**Prevalence and Comparisons of Alcohol, Candy, Energy Drink, Snack, Soda, and
Restaurant Brand and Product Marketing on Twitch, Facebook Gaming, and YouTube
Gaming**

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ABSTRACT

Objective: To compare and evaluate the prevalence of food and beverage marketing on the livestreaming platforms Twitch, Facebook Gaming, and YouTube Gaming, as well as examine growth of food and beverage marketing on these platforms over a 17-month period of data collection.

Design: Cross-sectional data was analyzed across three livestreaming platforms and six food and beverage categories: alcohol, candy, energy drinks, snacks, sodas, and restaurants.

Setting: Stream titles of livestreamed events as well as corresponding hours watched on Twitch, Facebook Gaming, and YouTube Gaming.

Participants: None

Results: There were significant differences between food and beverage brand mentions across all three studied platforms ($p < 0.05$), as well as hours watched ($p < 0.05$). Energy drinks dominated food and beverage brand mentions across platforms, followed by restaurants, soda, and snacks. All platforms demonstrated growth over the 17-month data collection period. Post-hoc analyses revealed that the COVID-19 pandemic impacted both immediate and sustained growth across all platforms, with the greatest impact observed on the Twitch platform.

Conclusions: Food and beverage marketing as measured through stream titles is widely prevalent across the three most popular livestreaming platforms, particularly for energy drinks. Food marketing on these platforms experienced growth over the past 17-months which was accelerated substantially by the COVID-19 pandemic. Future work should assess the sustained impact this growth may have on marketing practices and eating behavior.

Keywords: Food Marketing; Twitch; Streaming; Influencers; Energy Drinks

INTRODUCTION

Rates of overweight and obesity continue to rise worldwide¹. The underlying mechanism that contributes to weight gain is the consumption of energy in excess of the body's homeostatic needs². Excess consumption of energy can be driven by a number of factors, one of which includes the endemic presence of marketing for food and beverages in everyday life³. Food marketing and advertising has long been omnipresent and has been shown to impact both the unconscious mechanisms that regulate food consumption as well as conscious preferences for food choice^{4,5}. Recent, rapid advancements in technology and shifts in entertainment platforms have contributed to the development of innovative marketing techniques, exacerbating the impacts of the so-called "obesogenic environment"⁶⁻⁸. Therefore, it is vital that the prevalence of food marketing and the techniques employed by food companies on new platforms, such as social media, is monitored in order to understand the reach and potential impact on food choice and eating behavior.

"Livestreaming" is a relatively new form of influencer-entertainment on social media that has seen a dramatic climb in popularity over recent years^{9,10}. Currently, the three largest livestreaming social media platforms in the United States are Twitch (owned by Amazon), YouTube Gaming (owned by Google), and Facebook Gaming (owned by Facebook)¹¹. All three platforms enable streamers to broadcast live audiovisual content to viewers. In addition to the live broadcast content, influencers are able to directly interact with their audiences in real-time. This is accomplished through a live chat feature where viewers of the streaming content can send messages to both the streamer and other viewers, allowing for the community to interact in an organic way. Streamers also create a profile page which is displayed below their stream where they can provide information to their audiences about their content. This page often includes persistent product advertisements and endorsements⁶. Through an advertisement-based revenue model, streamers will often incorporate sponsored products into their entertainment content through a variety of means including overlay ads, product placements, mini-games, and giveaways. This influencer-led advertising content is presented alongside more traditional website-driven content such as pre- and mid-roll video and banner ads. Advertising on livestreaming platforms therefore combines a number of social media marketing techniques in an overlapping and interactive manner, which is unlike many other social media and entertainment

platforms. This integration of passive and participatory techniques has proven to be rewarding, as viewing of livestream events has been shown to be motivated by cognitive, affective, personal integrative, social integrative, and tension release motivations¹².

While livestreaming is commonly associated with video gaming, its reach extends far beyond the gaming niche. For example, while the most widely used livestreaming platform Twitch is known for its video game broadcasts, it has expanded its reach to include events such as sports, political rallies, and music, among others¹³. Since its launch in 2011, Twitch has become the most widely used livestreaming platforms¹¹. Twitch reports an average viewership of over 2.5 million users at any given moment, 30 million average daily viewers, and over 1 trillion minutes of watched content in 2020¹⁴. On a smaller scale, YouTube Gaming reported an average of 871,000 viewers streaming at any time during the fourth quarter of 2020 and over 10 billion hours of livestreaming content in 2020¹⁵. Facebook Gaming saw a 96% increase from 2019 in average concurrent viewership to 408,000 viewers by the end of 2020, and doubled its hours of streaming content from 0.5 billion at the end of 2019 to over 1 billion by the end of 2020¹⁶. This growth has not gone unnoticed by marketing agencies, including those marketing nutrient-poor, energy-dense foods. Previous work identified energy drinks, coffees, and teas as the most widely advertised products on Twitch over an 18-month period. However, restaurants and food delivery services and sugar-sweetened beverages were most frequently mentioned in chat messages, even though the marketing of these products through streamers was significantly lower than energy drink products. Despite these variations, all products, experienced significant growth in exposure over the study period, including sugar-sweetened beverages and candies⁶.

Livestreaming services have produced a profound shift in the media landscape, and content creation has shifted from large corporations and organizations to users as content creators, influencers, and brand “affiliates”^{17,18}. Influencer-marketing has proven effective on other internet platforms (e.g., YouTube, Instagram), and marketing of unhealthy snacks to children via influencers in particular has been associated with increased food intake even when the influencer discloses that they are advertising a product^{19,20}. This marketing is supported by the platforms themselves. As an example, in 2020 Twitch introduced a large number of new influencer-centered marketing techniques to increase revenue on the platform. This included the creation of the “Twitch Affiliate Program” to help facilitate contact between brands and streamers²¹ and the requirement that streamers run a set number of ads per hour of content²².

