

Using Ecological Momentary Assessment to Describe the Daily Fluctuations of Binge-
Watching Behaviour and its' Effect on University Students

Bachelor Thesis

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Abstract

With increasing online on-demand streaming services such as Netflix or Amazon Prime, binge-watching, i.e. watching more than two episodes in one sitting, has become a common leisure activity. There is considerable debate about the addictive potential of binge-watching and its relatedness to risky lifestyle behaviours, such as unhealthy snacking while watching, this possibly contributing to the rise of people being overweight. However, only few reliable studies are available on this topic, which are also limited by their retrospective design. Hence, this study aimed to describe and understand the binge-watching behaviour of university students and its relatedness to the students eating behaviour and weight status. Ecological Momentary Assessment (EMA) was used to collect data from 23 participants on their daily watching and eating behaviour for a period of 15 days. Results showed moderate fluctuations in the watching-time and the binge-watching proportion over the course of the week. On average, students watched 1.49 episodes for about 1.42 hours a day, whereas binge-watching occurred on 36% of these watching occasions. A higher watching-time was associated with a slightly increased beverage consumption and unintended snacking frequency. Students with a higher BMI spent more time watching than participants with a normal weight status. The present study offers a more detailed description of the patterns of binge-watching and its potential relatedness to an unhealthy eating behaviour. EMA appears to be useful and valid to measure these complex everyday behaviours and helps to overcome limitations of previous studies. Nevertheless, further research on this topic is necessary and should include the contextual factors and examine other potential consequences of binge-watching.

Keywords: binge-watching, Ecological Momentary Assessment (EMA), students, BMI, eating behaviour

Introduction

In the past two decades, the worldwide prevalence of individuals being overweight or obese has increased dramatically, with currently around half a billion people (20% of the population) being classified as overweight or obese (Platte, Vögele & Meule, 2014). Being overweight is the cause for many adverse health effects, such as type 2 diabetes, cardiovascular disease, hypertension and cancer which can lead to morbidity and mortality (Boulos, Vikre, Oppenheimer, Chang & Kanarek, 2012). Besides genetic influences, individual lifestyle issues are perceived as the main factors leading to being overweight, for instance an unhealthy eating behaviour and a lack of physical activity. While often being informed about the importance of a healthy nutrition for preventing these diseases, many children and adolescents still consume unhealthy high-caloric foods on a regular basis. Furthermore, due to an increasing sedentary lifestyle, physical inactivity is becoming more common. Many of these harmful habits begin during childhood or adolescence and usually continue into adulthood (Pearson, Ball & Crawford, 2011). In order to prevent the consequences associated with these detrimental lifestyles, it becomes increasingly important to understand the underlying mechanisms by which these are established.

A cross-sectional and prospective study conducted among children and adolescents found a positive relationship between their weight status and the television watching-time (Dietz & Gortmaker, 1985). The prevalence of being overweight rose with increasing time spent on watching television. Since then, many other researchers have found similar results and revealed that watching television influences both the eating behaviour and the time spend on physical activity (Boulos et al., 2012; Pearson et al., 2011; Platte et al., 2014). Meanwhile, by conducting a meta-analysis on 14 cross-sectional studies, Zhang and his colleagues found that with increased watching-time, the likelihood of gaining weight rose by 13% (Zhang, Wu, Zhou, Lu & Mao, 2015). In 1999, Robinson conducted a randomised-controlled trial on school children. The hours of watching television were reduced and the result showed a decrease in their body mass index (BMI). Additionally, a cross-sectional study revealed that children with a higher BMI watched television for longer time periods than peers with a normal weight status (Borghese et al., 2015). Taken together, increasing watching-time leads to a higher BMI, while at the same time, television is watched for longer time periods by people with a higher BMI. However, in his case-control study among students, Al-Ghamdi (2013) demonstrated that up to a certain amount of time, there was no association between watching television and overweight. After three hours of watching however, there was indeed an association between these two.

Among researchers, there is thus a general consensus that a connection exists between the numbers of hours a child or adolescent spends in front of the television and being overweight or obese. Nevertheless, there is a need for differentiation in these findings, as research also suggests this linkage only occurs from a certain time of watching and besides, this may be different for differing age groups.

The mechanisms which explain the positive relationship between the hours spend on watching television and the risk of overweight are manifold. Firstly, a main factor is the inactiveness while watching television. This leads directly into the second issue, the amount of time available for participating in physical activity. Consequently, less energy is used, increasing the likelihood of weight gain (Boulos et al., 2012). Hands et al. (2011) conducted a longitudinal study among children who spent different amounts of time watching television. Their findings demonstrated that two years later, the children who watched more television were less physically active and had higher body mass indices (BMI) than the children who rarely watched television. However, other studies could not replicate these findings and further research has shown that independent of the lack of movement while watching television, a further mechanism which encourages the development of overweight is a process called ‘mindless eating’, triggered while watching television and directly influencing the eating behaviour (Boulos et al., 2012).

While watching television, individuals often lack awareness of their eating behaviour and actual food and beverage consumption. It is estimated that about one third of the everyday food intake is consumed while watching the television (Temple, Giacomelli, Kent, Roemmich & Epstein, 2007), and numerous studies have revealed the negative effects it has on the individual’s eating behaviour. One effect, for example is that television watching while eating results in a rise of the incidences and amount of food eaten (Stroebele & de Castro, 2004). In addition, a laboratory study conducted among children has demonstrated that watching television is related to the type of food consumed by the viewers. Children who watched television while eating consumed more unhealthy food (i.e. pizza and sweetened beverages) than children who less frequently combined these two activities (Coon, Goldberg, Rogers & Tucker, 2001). Interestingly, longitudinal research has shown that even many years later, watching television while eating had led to an increased intake of unhealthy food and beverages (Pearson et al., 2011). As the abovementioned findings indicate, the ‘mindless eating’ behaviour occurring during television viewing does not only negatively influence the type of food eaten but also the actual amount which is consumed.

The negative impact of watching television on an individual's healthy lifestyle behaviour becomes even more concerning with regard to the current trend of watching online series and movies for longer periods of time. In the Netherlands, 60% of people watch television or listen to the radio online (CBS, 2015). This online watching behaviour is furthermore driven by advances in technology and the increasing availability of online on-demand streaming services such as Netflix or Amazon Prime. People no longer have to rely on scheduled television programmes and can access movies and series at any preferable time they want, leading to a trend which is often referred to as binge-watching.

Netflix defines binge-watching as “watching two to six episodes of the same show in one sitting” (Davis, 2016). This definition is often criticized for various reasons, one being that the length of the episodes is not taken into account when classifying a watching-session as binge-watching. Watching three 30 minute episodes could therefore be equally classified as binge-watching as watching the same number of 60 minute episodes.

In addition, there is considerable debate about the term binge-watching itself, as the word bingeing is normally used in the context of negative behaviours such as binge-eating or binge-drinking, these behaviours often being guilt-driven (Riddle, Peebles, Davis, Xu & Schroeder, 2017). However, when asking people how they feel about their binge-watching behaviour, the majority of them do not feel negative towards this (Flayelle, Maurage & Billieux, 2017). In line with this, some researchers are even convinced that binge-watching has a restorative purpose by, for instance, distracting the viewers and letting them escape from their own (negative) thoughts and feelings (Panda & Pandey, 2017). Hence, it is doubtful whether engaging in binge-watching is really guilt-driven and whether one should compare it to other addictive behaviours. Resulting from this debate, the term ‘media-marathon’ has been offered as an alternative (Pierce-Grove, 2016; Pittman, & Sheehan, 2015), though binge-watching is still most commonly found in literature.

Current knowledge regarding the prevalence of binge-watching is limited. Nielsen in 2013, has found that 88% of the people streaming via Netflix and 70% of the Hulu users have reported to once a week, watch at least three episodes on one day. Furthermore, during binge-watching sessions, people stated watching a mean of 2.94 episodes for a mean of 2.51 hours (Walton-Pattison, Dombrowski & Presseau, 2016). In addition, a survey among online on-demand platform users found that people younger than 39 most commonly binge-watched, while people older than 40 only binge-watched on half of their watching occasions (Harris Interactive, 2013). Further research has indicated that especially university students regularly binge-watch (Panda & Pandey, 2017), possibly linked to their flexible time schedule.

There are multiple mechanisms in which binge-watching is promoted, one of them being that online demand platforms, such as Netflix, commonly release entire seasons of a series in one day. This is very different to linear television watching, where only one episode per week is released and people have to rely on certain programme schedules. The opportunity to watch more than one episode already increases the likelihood of binge-watching. A second factor is that Netflix automatically proceeds to the next episode after the preceding one has ended, thus, making it more comfortable for viewers to continue watching. Furthermore, online streaming platforms commonly recommend certain series and movies to the viewer based on the content they have previously watched. This tailoring process increases the likelihood that people find new series and movies which they like and want to watch, hereby increasing watching frequency (Pittman & Sheehan, 2015).

