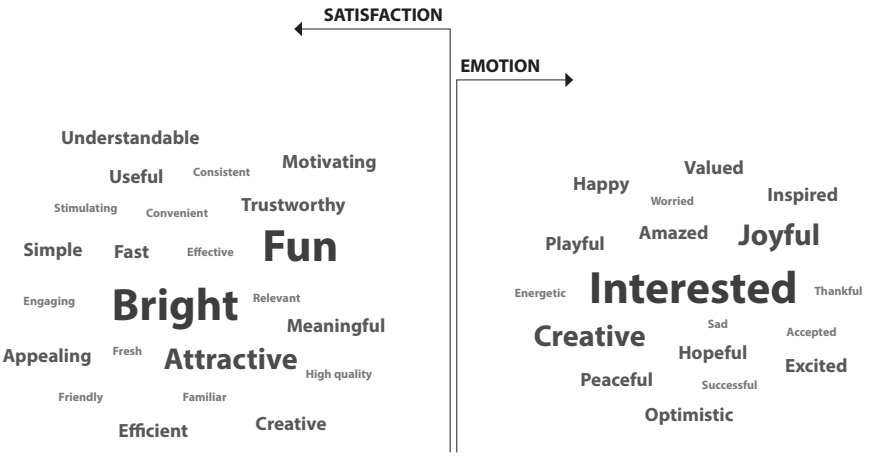

Figure 2 Word cloud – results from Iteration 5.

5 Evaluation

A performance test was devised in order to evaluate the impact of the completed motion graphics (Figure 3 and video), specifically regarding: (a) student awareness of issues related to obesity, nutrition and healthy eating choices prior to watching the motion graphics; (b) the impact of the motion graphics on understanding and recall of information; (c) opinion regarding the design and content of the motion graphics; and (d) the level of influence of watching the motion graphics on their future lifestyle approach.

Figure 3 Main sections of the motion graphics.

5.1 Method

5.1.1 Participants. Ninety-two participants completed the performance test: 59 female, 33 male; and 49 British, 43 International. All participants were students at the University of Leeds and their average age was 22.5 years.

5.1.2 Procedure and materials. Participants were tested individually and were asked to answer a set of questions on: (a) Obesity – general facts as published by WHO; (b) Nutrition – daily allowance of fat and sugar and the number of calories, fat and sugar in one of the most popular meals among students at the University of Leeds – the Meal Deal; (c) Healthy eating – healthy eating choices students should make in terms of snacks, drinks and treats. Participants were then asked to watch the motion graphics and answer the same set of questions again, but this time based on the information provided on the motion graphics. At the end of the performance test, participants were also asked to give their opinion regarding design, content and influence of the motion graphics on their future behavior.

5.1.3 Experimental Design and Measures. A paired samples t-test was used to compare knowledge before and after watching the motion graphics. Performance was measured by accuracy, the number of correct answers. In order to remove the element of guessed answers, La Barge's (2007) novel approach informed this method. After each question, participants were asked whether they knew the answer or whether they guessed the answer. In this way, it was possible to better quantify knowledge prior to participants watching the motion graphics. As for opinion, questions were designed using a five-point Likert scale.

5.2 Results

5.2.1 Accuracy. There was a significant difference in the number of correct answers for pre-test and post-test conditions. This was true for both accuracy measurements: (A) when including all correct answers – pre-test (M=5.0, SD=1.20) and post-test (M=6.9, SD=1.38) conditions, $t(91) = -13.727$, $p < 0.001$; (B) when excluding guessed answers, following La Barge's (2007) approach and counting guessed answers as inaccurate – pre-test (M=2.7, SD=1.18) and post-test (M=6.9, SD=1.38) conditions, $t(91) = -25.542$, $p < 0.001$. The same significant results were found for all male, female, British and international students (Table 4.1, Table 4.2 and Figure 4). These results clearly suggest that receiving tailored information through a motion graphics is an effective way for university students to understand and recall information.