Alongside these internal changes, the Federal Trade Commission (FTC) requires social media influencers, including streamers, to include “#ad” in the title of a stream when receiving compensation for mentioning a product²³. However, companies have been looking for ways to subvert regulations and partnerships to extend their advertising in unique ways, some more effective than others. For example, a recent Burger King campaign targeted popular streamers and their communities by donating the price of a Burger King meal to a pre-specified group of streamers during one of their streaming sessions. The donation triggered an automated bot to interrupt the stream with a message instructing the streamer and viewers to go to the nearest Burger King and purchase a meal. This type of viral marketing effectively sidestepped #ad disclosure requirements from the FTC while also appearing to provide a benefit to the streamer. However, this campaign received pushback from many of Twitch’s top users who said such marketing ploys were taking advantage of Twitch donation features as a way to avoid paying streamers²⁴.

Our group has published previously on the marketing techniques and presence of brand exposure for food and beverage items across stream titles, streamer profiles, and chat messages on the livestreaming platform Twitch⁶. The current study expands upon our previously published work to describe the presence of and potential differences between food and beverage brand mentions across three major livestreaming sites (Twitch, YouTube Gaming, and Facebook Gaming). To accomplish this, we examined brand presence across six distinct categories (i.e., alcohol, candy, energy drinks, processed snacks, sodas, and restaurants) during a 17-month time period (i.e., July 2019-November 2020). In addition, we sought to examine the impact the COVID-19 pandemic (i.e., March 2020 onwards) had on food advertising on these platforms, as it has been reported that advertising budgets shifted significantly to online outlets during this time period²⁵. This updated understanding on the degree and potential growth of food and beverage brand exposure provides much needed information on the presence of food and beverage brand exposure across livestreaming platforms for policy makers and researchers on current marketing trends that warrant further investigation.

METHODS

Generation of brand and product search term

A list of brands and products was compiled prior to data collection by the research team. The brand list was based on our previously published work⁶ but expanded to include new brands or brands that may have not been advertised on livestreaming platforms previously. To identify new brands, we first consulted updated reports of food marketing from the Rudd Center for Food Policy and Obesity²⁶. We then had two members of the research team examine the profile pages and stream titles of the top 100 Twitch, YouTube Gaming, and Facebook Gaming streamers for current food and beverage brands providing sponsorship or being advertised on these platforms²⁷. As in our previous work, only core brand names and products were searched, and variants of these brand names were not searched (e.g. ‘Coke’ was searched while ‘Coke Zero’ was not, as the base word “Coke” would still capture this product variant). To account for common misspellings (e.g., ‘Gfuel’ vs. ‘G fuel’), grammatical errors (e.g., ‘Reese’s vs. Reeses’), the use of ‘z’ instead of ‘s’ (e.g., ‘Cheez-Its’ vs. ‘Chees-Its), and general Internet slang (e.g., ‘Chick-fil-A’ vs. ‘Chikfila’), the finalized list was subjected to an algorithm to generate a variety of spelling variants for each brand²⁸. In total, 854 search terms were generated (including alternative spellings) to search for 312 brands across six distinct pre-identified categories: alcohol, candy, energy drinks (and other caffeinated beverages), processed snacks, soda (and other sugar-sweetened beverages), and restaurants (and food delivery services). A full list of initial candidate terms is available in the supplementary material.

Data Collection

All data were extracted from the analytics platform Stream Hatchet © (Stream Hatchet SLU)²⁹. While our previous work was able to cite three metrics of advertising in the livestream environment (i.e, the stream titles of each individual stream, the profile page of each streamer, and the chat room logs) limitations have since been placed on publicly available data that can be extracted from the Application Programming Interface (API) by the livestreaming platforms; therefore, it was only possible to access information for stream titles. Additionally, as Twitch was the only platform for which we would have been able to capture chat room data, we chose not to examine it for the purposes of this comparative analysis. Brand prevalence in stream titles and hours of viewership of stream titles were obtained using a Python 3 script that implemented the Selenium library to interact with the Stream Hatchet graphical user interface and automatically and iteratively search each brand and product. Data were collected in December of

2020 for a time period from July 2019 through November 2020. All mentions of food and beverage brands in stream titles were extracted, not just titles containing #ad, as brand exposure was still a result of use of the food and beverage brand, whether sponsored or not.

Data analysis and post-processing

All analyses were conducted using the R language and environment for statistical computing (version 4.0.3, R Studio Team, 2020) using the RStudio Graphical User Interface. All data mining was conducted in the Spyder integrated development environment with Python 3 (version 3.8.0). All code used in this project is openly available at #githublink.

To assess the prevalence of each brand or product mentioned in stream titles, the number of unique titles containing each brand or product was quantified (referred to as “titles” throughout). To assess brand exposure, the amount of viewer time (referred to as “hours watched”) was calculated as $h = m * n$, where m denotes the total minutes of content on the stream and n denotes the number of viewers of the stream at the time. In addition, because of the *a priori* knowledge of differences in viewership numbers on the three platforms of interest, the ratio of hours watched per title was calculated to standardize potential differences in exposure (i.e., hours watched) of the use of a food or beverage product in a stream title across categories and platforms. The total number of unique titles and total number of hours watched under each title was assessed on a monthly level for each brand in order to examine trends over time. Aggregated monthly totals were collapsed to a total value in order to examine differences between platforms over the study period.

Titles and hours watched were compared within brand categories and across platforms using chi-squared tests. To assess the change in prevalence of brands in both number of unique titles and the number of hours watched over time, linear regression analyses were conducted for each category and for each platform. To evaluate the individual contribution of specific brand titles to the overall brand category, the top 5-brands in each category were identified for each platform and their percentage contribution to the total stream titles or hours watched was calculated.

In addition to the main analyses, we conducted a post-hoc analyses to examine differences in linear growth trends in the data pre- and peri- the COVID-19 pandemic. This was done using interrupted time series analysis with March of 2020 as a breakpoint to analyze the

differences. This analysis evaluates the linear trend pre-March, the immediate change in exposure from March to April, and the linear trend post-March. Prior to running any statistical tests, a significance level of $\alpha=0.05$ was chosen.