So far, many studies have attempted to demonstrate the negative effects of watching television on people's lifestyle (Coon et al., 2001; Liang, Kühle and Veugelers, 2009; Pearson et al., 2011). However, these studies are predominantly of a cross-sectional design, which have several limitations. Firstly, these studies usually use single measurements of people's watching and eating behaviours. Yet, the lifestyle of adolescents, especially of students is often quite complex and dynamic and daily fluctuations in their behaviours are very common. For example, during the days before an exam, students are probably less likely to engage in binge-watching as they use the time rather to prepare for the exam. At other times though, students may have less responsibilities and more time to watch series or movies. A single, retrospective measurement may therefore not be very suitable to assess these behavioural patterns.

Furthermore, previous studies, such as above-mentioned study of Pearson et al., (2011) use retrospective measures of behaviours, these often being susceptible to several biases, one of the most common being the recall bias, where people fail to accurately report, at a later time, on past events or experiences. This may lead to over- or underestimation of their behaviour and thus, limit the research findings (Wonneberger & Irazoqui, 2017).

A method which could overcome these limitations is Ecological Momentary Assessment (EMA). Within an EMA study, participants repeatedly report on their symptoms, affect, behaviours and cognitions for a certain period of time (Shiffman, Stone & Hufford, 2008). These behaviours and experiences are collected in the context in which they occur, hence in the participants own natural environment. This increases the studies' ecological validity, meaning that the findings are more representative and generalisable. A further characteristic of EMA studies, is that within the participants' reports, their behaviours and

experiences are timely collected, thus minimising the above-mentioned recall bias. Therefore, EMA studies are useful to capture the variety of individual behaviours and experiences and how they fluctuate over time and across different settings.

The first aim of this study, while using EMA, was to describe, in detail, the online watching behaviour among university students and capture the diversity of this new behaviour. This has led to the following research question:

1. *How does the binge-watching frequency of university students vary over the course of a week?*

As previously mentioned, research findings strongly indicate that watching television for longer time periods can negatively influence peoples' eating behaviours. More snacks and beverages are consumed while watching television, this being possibly influenced by a process called 'mindless eating'. Whether these health-related risk behaviours also occur as a result of binge-watching has not yet been examined comprehensively. Despite this lack of research, the term binge-watching inherently holds negative connotations while these have not yet been proven. The current study thus also aimed to examine how binge-watching and healthy lifestyle behaviours, such as the (mindless) eating behaviour are related to each other, resulting in the following research questions:

2. *What is the association between binge-watching and the snack and beverage consumption of university students?*
3. *What is the impact of binge-watching on the unintended snack and beverage consumption of university students?*

In addition, research has shown that watching television increases the risk for gaining weight while at the same time, overweight people already watch television for longer periods of time. However, there is limited research on especially the latter finding and also whether this applies to students and binge-watching. Therefore, the last aim of this study was to examine whether the students with a normal weight status and an overweight status differ in their binge-watching behaviour. This is represented in the fourth research question:

4. *How does binge-watching and the snack and beverage consumption of university students differ between different BMI groups?*

Method

Design

For this study an experience sampling method (ESM) was chosen as a study design. For a period of 15 days, the participants' behaviour was measured in a real-life, real-time setting. Each day, the subjects were asked to report their behaviour of the previous day and their intended behaviour for the next 24 hours, in regard to binge-watching and eating/learning behaviour for every day at a fixed time. The data collection took place between 02.04.2018 and 16.04.2018, whereby all participants participated from day one. The measurement period included the Easter holidays of this year and therefore, consisted out of eight school days and seven non-school days. Through repeated reports from each individual participant, the reliability and statistical power increases. Therefore, a sample size above 20 persons is recommended and seen as sufficient (Kreft & de Leeuw, 1998; Conner & Lehmann, 2012).

Participants

Participants were recruited via convenience sampling and were contacted via social media or face-to-face, as they were mainly family members and friends of the researchers and well known to them. A group of acquaintances was asked to participate, to make it possible to motivate and encourage the participants to fill in the questionnaire regularly. During the study, the students had to fill in a questionnaire in English by using a mobile application. Therefore, it was required that they owned a smartphone and had a sufficient English language proficiency.

Furthermore, this study only included students enrolled in a university who had access to at least one on-demand streaming service and were available for at least ten minutes per day for a period of two weeks. All 23 participants were German nationals, 16 (69.57%) of them were enrolled in Dutch universities and 7 (30.44%) in German universities. Further, the population comprised of 7 males (30.44 %) and 16 females (69.56%). The participants were between 18 and 27 years old and their mean age was 22.52 years (SD=2.43).

Procedure

Firstly, the participants were informed about the duration of the data collection (15 days) and the overall topic of the research (binge-watching). After expressing their willingness to participate in this study, they received an email with more detailed information.

Also included in this email was a link to the baseline questionnaire via the website Qualtrics, this is a subscription software for collecting data.

The experience sampling was conducted via the PACO application (www.pacoapp.com). Within the first email, the participants also received an instruction on how to download this application on their smartphone or tablet. The research team proposed to compare the intended and actual behaviour of the participants in a period of respectively 24 hours. To cover the whole day, it was important that the questionnaire was filled in at the same point in time each day. The participants were therefore asked to fill in the questionnaire once a day between 11 a.m. and 2 p.m. As a reminder to fill in the questionnaire, they received an automated notification on their mobile devices at 11am. Nevertheless, also responses which deviated from this time period were admitted, to take the participants daily routine into account. Thus, all answers given between on the specific calendar day were used for the analysis.

During the two-week data collection period, the participants received three emails with further instructions and reminders to fill in their daily questionnaires. Additionally, the researchers monitored the individual responding rates and reminded the participants via WhatsApp to fill in the questionnaire. No compensation was given to the students.

Measures

Baseline questionnaire. Two different questionnaires were used in this study. Demographic information was collected with the first baseline questionnaire (see Appendix B). This questionnaire started off with an informed consent form and contained 27 questions, regarding information including age, gender, the enrolled university and an overall estimation of their regular binge-watching, eating and study behaviour. Response options were multiple choice, single words or numbers. Filling in the first questionnaire took around 10 minutes.

The variable binge-watching was measured by six items within the baseline questionnaire. They were mostly based on the research of Walton-Pattison et al. (2016) and Riddle et al. (2017), who also researched binge-watching behaviour and therefore, conducted a similar questionnaire. In order to receive an overview of the extent of their on-demand streaming habits, participants had to give an overall estimation of the hours and number of days per week they spent on watching online series and movies (i.e. 'On average, how many hours do you watch online series and movies per week?'). Furthermore, to receive a clearer insight into the students' binge-watching frequency they were asked the number of days per week that they watch two or more episodes in one sitting.

A question included which online on-demand streaming websites they had access to, to make sure all participants had the possibility to make use of such a service. This needed to be one or more out of the four most common on-demand streaming services (Netflix, Videoland, Amazon Prime Channels and Film1) and the answer 'Others' could be chosen. Based on the findings of de Feijter, Khan and van Gisbergen (2016), information regarding the time of day and the social context in which the participants usually watch online series and movies were requested. The choices here were 'Alone', 'With partner', 'With family' and/or 'With friends'.

The students' learning behaviour was assessed on the basis of five items. These are based on a survey by Lizzio, Wilson and Simons (2002). The participants were asked about the number of study points they had to obtain and actually obtained in the last academic year and their current weighted average grade, to collect an insight into the students' academic achievements. Furthermore, the time the students spent on self-study and university related events in an average week was estimated by the following question: 'On average, how many hours do you spend on your study per week? (incl. going to lectures, tutorials, studying for tests or writing assignments)'. Additionally, their attitude towards academic achievements were measured by asking about how important they considered high grades. They could rate this importance on a 5-point Likert scale ranging from 'Extremely important' to 'Not important at all'.

Seven items were used to assess the three variables snack, beverage and vegetable consumption. Participants were asked to indicate how often these were consumed on average. An example of one of these questions is the following: 'On average, how often do you eat vegetables (cooked/steamed), salad (i.e. lettuce, tomatoes) or fruit?'. The participants had to indicate their answer on a 5-point Likert scale ('Several times per day', 'Once a day', 'Several times per week', 'Several times per month', 'Several times per year', 'Less or Never'). The snack, beverage and vegetable categories are derived from the research of Zenk et. al (2014). Attitude towards a healthy nutrition was measured based on one item, asking the participants how important they consider a healthy nutrition.