		ACCURACY_ALL						
		N	M	SD	t	df	S	p
ALL	**Pre-test**	92	5.0	1.20	-13.727	91	.000	< 001
	Post-test		6.9	1.39				
FEMALE	**Pre-test**	59	5.1	1.17	-12.587	58	.000	< 001
	Post-test		7.2	1.03				
MALE	**Pre-test**	33	4.7	1.25	-6.546	32	.000	< 001
	Post-test		6.4	1.78				
BRITISH	**Pre-test**	49	5.3	.99	-12.990	48	.000	< 001
	Post-test		7.5	.86				
INTERNATIONAL	**Pre-test**	43	4.5	1.29	-7.284	42	.000	< 001
	Post-test		6.2	1.55				

Table 4.1 T-test results for accuracy, measured by the number of correct answers.

		ACCURACY_EXCLUDING GUESSED ANSWERS						
		N	M	SD	t	df	S	p
ALL	**Pre-test**	92	2.7	1.18	-25.542	91	.000	< 001
	Post-test		6.9	1.39				
FEMALE	**Pre-test**	59	2.8	1.12	-22.389	58	.000	< 001
	Post-test		7.2	1.03				
MALE	**Pre-test**	33	2.5	1.27	-13.212	32	.000	< 001
	Post-test		6.4	1.78				
BRITISH	**Pre-test**	49	2.8	1.04	-25.537	48	.000	< 001
	Post-test		7.5	.86				
INTERNATIONAL	**Pre-test**	43	2.5	1.33	-13.942	42	.000	< 001
	Post-test		6.2	1.55				

Table 4.2 T-test results for accuracy, measured by the number of correct answers, excluding guessed answers.

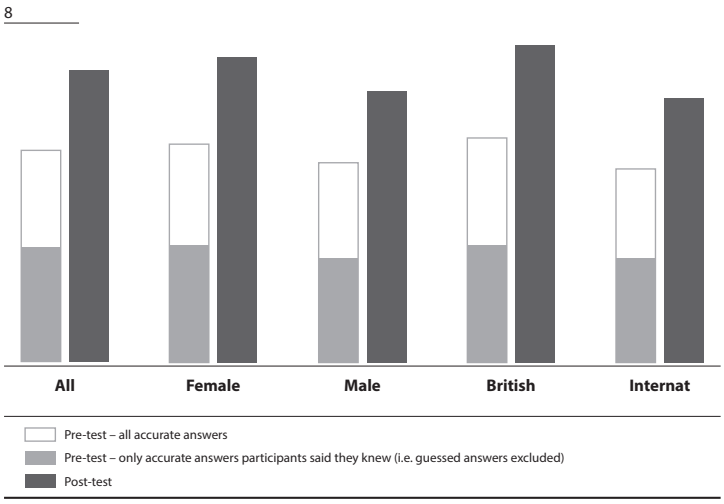

Figure 4 Mean accuracy, measured by the number of correct answers. Comparison between pre- and post-test.

5.2.2 Pre-knowledge. As the mean values reveal, knowledge prior to watching the motion graphics was low. This was true regarding both general obesity information and nutritional information (Table 5 and Figure 5). Although participants had a minimum knowledge about total number of calories in food, they knew little about quantities of sugar and fat in food and daily allowance of fat and sugar. However, participants had a fairly good knowledge on healthy eating and what options are healthier for snacks, drinks and treats. These results show a need to inform university students better about general obesity issues and consumption of fat and sugar.

	PRE-KNOWLEDGE								
	N	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**
Said knew answer	92	7	5	29	13	15	87	76	63
Said knew answer but got it wrong		3	2	8	5	11	5	2	8
Said knew answer and got it right		4	3	21	8	4	82	74	55

Multiple-choice questions (3 choices per question)

Q1. According to the World Health Organisation (WHO) how many people were **OVERWEIGHT** in 2014?
Q2. According to the World Health Organisation (WHO) how many people were **OBESE** in 2014?
Q3. The 'Meal Deal' (e.g. cheese sandwich + small pack crisps + regular coke) is a very popular choice among Leeds University students. How many **CALORIES** on average does a 'Meal Deal' contain?
Q4. How much **FAT** and **SUGAR** does the same 'Meal Deal' have on average?
Q5. How much of the **DAILY ALLOWANCE** of fat and sugar for adults, does the same 'Meal Deal' contain on average?
Q6. What should students **REPLACE** sugary **DRINKS** with?
Q7. What should students **TREAT** themselves with instead of crisps andsweets?
Q8. What should students eat when hungry that makes them feel **FULL FOR LONGER**?

Table 5 Mean accuracy, measured by the number of correct answers. Results shown per question, for answers given before watching the motion graphics and that participants said they knew (not guessed).