RESULTS

Analysis of All Platforms

Table 1 displays the Top 5 brands mentioned in stream titles across Platforms and Categories, as well as the contribution that each brand makes to the total stream titles in each category. There was a significant difference in the number of food and beverage brands from any category mentioned in stream titles ($\chi^2 = 900.7$, $df = 10$, $p<0.001$) between livestreaming platforms (see Figure 1). Across all stream titles observed, Twitch was responsible for 90% of all food and beverage brand mentions in stream titles, while Facebook contributed 6% and YouTube contributed 4%. Energy drinks were mentioned the most frequently in stream titles across all three platforms (74%), followed by restaurants (9%), soda (8%), processed snacks (5%), alcohol (3%), and candy (2%). In terms of hours watched there was similarly a significant difference in the hours watched under unique titles containing food and beverage brands ($\chi^2 = 2068296$, $p<0.001$) between livestreaming platforms (see Figure 1). Twitch was responsible for 90% of the total number of hours watched, while YouTube Gaming contributed 6% and Facebook Gaming contributed 4%. The product category with the most hours watched was Energy Drinks (80%) followed by Restaurants (10%), Soda (3%), Processed Snacks (3%), Alcohol (2%), and Candy (2%).

Figure 1. a) Bar plot depicting the number of titles containing a food brand or product name in the stream title for the platforms for all platforms across categories. b) Bar plot depicting the hours watched for all platforms across categories.

Twitch

Food and beverage brands or products were mentioned in 179,711 stream titles on the Twitch platform (Figure 2). The predominant category observed in stream titles on Twitch was energy drinks (73%, n=131,174) followed by restaurants (9%, n=16,091), soda (8%, n=14,346), processed snacks (5%, n=8,131), alcohol (3%, n=5,180), and candy (2%, n=4,249). Stream titles containing food and beverage brands or products were viewed for 196,645,623 hours. The predominant contributor to hours watched within Twitch was energy drinks (79%, n=156,181,993 hours) followed by restaurants (11% n=20,844,136), soda (3%, n=6,682,002), processed snacks (3%, n=5,596,166), alcohol (2%, n=3,443,472), and candy (2%, n=3,897,854). There was a significant increase in the number of brands mentioned in stream titles in each brand category examined on Twitch during the study period: soda (289% increase; $\beta=7.14$, 95% CI: 4.82-9.47, $p<0.001$), energy drinks (218% increase; $\beta=67.67$, 95% CI: 54.34-81.00, $p<0.001$), restaurants (158% increase; $\beta=9.10$, 95% CI: 6.81-11.40, $p<0.001$), snacks (148% increase; $\beta=3.37$, 95% CI: 2.19-4.54, $p=0.005$), alcohol (77% increase; $\beta=1.50$, 95% CI: 0.97-2.03, $p<0.001$), and candy (47% increase; $\beta=1.13$, 95% CI: 0.73-1.53, $p<0.001$). For hours watched, there was a significant increase in the hours of brand exposure on Twitch during the study period for snacks (1081% increase; $\beta=4364.00$, 95% CI: 2302.43-6424.98, $p<0.001$), soda (719% increase; $\beta=3712.00$, 95% CI: 2196.08-5227.32, $p<0.001$), energy drinks (289% increase; $\beta=106900$, 95% CI: 83023.03-130834.90, $p<0.001$), and restaurants (171% increase; $\beta=14220.00$, 95% CI: 8640.19-19797.20, $p<0.001$). No increase was observed for the candy ($p=0.87$) or alcohol ($p=0.06$).

Figure 2. a) Brands mentioned in stream titles on Twitch shown monthly for July 2019-November 2020 b) Hours Watched on Twitch shown monthly for July 2019-November 2020

Facebook Gaming

Food and beverage brands or products were mentioned in 11,971 stream titles on the Facebook Gaming platform (Figure 3). The predominant category mentioned on stream titles within Facebook Gaming was energy drinks (82%, n=9,807) followed by soda (7%, n=874), processed snacks (5%, n=628), restaurants (3%, n=343), alcohol (2%, n=202), and candy (1%, n=117). Stream titles containing food and beverage brands or products were viewed for 9,275,099 hours. The predominant contributor to hours watched within Facebook Gaming was energy drinks (83%, n=7,668,962 hours) followed by soda (7%, n=634,031), processed snacks (6%, n=601,400), restaurants (2%, n=145,880), alcohol (2%, n=188,065), and candy (<1%, n=36,761). There was a significant increase in the number of brands mentioned in stream titles for snacks (1125% increase; $\beta=4.88$, 95% CI: 2.58-7.17, $p=0.003$), soda (578% increase; $\beta=0.37$, 95% CI: 1.75-0.57, $p=0.001$), energy drinks (157% increase; $\beta=3.65$, 95% CI: 2.60-4.70, $p<0.001$), and restaurants (117% increase; $\beta=0.09$, 95% CI: 0.003-0.17, $p=0.04$). No increase was observed for Candy ($p=0.92$) or Alcohol ($p=0.30$). There was a statistically significant increase in the hours of brand exposure in soda (4072% increase; $\beta=347.00$, 95% CI: 89.71-604.26, $p=0.01$), snacks (3124% increase; $\beta=321.40$, 95% CI: 202.86-439.99, $p<0.001$), energy drinks (1270% increase; $\beta=5470$, 95% CI: 4317.42-6622.62, $p<0.001$), and restaurants (182% increase; $\beta=101.70$, 95% CI: 37.73-165.63, $p=0.004$). No increase was observed for candy ($p=0.36$) or alcohol ($p=0.95$).

Figure 3. a) Brands mentioned in stream titles on Facebook Gaming shown monthly for July 2019-November 2020 b) Hours Watched on Facebook Gaming shown monthly for July 2019-November 2020

YouTube Gaming

Food and beverage brands or products were mentioned in 8,434 stream titles on the YouTube Gaming platform (Figure 4). The predominant category mentioned in stream titles on YouTube Gaming was energy drinks (75%, n=6,299) followed by soda (11%, n=892), restaurants (7%, n=607), processed snacks (4%, n=297), alcohol (2%, n=186), and candy (2%, n=153). Stream titles containing food and beverage brands or products were viewed for 12,463,262 hours. The predominant contributor to hours-watched within YouTube Gaming was energy drinks (86%, n= 10,691,346 hours) followed by restaurants (5%, n= 676,724), processed snacks (4%, n= 542,016), soda (2%, n= 292,893), alcohol (1%, n= 119,243), and candy (1%, n= 141,040). Energy drinks were the only product category with a significant increase in the number of brands mentioned in stream titles during the study period (246% increase; $\beta=2.44$, 95% CI: 1.68-3.20, $p<0.001$). Similarly, only energy drinks experienced a significant increase in the hours of brand exposure on YouTube Gaming during the study window (790% increase; $\beta=6105.00$, 95% CI: 2822.98-9386.52, $p=0.001$).