Questionnaire within PACO application. The second questionnaire was taken within the PACO application (see Appendix A). It consisted of 17 questions each day, which could be answered by selecting one or several answers or by entering single words or numbers. This questionnaire was based on the above described baseline questionnaire but focused on specific behaviour in a short period of 24 hours, instead of giving an overall estimation. The research team decided to make the questionnaire as short and as easy to

answer as possible in order to increase the response rate. Therefore, the PACO questionnaire can be described as a more concentrated version of the baseline questionnaire.

The 17 items concentrated on the main variables watching-time, binge-watching behaviour (the number of episodes watched in a row), snack and beverage consumption, learning behaviour and important daily life activities. Also questions regarding the intended binge-watching and learning behaviour for the following 24 hours were asked. Filling in the questionnaire took around 5 minutes per day. These questions are inspired by the article of Hsieh, Li, Dey, Forlizzi, & Hudson (2008). Within this research, binge-watching was measured based on the following three items: 'How many hours did you spend on watching online series/movies in the last 24 hours? Give your answer in decimals (3 h 30 = 3.5)', 'How many episodes of the same series did you watch in one sitting in the last 24 hours? Give your answer in decimals (3 1/2 episodes = 3.5)' and 'How many hours are you planning to spend on watching online series/movies in the next 24 hours? Give your answer in decimals (3 h 30 = 3.5)'. The participants could answer these questions by entering the number of hours or episodes.

The students were asked about the social context of the on-demand watching behaviour, with choices between 'Alone', 'With partner', 'With family' or 'With friend(s)'. Learning behaviour and important daily life activities were assessed based on seven items. The participants were also asked to indicate the intended and past time spent on self-study activities and university related activities. Furthermore, the participants had to indicate if they spent more or less time than planned on the three important daily life activities housekeeping, physical activities and social activities. Therefore, a 5-point Likert scale was used, ranging from 'Much more than planned' to 'Much less than planned'.

The snack and beverage consumptions were assessed by five different items. Snack consumption was measured by asking participants to indicate whether they ate one or more of the following snacks based on the categories: (1) Cookies or sweetened-baked goods, (2) Chocolate or candy, (3) Ice cream or frozen dessert, (4) Salty snacks, (5) Others and (6) None. Beverage consumption was measured by asking participants whether they had consumed one or more beverages based on the following categories: (1) Soda, (2) Fruit juice, (3) Energy drink, (4) Alcoholic drink, (5) Others and (6) None. These categories were mainly derived from an earlier research of Zenk et. al (2014). The number of snacks and beverages were then calculated by summing up the amount of chosen options.

Furthermore, participants were asked whether they had consumed more snacks and beverages than intended during the past 24 hours. Answer options were yes or no. The last

item assessed whether the participants were watching online series and movies whilst eating and drinking.

Analysis

For the data analysis, the statistical program for social sciences (SPSS, version 23) was used. First of all, the data from the PACO application and the data from the baseline questionnaire from Qualtrics was transformed into SPSS. Then, these two datasets were merged into one dataset, so that all the variables were displayed in one file. Erroneous data, such as text input for numerical variables was altered. In addition, rows with missing inputs were deleted. Based on the guidelines of Conner and Lehman (2012), participants who did not respond to more than 40% of the prompts were deleted from the dataset.

Descriptive statistics were used to measure the demographics of the population and information regarding watching, study, important daily life activities and eating behaviour of the participants. BMI was calculated with the variables weight and height, to classify the sample as either in the normal weight range (18-25) or as overweight (25-30). Based on the conversion table of the University of Twente (University of Twente, n.d.) the average grade of the participants from German universities was adjusted to the Dutch grading system. To compare the watching behaviour of the higher and lower achieving students, the participants were divided into two groups. The first group with an average grade ranging from 6.5 to 7.5 and the second group with an average grade from 7.5 to 9.

A series of Linear Mixed Models analyses with an autoregressive covariance structure was conducted to analyse the hierarchical and nested structure of the repeated measurements per participant and/or time point. All values gathered by the Linear Mixed Model analysis take missing data into account and are therefore estimated. In each Mixed Models analysis, one of the variables watching-time, intended watching-time, number of episodes, self-study-time, time university, snack and beverage intake, unintended snack and beverage intake, BMI and the three important daily life activities were set as the dependent variable. Time_point was set as the fixed independent factor to examine these behaviours over the 15 days. Additionally, the participants' number was added as a factor when comparisons on an individual level were made. The output of the analysis provided a mean estimation of the dependent variables per day and/or per participant. Further, it could be established whether time had a significant influence on the variables. Excel was also used to compare the estimated means of the different variables and to create graphs to display how the different variables were related to each other. Bivariate Pearson Correlation analysis was used to

examine the relationship between the participants overall mean watching-time and the number of episodes and the intended and actual watching-time averaged over the 15 days. Effect size was interpreted based on Cohen's conventions (1988), whereas a correlation coefficient of .10 is considered as a weak correlation, a coefficient of .30 as a moderate correlation and a coefficient of .50 as a strong correlation. An independent-samples t-test was conducted to explore the differences in means in watching-time between the two different BMI and grading groups.

Results

The Baseline questionnaire was filled in by 33 students via the website Qualtrics. From this sample, 26 installed the PACO application on their mobile phones and 23 of them responded to the daily questionnaire on a regular basis (for at least 6 out of 15 days). On average, the participants responded on 11,7 days (78.3%) of the total 15 measurement days.

Watching-time and daily fluctuation

Over the 15 days, the participants watching-time varied from 0 to 10 hours, with the number of episodes ranging from 0 to 12. The observed mean watching-time during the measured time period was 1.42 hours per day ($SD = 1.74$) with on average 1.49 ($SD = 2.04$) episodes per day. A Mixed Models analysis was conducted and a significant effect of time on the watching behaviour of the participants was found (coefficient = 1.06, $p < 0.05$). Similarly, there was a significant effect of time on the number of watched episodes (coefficient = 1.09, $p < 0.05$). Figure 1 illustrates the fluctuations of the data over the course of the 15 days. According to the graph, both the watching-time and the number of episodes varied relatively analogous to each other over the course of the week.

The participants generally spent more time watching online series and movies on Fridays, less time for this was spent on Wednesdays and on the first measured weekend (Day 6 and 7). Here the watching-time and number of episodes declined considerably, with an average estimated watching-time of 0.84 ($SD = 0.39$) on day 6 and 0.62 ($SD = 0.39$) on day 7. After this sudden fall, the watching-time increased again to its previous level. The maximum average estimated watching-time of 1.85 hours was reached on day 12 (Friday). A strong significant positive correlation between the total estimated mean watching-time and the number of episodes was found ($r = .85$, $p < .01$).

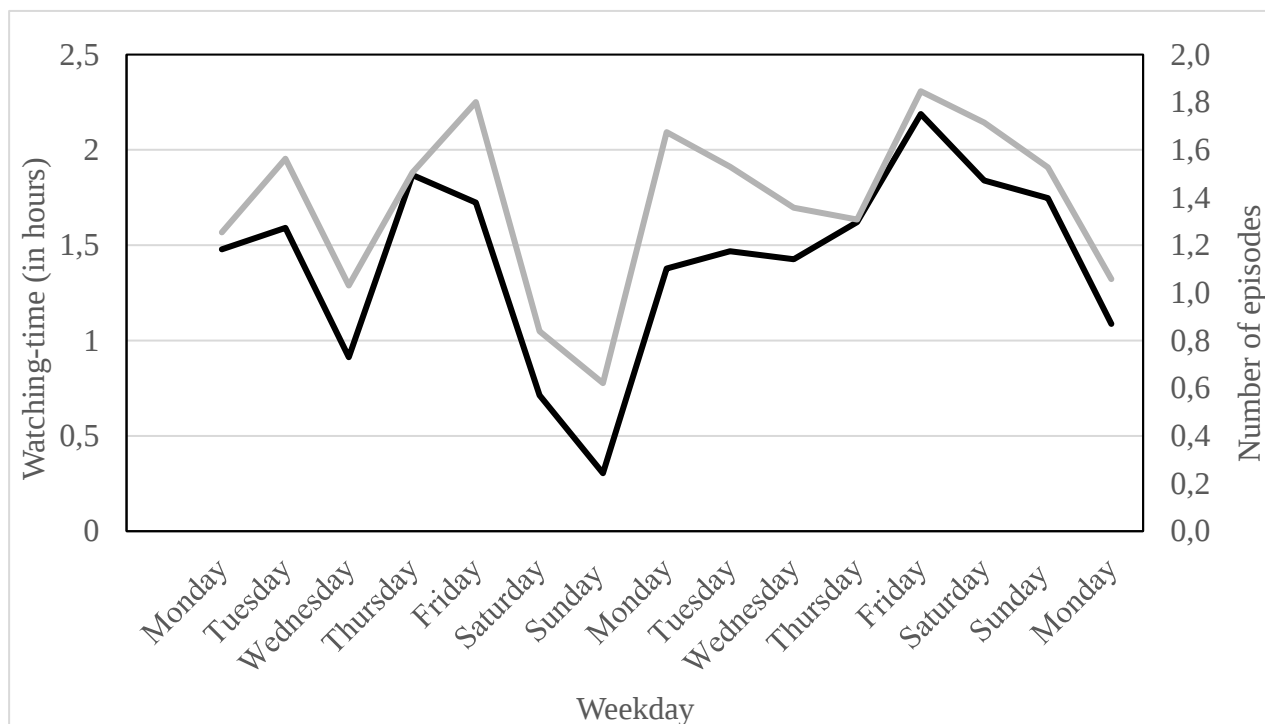


Figure 1: Mean estimated watching-time (in hours) in grey and number of episodes in black over the 15 days.