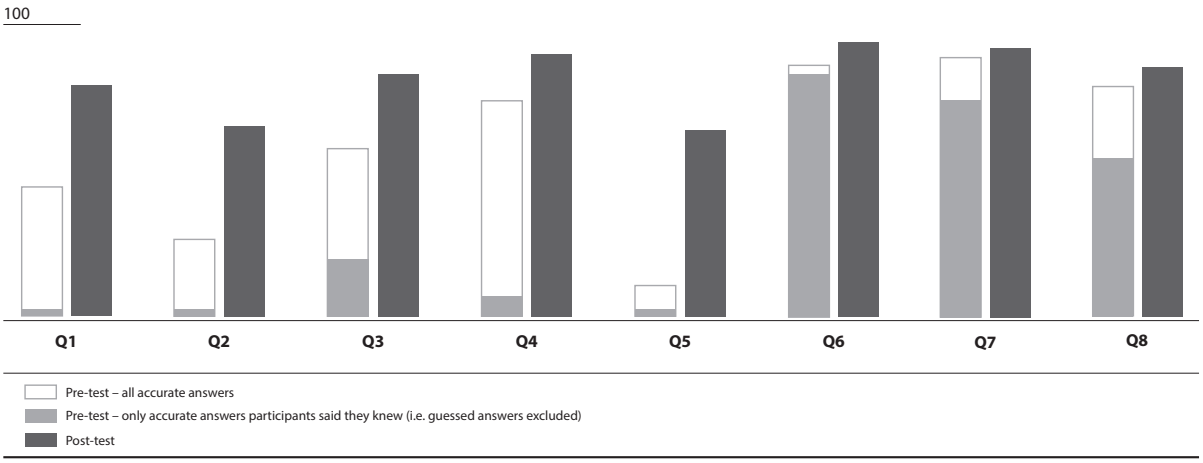

Figure 5 Number of correct answers per question. Comparison between pre- and post-test.

5.2.3 Opinion. As shown in Table 6 and Figure 6, the majority of participants agreed that information presented through a motion graphics is engaging and clear (89%-91%). The majority also agreed that tailored information for university students is helpful and meaningful (73%-89%). Although high, the lowest value was for whether the motion graphics encourages them to live a healthy lifestyle (64%). These results suggest that a motion graphics with tailored information is perceived as an effective tool for raising awareness and educating university students about obesity prevention. Although effective at encouraging students to live a healthy lifestyle, other complementary interventions could strengthen this information design strategy further.

	OPINION					
	N	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Op1. Engaging	92	0%	3%		48%	41%
		3%		**8%**	**89%**	
Op2. Clear	92	0%	2%		31%	60%
		2%		**7%**	**91%**	
Op3. Meaningful	92	1%	6%		28%	61%
		7%		**4%**	**89%**	
Op4. Tips helpful	92	1%	9%		32%	41%
		10%		**17%**	**73%**	
Op5. Encouraged to change	92	3%	2%		39%	25%
		5%		**30%**	**64%**	

Op1. Information is **ENGAGING** when presented through a motion graphics.
Op2. Information is **CLEAR** when explained in a visual manner.
Op3. Information specific to student lifestyle at the University of Leeds is more **MEANINGFUL** than general information.
Op4. TIPS on how to live a healthy lifestyle while studying at University are helpful.
Op5. Watching the motion graphics has **ENCOURAGED** me to live a healthy lifestyle while studying at University.

Table 6 Participant opinion regarding design, content and influence of motion graphics on their future behaviour. Results show percentages for all five levels of agreement.