Figure 4. a) Brands mentioned in stream titles on YouTube Gaming shown monthly for July 2019-November 2020 b) Hours Watched on YouTube Gaming shown monthly for July 2019-November 2020

Adjusted Hours per Title

There was a significant difference in the ratio of hours watched per titles across brand category by platform ($p<0.001$, Figure 5.) YouTube Gaming had the highest ratio of hours watched per titles (6528 hours per title), followed by Twitch (5217 hours per title), and Facebook Gaming (4136 hours per title). While Twitch had the highest number of food and beverage brands used in stream titles, as well as the highest hours watched, the only category in which Twitch had the highest ratio of hours watched titles was for restaurants. YouTube Gaming had

the highest ratio for candy, energy drinks, and snack, while Facebook Gaming had the highest ratio for alcohol and soda.

Figure 5. Bar plot depicting the ratio of hours of exposure to a stream title: titles containing a food brand or product name for the platforms Twitch, Facebook Gaming, and YouTube Gaming across categories.

Growth pre- and peri- COVID-19 (March 2020)

Collapsed across all brand categories, the interrupted time series analysis suggested a significant shift in number of stream titles containing brand or product names ($\beta_{\text{pre}}=0.88$, 95% CI: -8.94-10.71, $p=0.85$; $\beta_{\text{immediate}}=3269$, 95% CI: 1341.94-5195.90, $p=0.003$; $\beta_{\text{post}}=36.01$, 95% CI: 23.19-48.83, $p<0.001$), as well as hours watched for the Twitch platform ($\beta_{\text{pre}}=5196$, 95% CI: -14635.39-25028.27, $p=0.58$; $\beta_{\text{immediate}}=1913411$, 95% CI: -1976273.90-5803094.94, $p=0.31$; $\beta_{\text{post}}=61531$, 95% CI: 35658.70-87403.68, $p<0.001$; Figure 6). On Facebook Gaming, stream titles significantly increased prior to March 2020, but did not significantly increase after this date ($\beta_{\text{pre}}=1.50$, 95% CI: 0.11-2.88, $p=0.04$; $\beta_{\text{immediate}}=63.85$, 95% CI: -207.85-335.56, $p=0.62$; $\beta_{\text{post}}=-0.51$, 95% CI: -2.31-1.30, $p=0.56$). This phenomenon was also true of hours watched ($\beta_{\text{pre}}=1828$, 95% CI: 623.69- 3032.21, $p=0.006$; $\beta_{\text{immediate}}=50140$, 95% CI: -186053.90-286337.22, $p=0.65$; $\beta_{\text{post}}=2286$, 95% CI: -1342.44-1799.70, $p=0.76$). On YouTube Gaming, an immediate increase in stream titles was observed in March 2020, but differences between growth before and after this date were not significant ($\beta_{\text{pre}}=-0.08$, 95% CI: -0.98-0.83, $p=0.86$; $\beta_{\text{immediate}}=263.76$, 95% CI: 86.98-440.54, $p=0.007$; $\beta_{\text{post}}=0.23$, 95% CI: -0.94-1.41, $p=0.68$). There were no significant differences in hours watched pre-, peri-, or post- March 2020 ($\beta_{\text{pre}}=197.8$, 95% CI: -2855.81-3251.49, $p=0.89$; $\beta_{\text{immediate}}=453035.1$, 95% CI: -145887.98-1051958.15, $p=0.13$; $\beta_{\text{post}}=1337$, 95% CI: -2646.78-5320.77, $p=0.48$).

Figure 6. a) Growth trends for the number of food and beverage brand name used in stream titles on the Twitch Platform pre-March 2020 (yellow line) vs. after March 2020 (purple line) b) Growth trends for hours watched on Twitch pre-March 2020, after March 2020. Note that the yellow line post March 2020 is a projection of the trend had the COVID-19 pandemic not occurred and is not reflective of the true values.

Twitch

Between August 2019 and March 2020, the increase in titles containing energy drink brands on Twitch was not significant ($\beta_{\text{pre}}=1.32$, 95% CI: -5.58-8.21, $p=0.69$). The rapid shift to an online environment brought on by COVID-19 introduced an immediate increase in number of titles ($\beta_{\text{immediate}}=2053.23$, 95% CI: 701.10-8.21, $p=0.006$) that was sustained in the following months ($\beta_{\text{post}}=29.03$, 95% CI: 20.03-3405.37, $p<0.001$). Similar results were observed for hours watched of energy drinks ($\beta_{\text{pre}}=5934$, 95% CI: -9014.47-20881.90, $p=0.41$; $\beta_{\text{immediate}}=298656$, 95% CI: -2633182.70-34736.37, $p=0.829$; $\beta_{\text{post}}=54238$, 95% CI: 34736.37-73738.99, $p<0.001$). COVID-19 also impacted stream titles in all other categories: alcohol ($\beta_{\text{pre}}=-0.21$, 95% CI: -0.65-0.23, $p=0.32$; $\beta_{\text{immediate}}=110.04$, 95% CI: 24.02-196.06, $p=0.02$; $\beta_{\text{post}}=0.73$, 95% CI: 0.16-1.30, $p=0.02$), candy ($\beta_{\text{pre}}=-0.12$, 95% CI: -0.55-0.32, $p=0.56$; $\beta_{\text{immediate}}=95.49$, 95% CI: 10.12-180.86, $p=0.03$; $\beta_{\text{post}}=0.34$, 95% CI: -0.22-0.91, $p=0.21$), restaurants ($\beta_{\text{pre}}=-0.80$, 95% CI: -3.48-1.87, $p=0.53$; $\beta_{\text{immediate}}=518.17$, 95% CI: -6.30-1042.64, $p=0.05$; $\beta_{\text{post}}=3.94$, 95% CI: 0.45-7.42, $p=0.03$), and processed snacks ($\beta_{\text{pre}}=-0.04$, 95% CI: -1.16-1.08, $p=0.93$; $\beta_{\text{immediate}}=197.76$, 95% CI: -21.79-417.30, $p=0.07$; $\beta_{\text{post}}=1.10$, 95% CI: -0.36-2.60, $p=0.13$). COVID-19 impacted hours watched for Restaurants ($\beta_{\text{pre}}=-1402$, 95% CI: -6882.15-4078.69, $p=0.59$; $\beta_{\text{immediate}}=1382893$, 95% CI: 307999.85-2457787.04, $p=0.02$; $\beta_{\text{post}}=3328$, 95% CI: -3821.40-10478.05, $p=0.33$), but did not have an impact on the hours watched for Alcohol, Candy, or Processed Snacks, or Soda (all p 's>0.05).