The difference in the average watching-time between the two measured weeks is shown in figure 2. On average, the participants watched 1.30 hours (SD = 1.17) of online series and movies per day in the first week, 1.64 hours (SD = 1.16) were watched in the second week. The mean estimated watching-time was the highest on Friday, with 1.8 hours in the first week and a mean of 1.85 hours in the second week. Again, a notable difference in watching-time can be observed between the two weekends (Saturday and Sunday). Here, watching-time remained close to its previous level in week two, whereas it decreased considerably in week one. A moderate positive correlation was found between the watching-time in week one and week two ($r = .374$, $p < 0.05$).

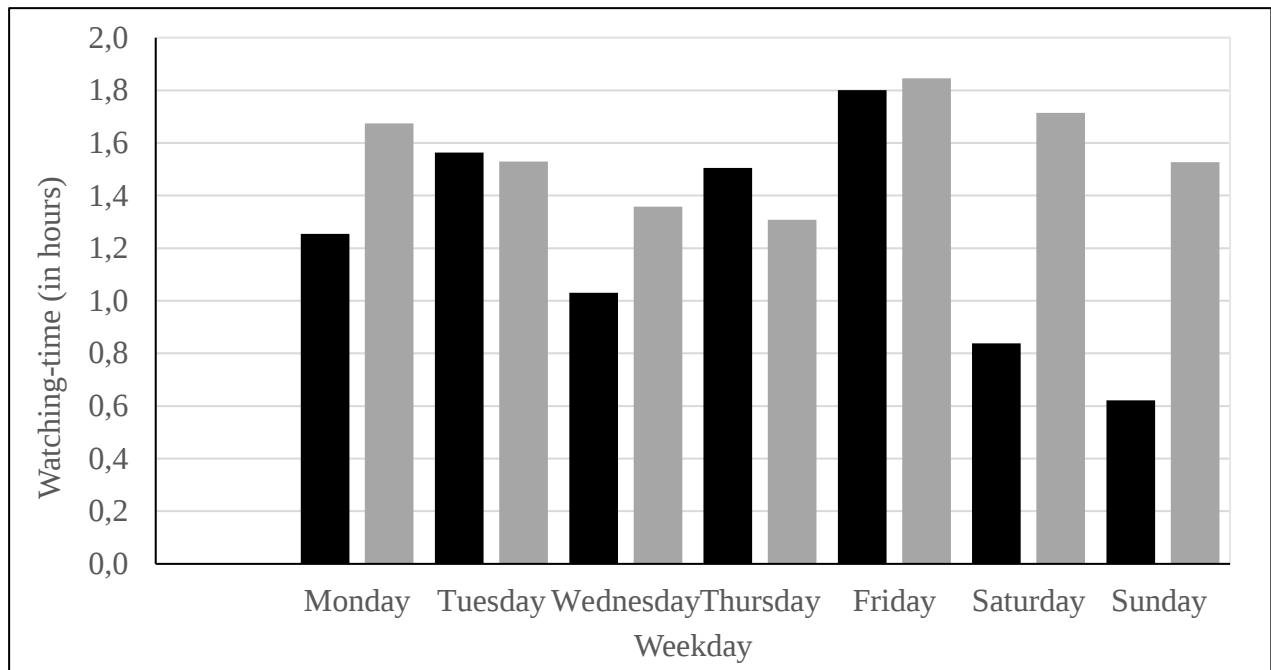


Figure 2: Mean estimated watching-time (in hours) in week one in black and week two in grey.

Figure 3 illustrates the difference in the mean observed watching-time per participant, whereby a strong variation within the group can be observed. Participant 11 spent the most time watching online series and movies, with an average of 3.74 (SD = 2.95) hours per day, whereas the lowest watching-time was reached by participant 16 with an average of 0.3 (SD = 0.61) hours per day.

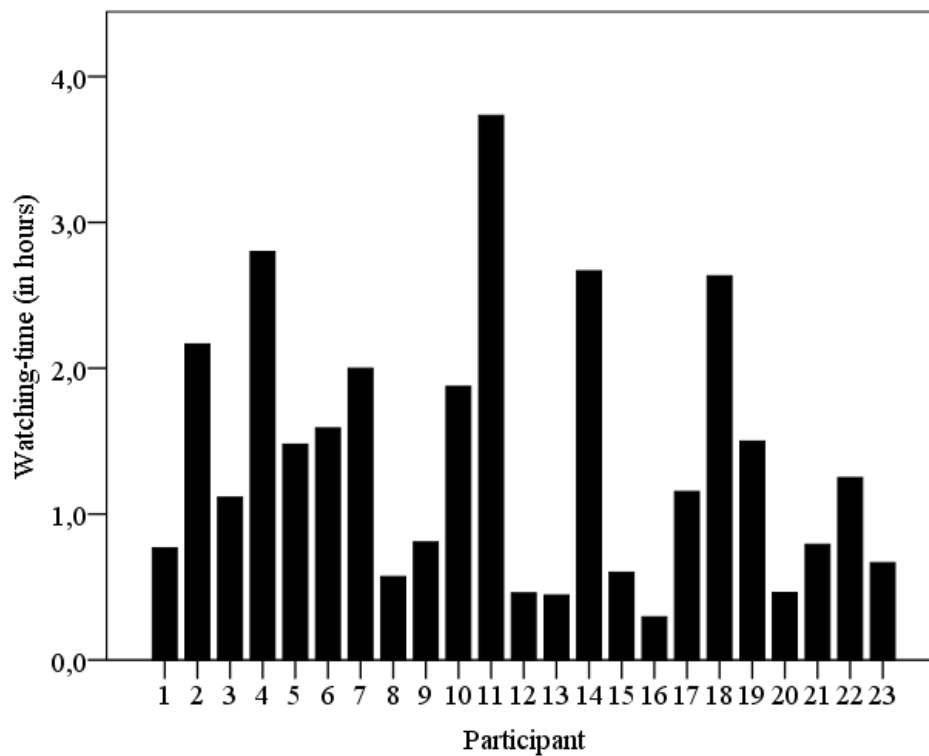


Figure 3: Mean observed watching-time (in hours) per day per participant.

To estimate the individual differences in binge-watching, a Mixed Models analysis was conducted. Figure 4 shows the proportion of binge-watching per participant, whereas a clear differentiation between the participants can be observed. On average, participants binge-watched for 36% of their watching-sessions. While participant 8 did not once watch more than two episodes in one sitting, participant 11 binge-watched on 86.66% of the total watching occasions. Also notable is that the proportion of binge-watching is either quite low or high for most of the participants.