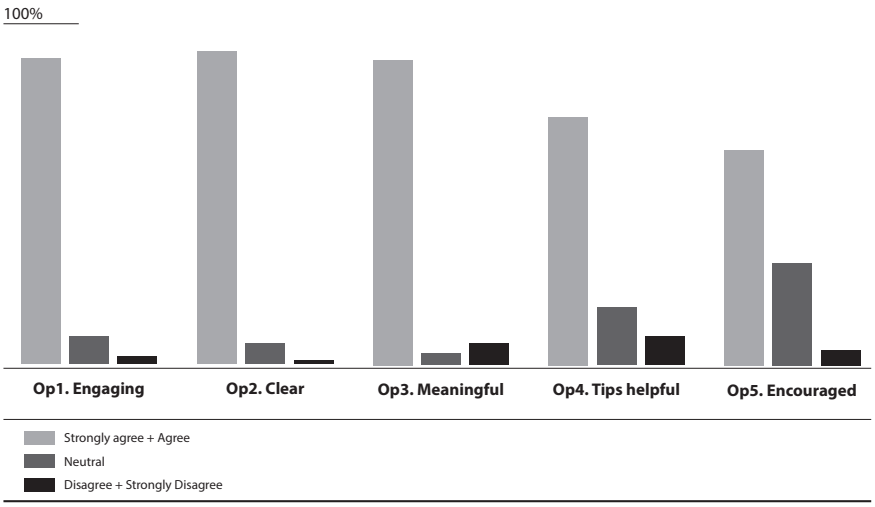

Figure 6 Participant opinion regarding design, content and influence of motion graphics on their future behaviour. Results converted into three levels only to show percentage of agreement and disagreement.

6 Discussion and conclusion

This is the first research study to propose an information design intervention using a motion graphics as an alternative communication tool to social marketing campaigns and community-based approaches. The purpose of such an intervention being to educate and raise awareness of obesity prevention among university students, who are considered a high-risk group. Moreover, it offers an innovative user-centered solution developed through a thorough design and research process which involved: (1) defining the problem, as well as the core message and content of the information design output in consultation with the users; (2) identifying in the literature and by observing and speaking with the user, the most appropriate information design output and the relevant design features for its success (in this case a motion graphics); (3) conducting usability testing at the various stages of the design process; (4) conducting a performance test to validate the output further; and (5) involving real and suitable users in all testing conducted.

The result, according to participant performance, is a clear and accessible motion graphics capable of delivering tailored information on obesity prevention in an effective way. The performance test results revealed a low level of knowledge about obesity issues prior to watching the motion graphics, but a high level of knowledge, understanding and recall of information after watching the motion graphics. Moreover, according to participant opinion, the motion graphics is clear and engaging in terms of design; meaningful and helpful in terms of tailored content; and influential in terms of encouraging university students to live a healthy lifestyle. This evidence therefore strongly supports the use of a tailored motion graphics as a powerful communication tool suitable to inform and raise awareness about obesity prevention among university students.

Overall, this research has high impact. In **academic** terms, this research is a significant contribution to information design research in general, and motion

graphics design and health communications specifically. This is not just because it presents research-based guidance and provides empirical evidence in support of information and motion design principles, but also because it is user-centered. There is a general consensus within the field of design that all design is user-centered, because we all design with the user in mind. However, user-centered design should be more than having the user in mind. We should 1) design for the user (identify who the user is and what their needs and motivations are); but also 2) design with the user (involve the user in every stage of the research and design process); and make sure we 3) implement what works for the user (after identifying the final design solution, implement it and test it for impact). This is exactly what this study offers, a "complete user-centered" design solution.

In **practical** terms, this study offers a ready-made solution for universities and health services to grab student attention and communicate complex information effectively that, in addition to being user-centered, can be either global or region and culture-specific. It also offers research-based guidance for information designers and design practitioners in general, which is much required in the field of design. The interplay between scientific research and practice delivers the most valid and reliable design solutions. As argued by some experts in the field of design (Hartley et al 2006; Beier 2012; Dyson 2013; Beier and Dyson 2014; Lonsdale 2014a, 2014b and 2016; Dillon 2017), and as shown through this study, design practice can inform the design of outputs and testing materials. Scientific studies, on the other hand, are able to provide concrete and tangible evidence regarding the problem and needs of the user, as well as on the impact of the final output. In conclusion, by following research-based guidance combining both practical knowledge and scientific analysis, design practitioners are better equipped to claim the validity and impact of their creations.

In terms of **research methodology**, this study also makes a significant contribution to knowledge. User-centered methods beyond product design, and usability testing beyond UI and UX design, are still emerging approaches and little guidance targeting information design research and practice is available. Dyson (2017) is one of the few exceptions, by proposing a framework for describing approaches used in information design research with the intention to enable students, teachers, researchers, and practitioners to choose their own research method. As shown in Figure 7, the research and design process followed in this study was extremely comprehensive and thorough and entirely user-centered. Moreover, various research methods were brought together at each stage of the process with the aim of gathering solid evidence and consequently increasing the validity and reliability of the outcomes. Such research and design process has the potential to serve as a model for the development of future user-centered information design research and design solutions.