Facebook Gaming

Prior to March 2020, the use of energy drink brand names in stream titles did not significantly increase ($\beta_{\text{pre}}=1.13$, 95% CI: -0.17-2.43, $p=0.05$). The introduction of COVID-19 demonstrated an immediate effect ($\beta_{\text{immediate}}=27.12$, 95% CI: -227.04-282.10, $p=0.005$), but the following growth was not statistically significant ($\beta_{\text{post}}=0.10$, 95% CI: -1.83-1.55, $p=0.08$). Hours watched of energy drinks was significantly increasing prior to March 2020 but not after ($\beta_{\text{pre}}=1473$, 95% CI: 258.14-2687.94, $p=0.02$; $\beta_{\text{immediate}}=29380$, 95% CI: -208897.08-267666.81, $p=0.79$; $\beta_{\text{post}}=449.3$, 95% CI: -1135.65-2037.24, $p=0.55$). COVID-19 also impacted stream titles in other categories: alcohol ($\beta_{\text{pre}}=0.08$, 95% CI: 0.02-0.14, $p=0.01$; $\beta_{\text{immediate}}=-7.12$, 95% CI: -18.65-4.41, $p=0.21$; $\beta_{\text{post}}=-0.08$, 95% CI: -0.16-0.006, $p=0.04$), candy ($\beta_{\text{pre}}=0.06$, 95% CI: 0.02-0.09, $p=0.003$; $\beta_{\text{immediate}}=-9.56$, 95% CI: -16.45—2.66, $p=0.01$; $\beta_{\text{post}}=-0.06$, 95% CI: -0.10 - -0.01, $p=0.01$), processed snacks ($\beta_{\text{pre}}=0.09$, 95% CI: -0.0006-0.17, $p=0.05$; $\beta_{\text{immediate}}=2.71$, 95% CI: 9.98-44.26, $p=0.005$; $\beta_{\text{post}}=-1.01$, 95% CI: -0.22-0.13, $p=0.08$), and soda ($\beta_{\text{pre}}=0.16$, 95% CI: 0.03-0.29, $p=0.02$; $\beta_{\text{immediate}}=23.62$, 95% CI: -1.04-48.29, $p=0.06$; $\beta_{\text{post}}=-0.18$, 95% CI: -1.04-48.29, $p=0.04$). COVID-19 did not have an impact of the use of restaurant names in stream titles ($p>0.05$). COVID-19 did not have an impact on the hours watched for alcohol, candy, processed snacks, restaurants, or soda (all $p>0.05$).

YouTube Gaming

COVID-19 had an immediate effect on the frequency of energy drink ($\beta_{\text{pre}}=0.15$, 95% CI: -0.53-0.83, $p=0.64$; $\beta_{\text{immediate}}=173.84$, 95% CI: 40.79-306.90, $p=0.02$; $\beta_{\text{post}}=0.26$, 95% CI: -0.62-1.15, $p=0.53$) and soda ($\beta_{\text{pre}}=-0.02$, 95% CI: -0.18-0.13, $p=0.76$; $\beta_{\text{immediate}}=51.33$, 95% CI: 20.57-82.09, $p=0.003$; $\beta_{\text{post}}=-0.13$, 95% CI: -0.34-0.07, $p=0.19$) brand names in stream titles. COVID-19 did not have an impact of the use of alcohol, candy, restaurants, or processed snack brands mentioned in stream titles (all $p's>0.05$). COVID-19 did not have an impact on the hours watched for any brand category on YouTube Gaming (all $p's>0.05$).

DISCUSSION

This study expands our previously published work and describes the presence of and potential differences between food and beverage brand exposure on three popular livestreaming

sites (Twitch, Facebook Gaming, and YouTube Gaming) across six distinct categories (alcohol, candy, energy drinks, processed snacks, soda, and restaurants) during a time period of 17-months (July 2019-November 2020). Of these platforms, Twitch was responsible for generating the greatest number of stream titles containing mentions of food and beverage brands and products. Additionally, Twitch was responsible for the majority of hours viewed under these food and beverage brands. This is not surprising given that Twitch is currently the largest livestreaming platform and has structured programs to drive advertising on their platforms^{11,21}. Recent work highlights that exposure to advertising for restaurants and food delivery services, digital (as compared to traditional) advertising, and advertising in recreational environments has been associated with an increased risk of developing obesity³¹. Therefore, characterizing the prevalence and growth of food and beverage marketing on livestreaming platforms is an important step in understanding the link between food and beverage marketing and rising rates of overweight and obesity.

Previous work has demonstrated that food advertising on traditional entertainment platforms, such as television, is dominated by calorically-dense products³²⁻³⁴. Our results are consistent with this previous work, particularly showing that the livestreaming environment is heavily saturated with energy drink advertising. We were able to see that the dominance of energy drinks was driven primarily by two brands across platforms: G FUEL (which accounted for 59% of all energy drink titles on Twitch) and NOS Energy (which accounted for 88% of all energy drink titles on Facebook Gaming and 63% of all energy drink titles on YouTube Gaming, respectively). The high numbers exhibited on these platforms are likely driven by ad campaigns and sponsored streams. As an example, G FUEL ran one of the most successful ad campaigns on the Twitch platform in 2020, drawing in over 524,000 hours of viewership by teaming up with a single top streamer¹¹. This number may not be a true approximation of the real amount of exposure obtained through this partnership as Twitch streamers often promote their Twitch streaming partnerships on other social media sites Instagram, Facebook, and YouTube, and post recordings of streaming events to their YouTube channels. Partnerships with streamers on livestreaming platforms therefore may be incredibly lucrative for brands looking for exposure.