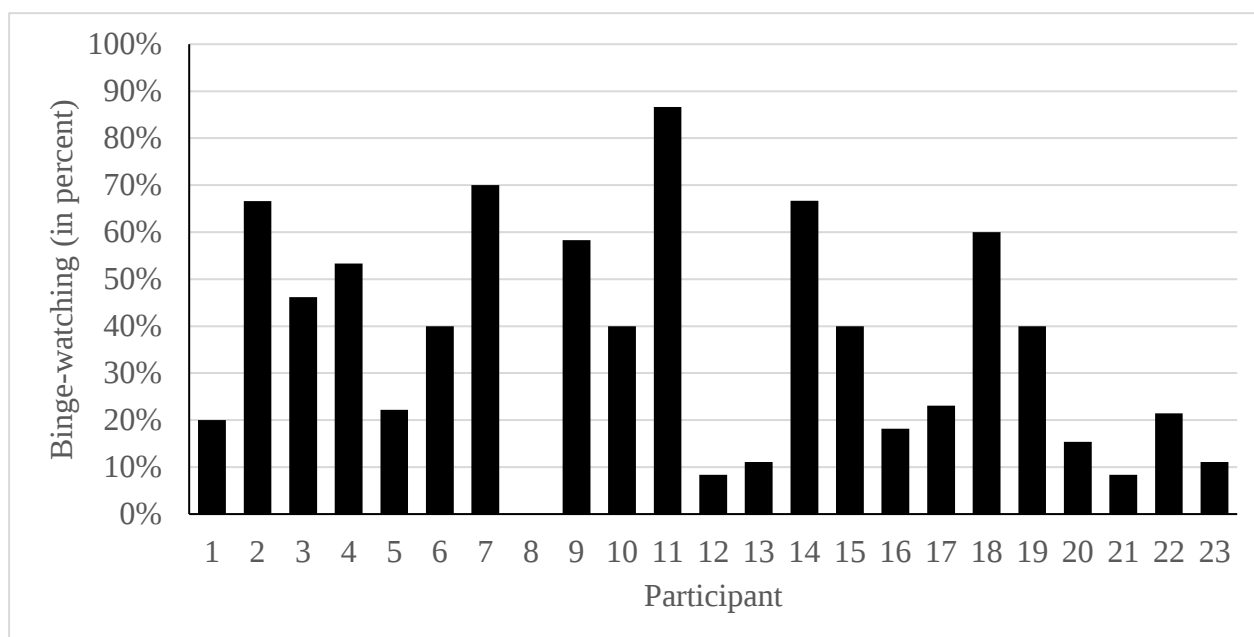


Figure 4: Proportion of binge-watching per participant (in percent).

To summarize, students regularly watched online series and movies during the measured time period. The watching-time and number of episodes did not alter remarkably from each other, however moderate fluctuations in both could be observed over the 15 days, with a notable decrease at the first weekend. Watching-time in week one and two differed moderately from each other, whereas a considerable difference could be observed between the two measured weekends. Within the group, there was a strong variation in watching-time and the proportion of binge-watching. Binge-watching occurred on about one third of the total watching-occasions.

Binge-watching and snack and beverage consumption

A healthy nutrition was considered as very important for 69.6% of the participants, whereas 26.1% of them found it moderately important and one participant slightly important. Participants reported to consume snacks and beverages on 20.7% of the total watching-occasions. On average, the participants consumed 0.79 snacks (SD = 0.78) and 0.82 beverages (SD = 0.69) per day. A Mixed Models analysis was conducted to estimate the daily means in snack and beverage consumption over the measured time period. A significant effect of time on the snacking-behaviour (coefficient = .69, $p < 0.05$) and beverage consumption (coefficient

= 1.01, $p < 0.05$) was found. This is illustrated in figure 5, where the snack and beverage consumption varied moderately and relatively analogous to each other over the 15 days. A small increase in the number of consumed snacks and beverages could be observed on both weekends. No significant correlation was found between the mean observed watching-time and the number of consumed snacks per day ($r = -.073$, $p = 0.36$). A moderate positive correlation was shown however, between the mean observed watching-time and number of beverages per day ($r = .374$, $p < 0.05$). This means that, with increased watching-time, the number of consumed beverages grew moderately.

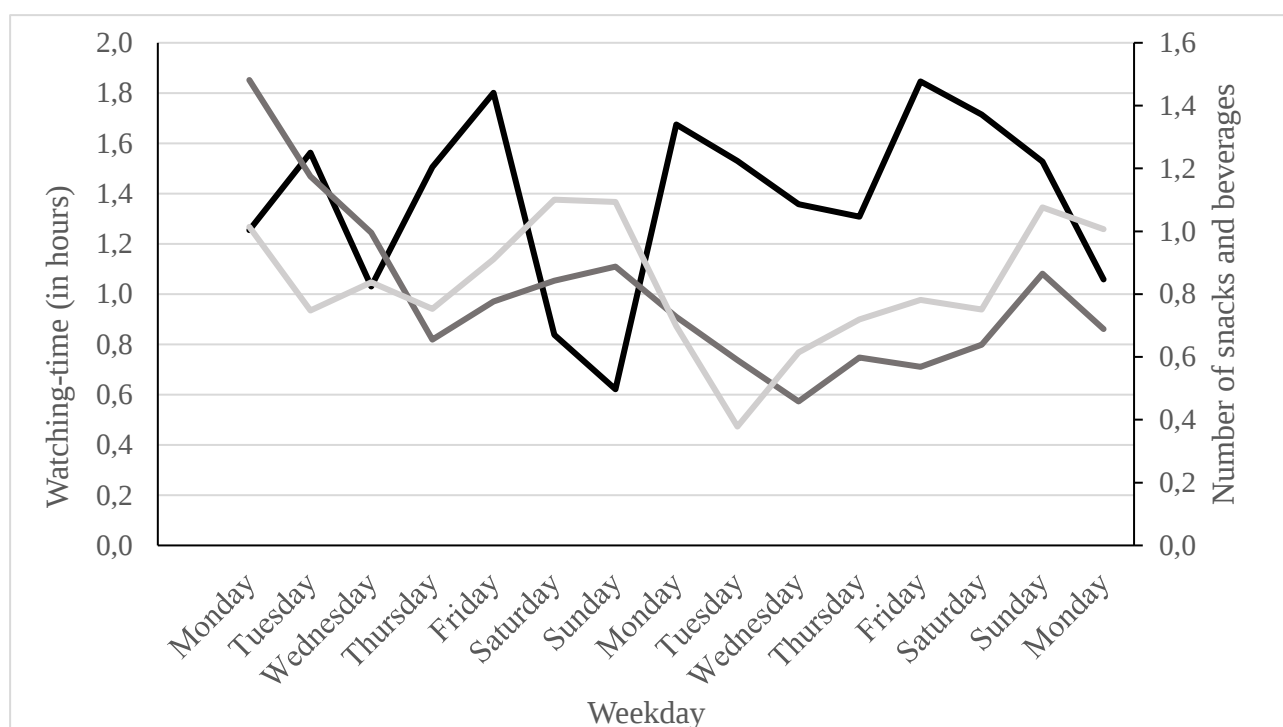


Figure 5: Mean watching-time (in hours) in black, number of consumed snacks in dark grey and number of consumed beverages in light grey over the 15 days.

In summary, with increased watching-time, the number of consumed beverages rose moderately. The number of consumed snacks and the average watching-time were unrelated.

Binge-watching and mindless snack and beverage consumption

A moderate positive correlation was found between the mean observed watching-time and eating more snacks than intended ($r = .38, p < 0.05$). The mean observed watching-time and consuming more beverages than intended were not related ($r = .24, p = 0.121$). A Mixed models analysis was conducted to estimate the mean number of unintended snack and beverage consumptions over the measured time period. A comparison of these behaviours is illustrated in figure 6. Moderate differences between the participants can be observed, whereas two participants (participant 11 and 12) reported no unintended snack and beverage consumption.