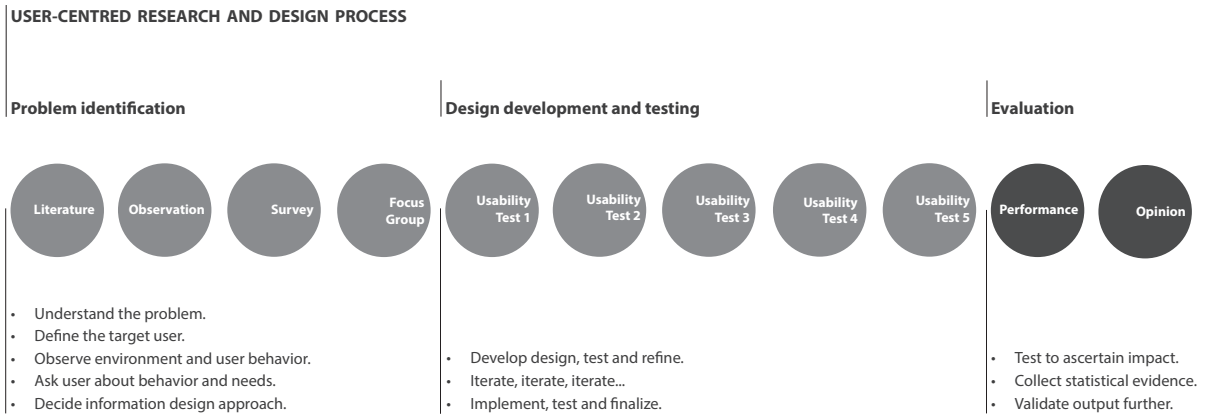

Figure 7 Overview of the user-centred research and design process followed.

In **theoretical** terms, this paper advances the theoretical debate in the field of information design. Despite information being an integral part of our lives and of extensive proportions, when compared to practical contributions, theoretical contributions fall short. This is illustrated in the book "Information Design: Research and Practice" (Black et al. 2017). The book, which is an excellent account of where the field of information design has come from and its current status, has 19 sections devoted to practical applications of information design, and only 7 sections that discuss theoretical approaches. Therefore, this paper and all its content, findings and discussion, add another layer to theories in the field of information design.

Finally, in terms of **future research**, two directions are proposed. The first is to ascertain long-term impact. The objective of this study was to ascertain whether students understood and remembered a message, as well as whether they were encouraged to follow a healthier diet and lifestyle. However, in the long run the ultimate goal for interventions aimed at tackling obesity among university students is adherence. According to Houts et al. (2006) "adherence involves two steps: accepting the message as something the person should act on and then actually carrying out the recommended actions." Therefore, a follow up and long term study would be needed to measure this.

Connected to this is the second direction for further research. This study offers strong evidence that a motion graphics is a very efficient tool to communicate

obesity prevention to university students. However, as suggested by results from participant opinion, encouraging students to live a healthy lifestyle while at university was, although still successful, the least successful result. As found by designers Ed O'Brien, Dora Drimalas and Brian Flynn in their project "Impact Teen Drivers", not every design output resonates with every student (Simmons 2011). Sometimes there is a need to produce a variety of materials in a wide range of media and formats to improve the effectiveness of a project. Therefore, the development and testing of other companion design outputs to the motion graphics could be ascertained, as a means of complementing and further strengthening an innovative information design intervention to help prevent obesity among university students, especially for long term impact and adherence.

In conclusion, this study reveals that motion graphic design can enhance the delivery of information in a quick, clear, effective and efficient way when user context (experiences and opinions) is determined, motion graphics design principles and theories (from both research and practice) are considered, and usability testing, involving various stages of iteration and close consultation with the user, is conducted. Therefore, this study is the first step towards a more tailored, accessible and effective approach to tackle obesity among a high-risk group such as university students. Due to the interdisciplinary nature of this research, the findings presented in this paper are a significant contribution to knowledge in the fields of information design and obesity.

7 References

Adefemi, K. & Awasthi, K.J. (2016). What works? Review of current health communication strategies for obesity control. *The International Journal of Communication and Health*, 8, 80-85.

American College Health Association. (2008). National College Health Assessment spring 2007 reference group data report. *Journal American College Health*, 56, 469-79.