To better understand which platforms were providing the greatest exposure per title, we examined a ratio of hours watched per number of stream titles on a given platform. This gives some insight into the potential impact of a single stream title on a specific platform despite

disparities between viewer counts across platforms. For example, Twitch has substantially more users than the other platforms, but it also has more streamers, therefore diluting the potential impact of a single sponsored streams on this platform. Therefore, this may necessitate the development of marketing campaigns that are spread over multiple streamers such that they can reach the desired audience. Even though Facebook Gaming and YouTube Gaming have fewer overall viewers as a platform, our data shows that sponsored streams on these platforms may still have a significant impact on generating exposure for brands that are targeting key streamers. This may also be indicative of the overall markets of these separate platforms and how food companies may view consumer segments based on platform or streamer segments. As these platforms continue to grow, marketing dollars and targeted ad campaigns may be more effective on these platforms, particularly for products that are not as widely advertised on Twitch. It may also be possible that these platforms are more familiar and more accessible for individuals who are not in the gaming community, and therefore targeted marketing campaigns are able to more easily draw in viewers. Future work is needed to fully characterize the potential differences between demographic characteristics of viewers across platforms to fully understand the differences in marketing on different livestreaming platforms.

Across all platforms and brand categories, increases were observed in the number of titles containing brand names and the number of hours watched associated with food brands over time. Intriguingly, neither brand exposure nor hours watched significantly decreased on any platform for any brand category. The consistent, observed growth in this project aligns with our previous work demonstrating growth on the Twitch platform in years prior to 2020. The present work also shows similar growth on other popular livestreaming platforms (i.e., Facebook Gaming and YouTube Gaming) most notably among energy drinks⁶. It is important to note that the scale of growth between platforms is different in absolute terms as the difference in usership across platforms is vast¹¹. Our results also demonstrate that COVID-19 had a significant immediate and sustained impact on the presence of food brands on livestreaming platforms. This is in line with reports from marketing research that have stated that a large shift of marketing dollars to online platforms in response to COVID-19²⁵. Indeed, there seems to be some agreement that advertising on digital platforms (including novel technologies such as livestreaming) is likely to continue to grow at a faster rate than previously expected²⁵. Time spent online had already been labeled “unprecedented,” but shelter-in-place orders and the transition to online-based work and school

pushed hours spent online to record peaks³⁵. Livestreaming has traditionally been considered a niche marketing for video gamers, yet rapid technological shifts facilitated the movement of daily events to livestreaming: children livestreamed school and social events like virtual birthday parties³⁵, political figures livestreamed video games as well as historic events³⁶, and reality TV, sports, and competition shows began trending across livestreaming platforms due to restrictions placed on in-person filming³⁷. Livestreaming is becoming increasingly commonplace, and according to the previous work, food and beverage marketing will be coming along as well.

While stream titles and hours watched are able to capture a birds-eye view of brand exposure, livestreaming platforms are abundant with other types of simultaneous brand exposure. A company has the ability to saturate the stream with advertising, including commercial ad breaks, overlay ads in the game window, banner ads above the chat window, and promotional codes given through the chat function. If a gamer is sponsored by a company, the advertisement is also linked to their social media accounts and links to product company websites. This varied advertisement exposure may work synergistically to increase brand recall, increase positive brand attitude, and actual purchasing or food choice behavior and future work is needed to fully explore these potential synergistic relationships.

While we were able to highlight the massive amounts of brand exposure and corresponding rapid growth on livestreaming platforms, future work is needed to understand the sustained effect this will have on both future marketing strategies and eating behaviors. There are currently purposeful and powerful systems in place to sustain user exposure to popular marketing campaigns. Across platforms streams are recommended to users via algorithms³⁸. Not only are social media platforms able to target potential users, but they also have access to users' browser history, metadata, and searching behavior, allowing them to push personalized marketing content onto users³⁸. For instance, Facebook Gaming recommended streams to users via algorithms, a feature that is common across all analyzed platforms³⁸. Similarly, a recent analysis of the impact of recommendations generated via algorithms on YouTube revealed that algorithm-generated recommendations were second in generating the most views only to intentional key word searches, indicating that these algorithms work in pushing content^{39,40}. Sharing of content by individuals, not just algorithms, across platforms is also commonplace. In a study published in 2020, Murphy et al. analyzed adolescents' responses to food advertising on social media and found that adolescents were more likely to share unhealthy food advertisements with friends

compared to healthy food advertisements. Additionally, they rated their peers more positively when they had unhealthy posts in their feeds⁴¹. This sharing and viewing of food advertisements alongside social components of the livestreaming environment may be particularly problematic, especially given the dearth of marketing regulations in the livestreaming environment ⁴².

Therefore, future work is need to examine how the presence and combinations of these marketing techniques impacts consumer food choice and eating behavior

This study drew its strengths from its comparison between multiple popular livestream platforms and analyzing the multiple forms of brand exposure, yet it is not without limitations. First, we were only able to look at steam titles, while previous work allowed us a more comprehensive view of the advertising on the entire platform (such as streamer profiles). This suggests that the results presented here are likely a conservative estimate of the true amount of food marketing on these platforms. Second, analysis was not restricted to sponsored streams (e.g., those with #ad in the title). This was a conscious choice, as limiting the search to #ad would have caused us to miss naturally occurring brand exposure and potential bleed over from traditional marketing campaigns into the livestreaming environment. Further, our main interest was to measure the amount of exposure of food brands, which takes place regardless of the presence of #ad. Finally, the brands of interest were developed from a published list of brands that advertised on Twitch and was updated by looking at the profiles and streams of the top 100 streamers on Twitch, YouTube Gaming, and Facebook Gaming. As a result, brands that were not on the list or found on the streamer's profiles could have been missed. However, given the extensive list of brands included in the search, the number of brands missed is likely minimal.