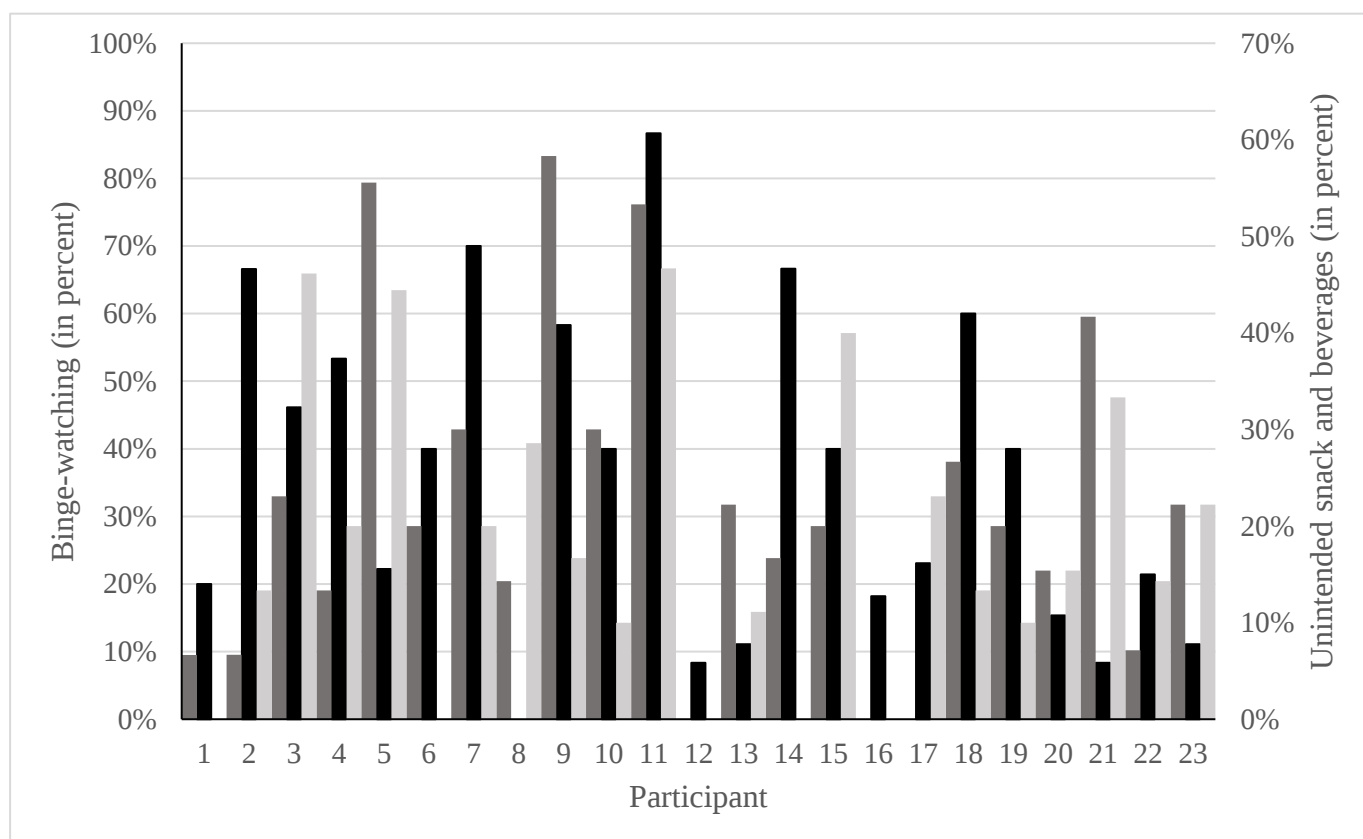


Figure 6: Proportion of binge-watching in black, unintended snack consumption in dark grey and unintended beverage consumption in light grey per participant (in percentage).

To conclude, with increasing watching-time the number of unintended snacks also rose slightly. In other words, participants who binge-watched tended to eat more snacks than intended.

Binge-watching and BMI

The participants' average BMI was 22.09 (SD = 2.72) and ranged from 18.52 to 27.68. Most of the participants fell into the normal weight range (82.61%), 4 of the 23 participants

(17.4%) were categorized as overweight. Over the 15 days, participants with a normal BMI watched significantly less online series and movies with an average of 1.31 hours per day (SD = 0.11) than participants in the overweight BMI group, who watched 1.84 hours per day (SD = 0.28), $t(21) = 6.19$, $p < 0.0001$. This difference in the mean watching-time is illustrated in figure 7.

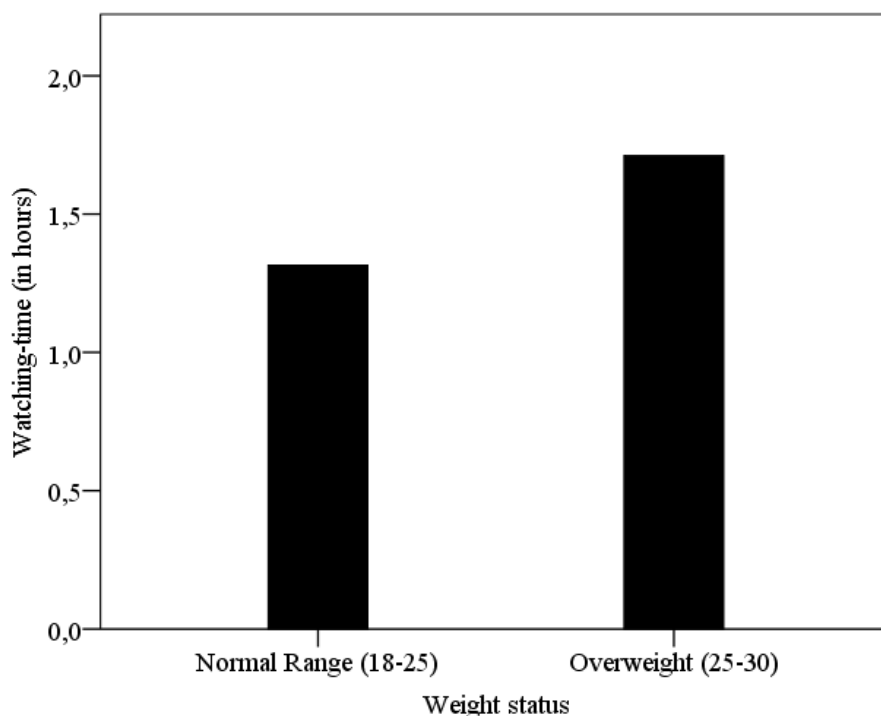


Figure 7: Comparison of mean observed watching-time (in hours) between the normal weight and overweight BMI groups.

A Linear Mixed Models analysis was conducted to estimate the average watching-time of the two BMI groups over the measured time period. A significant difference in watching-time was found between normal weight and overweight participants ($r = .471$, $p = 0.05$). According to figure 8, the watching-time of the normal BMI group was relatively stable during the measured time period, while the overweight BMI group strongly fluctuated in hours of watching from day to day. Also notable is the low watching-time of the high BMI group on the days 6 and day 7.

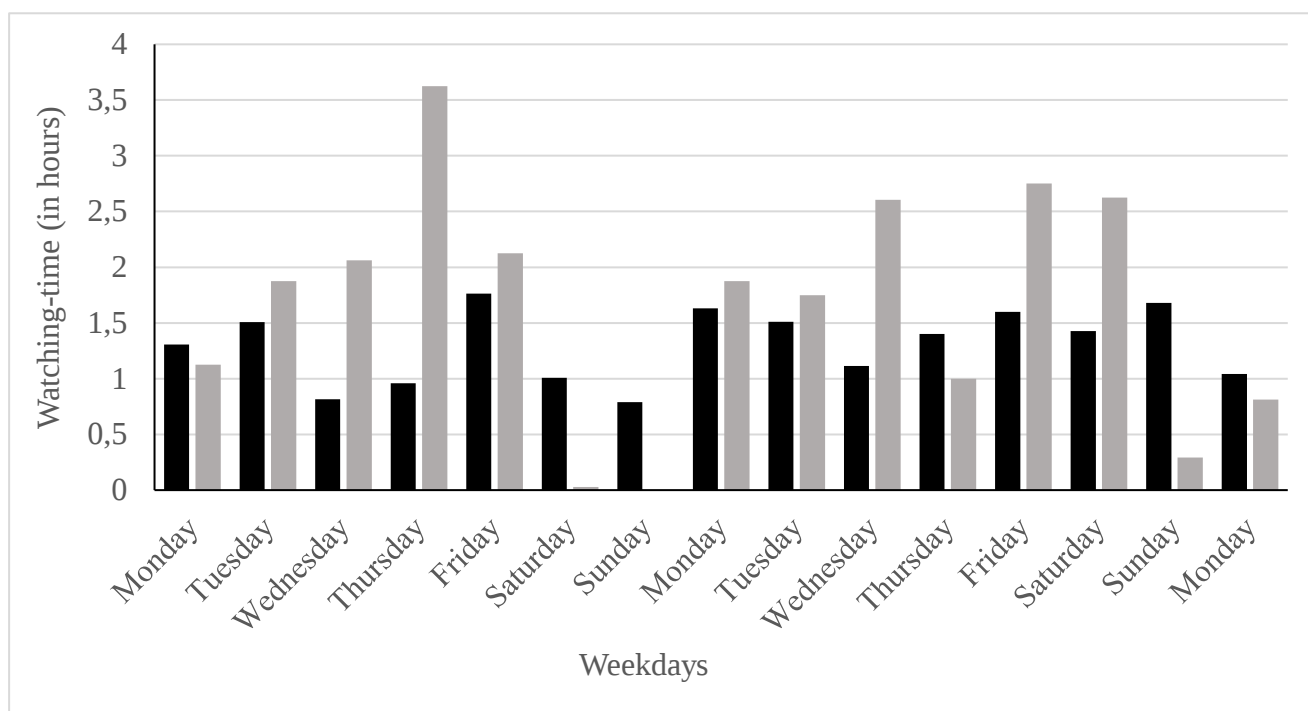


Figure 8: Mean estimated watching-time (in hours) of normal weight in black and overweight participants in grey over 15 days

To summarize, a significant difference in watching-time between the two BMI groups was found. Over the week, watching-time fluctuated more intensively within the high BMI group than in comparison to the normal BMI group.