Babic, N., Pibernik, J. & Mrvac, N. (2008). Media Study: Motion Graphics. *50th International Symposium ELMAR-2008, 10-12 September 2008*, Zadar, Croatia. Croatia, 499-502.

Beier, S. (2012). *Reading letters: designing for legibility*. Amsterdam: BIS.

Beier, S. & Dyson, M.C. (2014). The influence of serifs on 'h' and 'i': useful knowledge from design-led scientific research. *Visible Language*, 47(3), 74-95.

Bellato, N. (2013). Infographics: A visual link to learning. *eLearn*, 12(1). [Online]. [Accessed 9 January 2017]. Available from: http://elearnmag.acm.org/featured.cfm?aid=2556269

Black, A., Luna, P., Lunda, O. & Walker, S. (Eds). (2017). *Information Design: Research and practice*. London: Routledge (Taylor and Francis Group).

Brigas, J. & F. Ramos. (2015). As infografias como ferramentas auxiliares para o ensino/aprendizagem. *Revista de Comunicación de la SEECI*, 19(36), 178-184.

Buckley, J.P., Hedge, A., Yates, T., Copeland, R.J., Loosemore, M., Hamer, M., Bradley, G. & Dunstan, D. W. (2015). The sedentary office: a growing case for change towards better health and productivity. Expert statement commissioned by Public Health England and the Active Working Community Interest Company. *British Journal of Sports Medicine*. 49(21), 1357-1362.

Cluskey, M. & Grobe, D. (2009). College weight gain and behavior transitions: male and female differences. *Journal American Diet Association*, 109(2), 325–329.

Crook, I. & Beare, P. (2015). *Motion graphics. Principles and practices from the ground up*. London: Bloomsbury.

Deliens, T., Clarys, P., De Bourdeaudhuij, L. & Deforche, B. (2014). Determinants of eating behaviour in university students: a qualitative study using focus group discussions. *BMC Public Health*, 14(53), 1-12.

Deliens, T., Deforche, B., De Bourdeaudhuij, I. & Clarys, P. (2015). Changes in weight, body composition and physical fitness after 1.5 years at university. *European Journal of Clinical Nutrition*, 69, 1318–1322.

Delp, C. & J. Jones. (1996). Communicating information to patients: The use of cartoon illustrations to improve comprehension of instructions. *Emergency Medicine*, 3(3), 264-270.

Dillon, A. (2017). Applying science to design: The quest for the bridging representation. In: Black, A., P. Luna, O. Lunda, Walker, S. (Eds). *Information Design: Research and practice* (pp. 291-299). London: Routledge (Taylor and Francis Group).

Dixon, J.B. (2010). The effect of obesity on health outcomes. *Molecular and Cellular Endocrinology*, 316, 104–108.

Dyson, M. C. (2017). Information design research. Why, when, who, what, and how? In: Black, A., P. Luna, O. Lunda, Walker, S. (Eds). *Information Design: Research and practice* (pp. 435-449). London: Routledge (Taylor and Francis Group).

Finke, T., Manger, S. & Fichtel, S. (2012). *Informotion. Animated infographics*. Berlin: Gestalten.

Guo, S.S., Wu, W., Chumlea, W.C. & Roche, A.F. (2002). Predicting overweight and obesity in adulthood from body mass index values in childhood and adolescence. *American Journal Clinical Nutrition*, 76(3), 653–8.

Hartley, J., Trueman, M., Betts, L. & Brodie, L. (2006). What price presentation? The effects of typographic variables on essay grades. *Assessment & Evaluation in Higher Education*, 31(5), 523-534.

Höffler, T.N. & Leutner, D. (2007). Instructional animation versus static pictures: A Meta- Analysis. *Learning and Instruction*, 17(6), 722-738.

Houts, P.S., Doak, C.C., Doak, L.G. & Loscalzo, M.J. (2006). The role of pictures in improving health communication: a review of research on attention, comprehension, recall, and adherence. *Patient Education and Counseling*, 61, 173–190.

Hsueh, C., Chou, J. & Ma, K. (2016). A Study of using motion for comparative visualization. In: *IEEE Pacific Visualization Symposium 2016*, 19–22 April, Taipei, Taiwan. California: IEEE, 219-223.