This work highlights the continued high levels of exposure to food and beverage brands and products on the livestreaming platforms Twitch, Facebook Gaming, and YouTube Gaming, and found that most of the brand exposure was derived from energy drink marketing on Twitch. It also is the first study to model the real-world impact of the COVID-19 pandemic on food and beverage brand marketing growth on livestreaming platforms. These findings indicate that food and beverage marketing on livestreaming platforms is an important component of online marketing practices, and should continue to be monitored.

Table 1. Top 5 brands in each of the six brand and product categories on Twitch, Facebook Live, and YouTube Gaming.

	Twitch					Facebook Gaming					YouTube Gaming				
Category	Brands	Titles	%	Hours	%	Brands	Titles	%	Hours	%	Brands	Titles	%	Hours	%
Alcohol (n=56)	Total	5180		3443472		Total	202		188065		Total	186		119243	
	Top 5	3591	69%	2878281	84%	Top 5	160	79%	176768	94%	Top 5	139	75%	107824	90%
	White Claw	1232	24%	288070	8%	Modelo	57	28%	61614	33%	Jack Daniels	49	26%	5239	4%
	High Noon	714	14%	364099	11%	Heineken	55	27%	104090	55%	Guinness	43	23%	87076	73%
	Budweiser	679	13%	2004709	58%	High Noon	31	15%	8045	4%	High Noon	19	10%	9324	8%
	Modelo	555	11%	160828	5%	Crown Royal	9	4%	557	0%	Budweiser	14	8%	4320	4%
	Heineken	411	8%	60575	2%	White Claw	8	4%	2462	1%	Modelo	14	8%	1865	2%
Candy (n=25)	Total	4249		3897854		Total	117		36761		Total	153		141040	
	Top 5	2707	64%	2728254	70%	Top 5	98	84%	21369	58%	Top 5	121	79%	66617	47%
	Oreo	975	23%	196368	5%	Oreo	56	48%	8708	24%	Oreo	46	30%	36575	26%
	Snickers	601	14%	1266912	33%	Kit Kat	22	19%	7060	19%	Kit Kat	28	18%	22823	16%
	Skittles	572	13%	178690	5%	Skittles	8	7%	1986	5%	Milky Way	18	12%	3018	2%
	Reese's	294	7%	1011653	26%	Milky Way	8	7%	2952	8%	Twix	17	11%	3884	3%
	Twix	265	6%	74631	2%	Snickers	4	3%	663	2%	Nestle	12	8%	317	0%
Energy Drinks (n=28)	Total	131714		156181993		Total	9807		7668962		Total	6299		10691346	
	Top 5	129801	99%	155270003	99%	Top 5	9667	99%	7618159	99%	Top 5	6114	97%	10609237	99%
	G Fuel	77571	59%	117764256	75%	Nos Energy	8628	88%	6319573	82%	Nos Energy	3964	63%	7515311	70%
	Nos Energy	40216	31%	18321982	12%	Red Bull	671	7%	495155	6%	Red Bull	1114	18%	1952510	18%
	Red Bull	8925	7%	14711888	9%	Monster Energy	145	1%	718294	9%	Rockstar Energy	571	9%	521662	5%
	Monster Energy	1921	1%	3951548	3%	Starbucks	127	1%	37772	0%	G Fuel	374	6%	605027	6%
	Rockstar Energy	1168	1%	520329	0%	G Fuel	96	1%	47365	1%	Monster Energy	91	1%	14727	0%
Processed Snacks (n=92)	Total	8131		5596166		Total	628		601400		Total	297		542016	
	Top 5	3907	48%	3397483	61%	Top 5	505	80%	528798	88%	Top 5	206	69%	521893	96%
	Doritos	1252	15%	2193176	39%	Dole	342	54%	245119	41%	Goldfish	89	30%	466191	86%
	Nutella	828	10%	167378	3%	Kashi	91	14%	29053	5%	Doritos	50	17%	22036	4%
	Kraft	634	8%	305352	5%	Belvita	25	4%	690	0%	Nutella	39	13%	4297	1%
	Hot Pockets	601	7%	604092	11%	Nutella	24	4%	19021	3%	Pringles	16	5%	28062	5%
	Goldfish	592	7%	127485	2%	Doritos	23	4%	234915	39%	Fritos	12	4%	1307	0%
Soda (n=68)	Total	14346		6682002		Total	874		634031		Total	892		292893	
	Top 5	9659	67%	4647951	70%	Top 5	713	82%	498190	79%	Top 5	710	80%	169962	58%
	Mountain Dew	2880	20%	1707029	26%	V8	303	35%	37681	6%	V8	373	42%	54493	19%
	Pepsi	2249	16%	236494	4%	Coke	148	17%	190100	30%	Fanta	157	18%	15806	5%
	Coke	1804	13%	1878258	28%	Pepsi	112	13%	129838	20%	Coke	63	7%	9991	3%
	Fanta	1500	10%	555292	8%	Fanta	85	10%	109792	17%	Pepsi	60	7%	38348	13%
	V8	1226	9%	270878	4%	Sprite	65	7%	30779	5%	Sprite	57	6%	51324	18%
Restaurants (n=43)	Total	16091		20844136		Total	343		145880		Total	607		676724	
	Top 5	11313	70%	9864282	47%	Top 5	263	77%	106188	73%	Top 5	450	74%	323161	48%
	Uber Eats	3062	19%	3097063	15%	KFC	145	42%	47368	32%	KFC	198	33%	109978	16%
	KFC	2647	16%	918424	4%	McDonalds	42	12%	32020	22%	Seamless	91	15%	21658	3%
	Chipotle	2462	15%	3943267	19%	Uber Eats	26	8%	3378	2%	McDonalds	81	13%	148790	22%
	McDonalds	1855	12%	1648387	8%	Chipotle	25	7%	21117	14%	Uber Eats	46	8%	19482	3%
	Taco Bell	1287	8%	257141	1%	Seamless	25	7%	2305	2%	Home Chef	34	6%	23253	3%