Discussion

The present study was one of the first to provide a detailed description of the binge-watching behaviour and its effect on the healthy lifestyle behaviour of university students by making use of ecological momentary assessment (EMA). To document the daily fluctuations in the watching behaviour and the snack and beverage consumption of the students, a sample consisting of 23 university students filled in a daily questionnaire regarding these behaviours via a mobile application. The average watching-time varied moderately over the week, with a higher watching-time towards the end of the week. Further, clear differences in the binge-watching frequency were ascertained between the participants. Interestingly, participants with a higher BMI watched more online series and movies than participants with a normal weight status. With increased watching-time, the number of beverages rose moderately, while the number of snacks was not influenced. Unintended snacking, however, rose with increased watching-time while the unintended consumption of beverages remained unaffected.

Results of the present study show that the students watched, on average, 1.49 episodes per day for a watching-time of 1.42 hours. Both measurements, the watching-time and the number of episodes varied relatively analogous to each-other from day to day. While not directly comparable, the watching-time and the proportion of binge-watching in this study was similar to estimates of binge-watching in the literature, where binge-watching is seen as a popular and frequent activity, occurring at least once a week (Nielsen, 2013). However, in both, the present and previous studies, no distinction was made between active and passive watching, whereas the latter may account for a considerable proportion of the binge-watching time. In this respect, participants reported streaming online series and movies while being engaged in another activity such as cooking or doing the housekeeping, suggesting that they did not actively watch that the streaming serves rather as a background noise. Furthermore, previous studies used a broad sample of online on-demand users in general, while the present study only included university students, whose lifestyle may be quite different to those of the broader population.

In addition, a very strong correlation between the watching-time and the number of episodes was found. In literature, the definition of binge-watching from Netflix is often criticized for not considering the varying length of the watched episodes when categorizing a watching occasion as binge-watching. However, it appears that the episodes and watching-time of the participants match quite well, suggesting that there is no need to take the time spend watching into account when classifying binge-watching. Nevertheless, considering the length of the watched episodes in the context of binge-watching provides additional

information with regard to the watching behaviour of the students and in this way might contribute to a deeper understanding of this leisure activity. Thus, it may still be useful to include the watching-time when assessing the binge-watching behaviour.

Over the 15 days, the watching-time fluctuated moderately, with an increase in watching-time towards the end of the week (Friday), and a small decrease during the middle of the week (Wednesday). One important observation was the low watching-time during the first weekend, as compared to the higher watching-time at the second weekend. This is possibly related to the Easter holidays, as on these days people are less likely to spend time watching online series and movies due to family events or being on holiday. Furthermore, the watching-time differed considerably between the participants, whereas the majority of them scarcely or never watched more than two episodes in a single watching session, some binge-watched for more than 50% of their watching-time. This is an important finding, as EMA was used to deepen our knowledge on this.

The rise in watching-time on Fridays and at the weekend of the second week suggests that the probability of binge-watching to occur, increases at the weekend, possibly because people do not have to work or have to attend lectures and/or tutorials and thus, have more time to watch online series and movies. The considerable reduction in watching-time over the Easter holidays (first weekend) indicates that situational factors also play an important role in binge-watching, and that this is to a certain extent a planned and controllable activity. This is contrary to the predominant depiction of binge-watching found in literature, where it is often described as an excessive conduct which is driven by internal tendencies and thus comparable with other addictive behaviours (Riddle et al., 2017). The present findings in this study suggest that binge-watching may rather be seen as a habit, which can be controlled and adjusted to environmental factors. However, this requires further research, as some participants had a relatively high binge-watching proportion and may be especially susceptible to binge-watch.

In general, the frequency of snack and beverage consumption while watching online series and movies during the measured time period was low, as compared to the estimations found in literature (Stroebele & de Castro, 2004; Temple et al., 2007). With increased watching-time, the participants drank moderately more beverages, while the snacking frequency was not influenced. These results do not completely match with the findings of previous studies, which demonstrated that besides sweetened beverages, also the consumption of unhealthy snacks rises with every additional hour of watching television.

In line with the findings of Boulos et. al (2012), who state that television watching while eating leads to a weakened awareness of the actual meal intake ('mindless eating'), this study demonstrates that unintended snack consumption increased moderately with a higher watching-time, while the unintended beverage consumption stays unaffected. This is an interesting finding, as the actual snack consumption did not rise with increased watching-time while the participants themselves had the feeling that they consumed more snacks than intended. The majority of the sample stated that a healthy nutrition is very important to them and research has shown that a healthy eating attitude is strongly related to a nutritious eating behaviour (Jun, Kang, Arendt, 2014), including a low consumption of unhealthy snacks, respectively. This may explain the discrepancy with prior research. Interestingly, some of the participants reported being so distracted while binge-watching that they forgot to eat or drink anything. Up to date, no literature can be found on this effect, suggesting that this is a new finding which requests further research.

Lastly, the average watching-time differed significantly between the normal weight and overweight participants in the present study, this being in line with the findings of Borghese et. al (2015), who found that overweight children watched more television than children in the normal weight range. Although the overweight group was very small in this sample, this finding may suggest that people with a higher BMI are at special risk to binge-watch more than people with a normal weight and therefore, can be recognized as an at-risk group for binge-watching.

The present study used Mixed Models analysis to estimate the means and test for the significance of time on the variables. This method is optimally suited for the nested and hierarchical structure of the measurements. Also, it handles missing responses, which eliminates the problems associated with incomplete data, these often being encountered with traditional methods, such as ANOVA or Multiple Regression analysis. In addition, the strong correlation between the watching-time and number of episodes indicates a high validity of the measurements and shows that the daily questionnaire was filled in conscientiously by the participants. Further, the watching-time in week one and in week two shows a moderate correlation, which signifies that the measured data has an acceptable test-retest reliability. This benefits the study in allowing for confidence in the data and demonstrating consistency over time.

Another strength of this study is the used EMA approach to gather the data, offering several benefits over the retrospective methods used in previous research. Firstly, it offers the opportunity to capture the daily fluctuations in the students' binge-watching and eating

behaviour and to examine how they are related to each other. This is especially useful when considering the students' dynamic lifestyle which often varies significantly from day to day. The considerable decrease in watching-time over the Easter holiday for instance, would probably not have been found by a cross-sectional, retrospective design used in previous studies. Secondly, EMA may give a much better estimation of the daily watching and eating behaviour than other methods, as it limits the recall bias by gathering the data on a daily basis. Taken together, the EMA approach is thus very useful in exploring these everyday activities and leads to more confidence in the results, by taking daily deviations into account and reducing the likelihood of recall bias.

However, the validity of the measurements may still be susceptible to other biases, one being the social desirability bias, in which respondents tend to answer in ways that show them in a more favourable light. Especially health related behaviours, such as the eating behaviour or sedentary behaviour (watching television) and BMI, including the reporting of height and weight, are prone to this kind of bias (Pettee, Ham, Macera & Ainsworth, 2009). Answering daily questions regarding these behaviours can, in addition, be relatively confronting for the participants and may lead to an increased awareness towards them. These issues may have resulted in the underreporting of the self-reported number of consumed snacks and beverages and the actual watching-time. A possibly way to overcome the latter bias in a future EMA study, would be for instance, to let one group fill in the questionnaire on only two days per week and compare their watching-time with a group who filled it in every day.

Another concern for this study is that the sample consisted only of students with the German nationality, who in addition, rarely deviated from their watching and/or eating plans, this possibly indicates a high level of self-control. This sample may therefore not be representative for the average student, hence, the generalisability of the results to a broader (student) population may be limited. Furthermore, a considerable number of participants had to be excluded from the analysis as they did not install the mobile application or did not respond to enough prompts, which might have led to a selection bias. In order to decrease the likelihood of these biases, possible adjustments to the present study would be to extend the measurement period, increase the sample size and encourage the participants to fill in the questionnaire regularly.

Further investigation on binge-watching is indispensable. With regard to the addiction debate, this study proposes that binge-watching may rather be considered as a habitual and relatively controllable activity than a serious addiction. Though, in extreme cases, watching online series and movies may indeed have negative consequences and addictive features.

Underestimating this addictive potential could have detrimental effects for individuals, especially when insufficient evidence is available on this topic. Conducting qualitative research may be useful to explore both the negative and positive consequences of binge-watching. Also, examining the (social) context in which binge-watching occurs can shed further light on this debate. In order to achieve a more accurate estimation of the binge-watching frequency, it is advisable that upcoming studies make a distinction between active and passive watching of online series and movies. Additionally, the relation between binge-watching and individuals eating behaviour requires further investigation, particularly the role of distraction snacking while watching online series and movies. Lastly, it becomes crucial to identify individuals who are susceptible to binge-watching more than other viewers in order to classify them as a potential risk group.