ISO – The International Organization for Standardization. (2013). ISO/TS 20282-2:2013(en). Usability of consumer products and products for public use — Part 2: Summative test method. [Online]. [Accessed 28 January 2016]. Available from: https://www.iso.org/obp/ui/#iso:std:iso:ts:20282:-2:ed-2:v1:en

Krasner, J. (2013). *Motion graphic design. Applied history and aesthetics* (3rd ed.). London: Focal Press, Taylor & Francis Group.

La Barge, G. (2007). Pre- and post-Testing with more impact. *Journal of Extension*, 45(6). [Online]. [Accessed 14 April 2017]. Available from: https://www.joe.org/joe/2007december/iw1.php

Landa, R. (2016). *Advertising by design. Generating & designing creative ideas across media* (3rd ed.). New Jersey: Wiley.

Lasseter, J. (1987). Principles of traditional animation applied to 3D computer animation. *Computer Graphics*, 21(4), 35-44.

Lloyd-Richardson, E.E., Bailey, S., Fava, J.L. & Wing, R. (2009). A prospective study of weight gain during the college freshman and sophomore years. *Preventive Medicine*, 48, 256–261.

Lofti, S.I. (2015). Prevalence and risk factors of obesity and overweight among Taif University Students, Taif, Saudi Arabia. *International Journal of Public Health and Epidemiology*, 4(1), 98-106.

Lonsdale, M. d S. (2014a). The effect of text layout on performance. A comparison between types of questions that require different reading processes. *Information Design Journal*, 21(3), 279-299.

Lonsdale, M. d S. (2014b). Typographic features of text: outcomes from research and practice. *Visible Language*, 48(3), 29-67.

Lonsdale, M. d S. (2016). Typographic features of text and their contribution to the legibility of academic reading materials: An empirical study. Visible Language, 50(1), 79-111.

Nelson, M.C., Kocos, R., Lytle, L.A. & Perry, C.L. (2009). Understanding the perceived determinants of weight-related behaviors in late adolescence: a qualitative analysis among college youth. *Journal Nutritional Education Behavior*, 41(4), 2, 87–292.

Marquis, M. (2005). Exploring convenience orientation as a food motivation for college students living in residence halls. *International Journal Consumer Studies*, 29(1), 55–63.

Mokdad, A.H., Serdula, M.K., Dietz, W.H., Bowman, B.A. Marks, J.S. & Koplan, J.P. (1999). The spread of the obesity epidemic in the United States. *JAMA*, 282, 1519-22.

Musselman, R.W. (2013). *Effect of ornamentation on the emotional response and perception of motion graphics*. MA Dissertation, Virginia Polytechnic Institute and State University.

NHS Choices. (2014). *What are 'reference intakes' on food labels?* [Online]. [Accessed 13 January 2017]. Available from: http://www.nhs.uk/Livewell/Goodfood/Pages/reference-intakes-RI-guideline-daily-amounts-GDA.aspx

NHS Choices. (2015). *Hidden causes of weight gain*. [Online]. [Accessed 13 January 2017]. Available from: http://www.nhs.uk/Livewell/loseweight/Pages/Puttingonweight.aspx

Nielsen, J. (2012). Usability 101: Introduction to Usability. *Nielsen Norman Group*. [Online]. [Accessed 28 January 2016]. Available from: https://www.nngroup.com/articles/usability-101-introduction-to-usability/

Occa, A. & Suggs, S. (2016). Communicating breast cancer screening with young women: An experimental test of didactic and narrative messages using video and infographics. *Journal of Health Communication*, 21, 1–11.

Onesimusix. (2015). *'I Feel' - Emotional Word Wheel*. [Online]. [Accessed 9 November 2016]. Available from: http://imgur.com/gallery/q6hcgsH

Ozdaml, F., Kocakoyuna, S., Sahina, T. & Akdaga, S. (2016). Statistical reasoning of impact of infographics on education. *Procedia Computer Science*, 102(2016), 370–377.

Pannafino, J. (2015). 12 Basic Principles of Animation in Motion Design. *HOW Magazine*. [Online]. [Accessed 10 January 2016]. Available from: http://www.howdesign.com/web-design-resources-technology/12-basic-principles-animation-motion-design/

Pernice, K. (2016). UX Prototypes: Low Fidelity vs. High Fidelity. *Nielsen Norman Group*. [Online]. [Accessed 10 January 2016]. Available from: https://www.nngroup.com/articles/ux-prototype-hi-lo-fidelity/

Pliner, P. & Saunders, T. (2008). Vulnerability to freshman weight gain as a function of dietary restraint and residence. *Physiology & Behavior*, 93, 76–82.

Ross, J. (2015). 17 usability testing myths and misconceptions. *UXmatters*. [Online]. [Accessed 15 January 2017]. Available from: http://www.uxmatters.com/mt/archives/2015/01/17-usability-testing-myths-and-misconceptions.php

Shafipoor, M., Sarayloo, R. & Shafipoor, A. (2016). Infographic (information graphic); a tool for increasing the efficiency of teaching and learning processes. I*nternational Academic Journal of Innovative Research*, 3(4), 39-45.

Shaw, A. (2016). *Design for motion. Fundamentals and techniques of motion design*. Oxon: Focal press.

Shir, M.F.D. & Asadollahi, M. (2014). The role of motion graphics in visual communication. *Indian Journal Science Research*, 7(1), 820-824.

Simmons, C. C. H. (2011). Just design: Socially conscious design for critical causes. Cincinnati, Ohio: How Books.

Sofía, R.B.A., María, T.T.L., del Pilar, P.D.M., Dario, G.H., Adame, N.A.E & Guillermo, O.V. (2015). Prevalence and factors associated with overweight and obesity among university students of the health field in San Luis Potosí México. Health, 7, 328-335.

Sparling, P. B. (2007). *Obesity on campus. Preventing Chronic Disease*. [Online]. 4(3), 1-4. [Accessed 5 January 2017]. Available from: http://www.cdc.gov/pcd/issues/2007/jul/06_0142.htm.

Stones, C. & Gent, M. (2016). *The 7 graphic principles of public health Infographic Design*. AHRC. [Accessed 16 January 2017]. Available from: https://visualisinghealth.com/design-guidelines/

Strizver, I. (2014). *Type rules! The designer's guide to professional typography* (4th ed.). New York: John Wiley and Sons Inc.

The Guardian. (2016). *The chicken shop mile and how Britain got fat* [Online]. [Accessed 11 January 2017]. Available from: https://www.theguardian.com/society/2016/jan/28/chicken-shop-mile-britain-fat-cheap-food-obesity

Travis, D. (2009). Measuring satisfaction: Beyond the usability questionnaire. *Userfocus*. [Online]. [Accessed 14 January 2017]. Available from: http://www.userfocus.co.uk/articles/satisfaction.html

Tufte, E.R. (2004). *The visual display of quantitative information* (2nd ed). Chesire: Graphics.

Vadeboncoeur, C., Townsend, N. & Foster, C. (2015). A meta-analysis of weight gain in first year university students: is freshman 15 a myth? *BMC Obesity*, 2(22), 1-7.

Vadeboncoeur, C., Foster, C. & Townsend, N. (2016). Freshman 15 in England: a longitudinal evaluation of first year university student's weight change. *BMC Obesity*, 3(45), 1-9.

Vella-Zarb, R.A. & Elgar, F.J. (2009). The 'Freshman 5': A Meta-Analysis of Weight Gain in the Freshman Year of College. *Journal of American College Health*, 58(2), 161-166.

Vella-Zarb, R. A. & Elgar, F.J. (2010). Predicting the 'freshman 15': Environmental and psychological predictors of weight gain in first-year university students. *Health Education Journal*, 69(3), 321–332.

Visscher, T.L.S. & Seidell, J.C. (2001). The public health impact of obesity. *Annual Review of Public Health*, 22, 355–75.

Walls, H., Peeters, A., Proietto, J. & McNeil, J. (2011). Public health campaigns and obesity - a critique. *BMC Public Health*, 11(136), 1-7.

World Health Organization (WHO). (2016). *Obesity and overweight*. [Online]. [Accessed 9 January 2017]. Available from: http://www.who.int/mediacentre/factsheets/fs311/en/

Willenskomer. I. (2017). *Creating Usability with Motion: The UX in Motion Manifesto* [Online]. [Accessed March 2017]. Available from: https://medium.com/ux-in-motion/creating-usability-with-motion-the-ux-in-motion-manifesto-a87a4584ddc

Yıldırım, S. (2016). Infographics for Educational Purposes: Their Structure, Properties and Reader Approaches. *TOJET: The Turkish Online Journal of Educational Technology*, 15(3).