The present study has contributed towards a deeper understanding of the binge-watching behaviour and its' effect on university students. EMA appears to be very useful and valid in measuring these everyday behaviours of the students by taking their dynamic lifestyle into account and capturing the resulting behavioural fluctuations over the time. Future behavioural research can highly benefit from using EMA and should recognize the potential of this promising method.

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Appendices

Appendix A: PACO Application Questionnaire

←  Binge-Watching and i... ⋮

How many hours did you spend on watching online series/movies in the last 24 hours? Give your answer in decimals (3 h 30 = 3.5)

_____ 

How many episodes of the same series did you watch in one sitting in the last 24 hours? Give your answer in decimals (3 1/2 episodes = 3.5)

_____ 

In which social context did you watch?

MAKE SELECTIONS

How many hours did you spend on visiting university related activities (e.g. lectures, tutorials, practicals etc.) in the last 24 hours? Give your answer in decimals (3 h 30 = 3.5)

_____ 

←  Binge-Watching and i... ⋮

How many hours did you spend on self-study activities (e.g. studying for tests, preparing for classes, writing assignments etc.) in the last 24 hours? Give your answer in decimals (3 h 30 = 3.5)

_____ 

Did you spend more or less time than planned on physical activities (e.g. doing sports, going for a walk, cycling etc.) in the last 24 hours?

Please select an option ▼

Did you spend more or less time than planned on social activities (e.g. going out for a drink, spending time with friends and family, chatting with flatmates etc.) in the last 24 hours?

Please select an option ▼

←  Binge-Watching and i... ⋮

Did you spend more or less time than planned on housekeeping (e.g. cleaning, grocery shopping, cooking etc.) in the last 24 hours?

Please select an option ▼

Did you consume one or more of the following snacks in the last 24 hours?

MAKE SELECTIONS

Did you consume one or more of the following sweetened beverages in the last 24 hours?

MAKE SELECTIONS

Did you eat more snacks than intended in the last 24 hours?

Please select an option ▼

←  Binge-Watching and i... ⋮

Did you consume more sweetened beverages than intended in the last 24 hours?

Please select an option ▼

Did you watch online series/movies while consuming these snacks and/or sweetened beverages in the last 24 hours?

Please select an option ▼

How many hours are you planning to spend on watching online series/movies in the next 24 hours? Give your answer in decimals (3 h 30 = 3.5)

_____ 

How many hours are you planning to spend on visiting university related

←  Binge-Watching and i... ⋮

How many hours are you planning to spend on visiting university related activities (lectures, tutorials, practicals etc.) in the next 24 hours? Give your answer in decimals (3 h 30 = 3.5)

_____ 

How many hours are you planning to spend on self-study related activities (studying for tests, preparing for classes, writing assignments etc.) in the next 24 hours? Give your answer in decimals (3 h 30 = 3.5)

_____ 

Are you currently on a semester break?

Please select an option ▼

SAVE RESPONSE

Appendix B: Informed Consent and Baseline Questionnaire

INFORMED CONSENT

Maxine E. Lauhoff & Eva M. Steinbach

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Faculty of Psychology, Health & Technology

1st supervisor: Dr. P. M. ten Klooster

2nd supervisor: Dr. M. E. Pieterse

Binge-Watching and its Impact on Learning and Eating Behaviour and Important Daily Life Activities among University Students

PURPOSE OF STUDY

You are being asked to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. Please read the following information carefully. Please ask the researchers if there is anything that is not clear or if you need more information.

The purpose of this study is to find out more about online television watching. Due to increasing popularity of on-demand streaming websites, such as Netflix, Amazon Channels or PopcornTime.to, watching online series and movies becomes more and more frequent, especially among university students. Within this study we want to learn more about the influence of online television watching on learning and eating behaviour and important daily life activities, as this has not yet been examined in depth.

STUDY PROCEDURES

If you participate in this study, you have to fill out a short-online questionnaire with demographic questions and also questions regarding your overall behaviour concerning learning, eating and binge-watching (approximately 10 minutes). After this, you will be asked to download the PACO application on your mobile device. You will use this application for a period of two weeks to answer a short daily questionnaire (approximately 3-5 minutes). For the purpose of this study, it is important that these questions are answered between 11am and 2pm.

CONFIDENTIALITY

The information that we collect from this research project will be kept confidential. This means that only the researchers have insight into your answers. All personal data (such as e-mail, age, gender etc.) will be anonymized and will not be published and/or given to a third party.

CONTACT INFORMATION

If you have questions at any time about this study, you may contact the researchers.

VOLUNTARY PARTICIPATION

Your participation in this study is voluntary. You are free to withdraw from this study at any time and without giving a reason.

CONSENT

I have read and understood the information provided and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I hereby voluntarily agree to take part in this study.

1. Please enter your google mail address (with which you were invited to this survey)

2. How old are you?

3. What is your gender?

- ☐ male
☐ female

4. At which university are you currently enrolled?

5. What are you studying?

6. On average, how many hours do you spend for your study per week? (incl. going to lectures, tutorials, studying for tests or writing assignments).

7. What is your current weighted average grade? (For University Twente students: this can be found on osiris.utwente.nl under the point 'Progress') Give your answer in decimals (e.g. 6.5 for Dutch students or 2.7 for German students)

8. How many credit points did you have to obtain in the last full academic year in order to finish your study in the standard period?

9. How many credit points did you actually obtain in the last academic year?

10. How important do you consider high grades?

- ☐ Extremely important
- ☐ Very important
- ☐ Moderately important
- ☐ Slightly important
- ☐ Not at all important

11. What is your height (in cm)?

12. How much do you weigh (in kg)?

13. On average, how often do you eat cookies or sweetened baked goods (e.g., cake, donuts)?

- ☐ several times per day
- ☐ once a day
- ☐ several times per week
- ☐ several times per month
- ☐ several times per year
- ☐ less or never

14. On average, how often do you eat chocolate or candy?

- ☐ several times per day
- ☐ once a day
- ☐ several times per week
- ☐ several times per month
- ☐ several times per year
- ☐ less or never

15. On average, how often do you eat ice cream or frozen dessert?

- ☐ several times per day
- ☐ once a day
- ☐ several times per week
- ☐ several times per month
- ☐ several times per year
- ☐ less or never

16. On average, how often do you eat salty snacks (e.g. potato chips)?

- ☐ several times per day
- ☐ once a day
- ☐ several times per week
- ☐ several times per month
- ☐ several times per year
- ☐ less or never

17. On average, how often do you eat other snacks not mentioned above?

- ☐ several times per day
- ☐ once a day
- ☐ several times per week
- ☐ several times per month
- ☐ several times per year
- ☐ less or never

18. On average, how often do you drink sugar-sweetened beverages (e.g. soda, fruit juice, alcohol)?

- ☐ several times per day
- ☐ once a day
- ☐ several times per week
- ☐ several times per month
- ☐ several times per year
- ☐ less or never

19. On average, how often do you eat vegetables (cooked/steamed), salad (e.g. lettuce, tomatoes) or fruit?

- ☐ several times per day
- ☐ once a day
- ☐ several times per week
- ☐ several times per month
- ☐ several times per year
- ☐ less or never

20. How important is a healthy nutrition for you?

- ☐ Extremely important
- ☐ Very important
- ☐ Moderately important
- ☐ Slightly important
- ☐ Not at all important

21. Do you have access to any video on demand streaming portal, such as...? (Multiple answers possible)

- ☐ Netflix
- ☐ Videoland
- ☐ Amazon Prime Channels
- ☐ Film1
- ☐ Others, namely...
- ☐ None

22. On average, on how many days per week do you watch online series/movies?

23. On average, how many hours do you spend watching these online series/movies per week? Give your answer in decimals (for example, 12 hours and 45 minutes = 12.75)

24. On average, how often do you watch more than two episodes of a series in one sitting per week? Give your answer in decimals (for example, 4-5 times = 4.5)

25. When do you usually watch series/movies? (Multiple answers possible)

- ☐ 5am-11am
- ☐ 11am-14pm
- ☐ 14pm-18pm
- ☐ 18pm-22pm
- ☐ 22pm-5am

26. In which context do you usually watch online series/movies? (Multiple answers possible)

- ☐ Alone
- ☐ With partner
- ☐ With family
- ☐ With friend(s)

Q27. Who do you currently live with?

- ☐ Rommate(s)
- ☐ Family
- ☐ Partner
- ☐ Alone