References

1. Fryar CD, Carroll MD, Afful J. Prevalence of Overweight, Obesity, and Severe Obesity Among Adults Aged 20 and Over: United States, 1960–1962 Through 2017–2018. *NCHS Heal E-Stats*. Published online 2020:1-7. doi:10.1001/jama.2020.14590
2. Liu CM, Kanoski SE. Homeostatic and non-homeostatic controls of feeding behavior: Distinct vs. common neural systems. *Physiol Behav*. 2018;193(February):223-231. doi:10.1016/j.physbeh.2018.02.011
3. Harris JL, Pomeranz JL, Lobstein T, Brownell KD. A crisis in the marketplace: How food marketing contributes to childhood obesity and what can be done. *Annu Rev Public Health*. 2009;30:211-225. doi:10.1146/annurev.publhealth.031308.100304
4. Zimmerman FJ. Using marketing muscle to sell fat: The rise of obesity in the modern economy. *Annu Rev Public Health*. 2011;32:285-306. doi:10.1146/annurev-publhealth-090810-182502
5. Cohen DA, Farley TA. Eating as an automatic behavior. *Prev Chronic Dis*. 2008;5(1).
6. Pollack CC, Kim J, Emond JA, Brand J, Gilbert-diamond D, Masterson TD. Prevalence and strategies of energy drink, soda, processed snack, candy and restaurant product marketing on the online streaming platform Twitch. Published online 2020:1-11. doi:10.1017/S1368980020002128
7. Wood B, Williams O, Nagarajan V, Sacks G. Market strategies used by processed food manufacturers to increase and consolidate their power : a systematic review and document analysis. Published online 2021:1-23.
8. Boyland E, Thivel D, Mazur A, Ring-Dimitriou S, Frelut ML, Weghuber D. Digital Food Marketing to Young People: A Substantial Public Health Challenge. *Ann Nutr Metab*. 2020;76(1):6-9. doi:10.1159/000506413
9. Anderson M, Jiang J. Teens, Social Media & Technology 2018. *Pew Research Center: Internet and Technology*. 2018.
10. Bründl S, Hess T. Why do users broadcast? Examining individual motives and social capital on social live streaming platforms. *Pacific Asia Conf Inf Syst PACIS 2016 - Proc*. 2016;(September).
11. Hatchet S. *Video Game Streaming Trends Report: 2020 Yearly Report.*; 2020.
12. Sjöblom M, Törhönen M, Hamari J, Macey J. Content structure is king: An empirical study on gratifications, game genres and content type on Twitch. *Comput Human Behav*. 2017;73:161-171. doi:10.1016/j.chb.2017.03.036
13. Bowman J. The Best Non-Gaming Twitch Channels, According to Twitch Streamers. *The Strategist*. <https://nymag.com/strategist/article/best-non-gaming-twitch-channels.html>. Published 2020.
14. Twitch. Facts and Figures. Published 2021. Accessed September 3, 2021. <https://www.twitch.tv/p/press-center/>

15. Clement J. Average number of viewers of YouTube Gaming Live 2020. Statista. Published 2021. <https://www.statista.com/statistics/761100/average-number-streamers-on-youtube-gaming-live-and-twitch/#:~:text=The statistic shows the average,in the last measured period.>
16. May E. Streamlabs and Stream Hatchet Q4 Live Streaming Industry Report. Streamlabs Quarterly Report. Published 2020. <https://blog.streamlabs.com/streamlabs-and-stream-hatchet-q4-live-streaming-industry-report-a898c98e73f1#:~:text=In 2020%2C viewers watched a total of 3.1 billion hours,million hours watched in Q3.>
17. Cha M, Kwak H, Rodriguez P, Ahnt YY, Moon S. I tube, you tube, everybody tubes: Analyzing the world's largest user generated content video system. *Proc ACM SIGCOMM Internet Meas Conf IMC*. Published online 2007:1-14. doi:10.1145/1298306.1298309
18. Hilvert-Bruce Z, Neill JT, Sjöblom M, Hamari J. Social motivations of live-streaming viewer engagement on Twitch. *Comput Human Behav*. 2018;84:58-67. doi:10.1016/j.chb.2018.02.013
19. Coates AE, Hardman CA, Halford JCG, Christiansen P, Boyland EJ. Social media influencer marketing and children's food intake: A randomized trial. *Pediatrics*. 2019;143(4). doi:10.1542/peds.2018-2554
20. Coates AE, Hardman CA, Halford JCG, Christiansen P, Boyland EJ. The effect of influencer marketing of food and a "protective" advertising disclosure on children's food intake. *Pediatr Obes*. 2019;14(10):1-9. doi:10.1111/ijpo.12540
21. Mikkim Marvel. Everything you need to know about "Affiliate" on Twitch. Streamer Square. Published 2020. <https://streamersquare.com/everything-you-need-to-know-about-affiliate-on-twitch/>
22. Stephen B. Twitch is testing mid-roll ads that streamers can't control. The Verge2. Published 2020. <https://www.theverge.com/2020/9/15/21437787/twitch-midroll-ad-affiliate-partner-cpm>
23. Commission FT. *Guides Concerning the Use of Endorsements and Testimonials in Advertising*.; 2009.
24. Chalk W. Twitch: The streamers furious at Burger King. *BBC News*. <https://www.bbc.com/news/newsbeat-53862091#:~:text=The whole thing revolves around,to advertise its latest offers.> Published 2020.
25. Hillier L. Stats roundup: the impact of Covid-19 on marketing & advertising. Econsultancy. Published 2021. Accessed January 3, 2021. <https://econsultancy.com/stats-roundup-coronavirus-impact-on-marketing-advertising/>
26. UConn. UConn Rudd Center for Food Policy and Obesity "Food Advertising to Children and Teens Score" Reports. Published 2020. <https://uconnruddcenter.org/research/food-marketing/facts/>
27. Rudd Report. 2019;(January).
28. Python. Difflib.py. Published online 2020.

- <https://github.com/python/cpython/blob/3.9/Lib/difflib.py>
29. Streamhatchet.com. Published 2021. <https://streamhatchet.com/>
 30. Team RC. R: A language and environment for statistical computing. Published online 2020. <https://www.r-project.org/>
 31. Yau A, Adams J, Boyland EJ, et al. Sociodemographic differences in self-reported exposure to high fat, salt and sugar food and drink advertising: a sectional analysis of 2019 UK panel data. *BMJ Open*. 2021;11:1-12. doi:10.1136/bmjopen-2020-048139
 32. Boyland EJ, Whalen R. Food advertising to children and its effects on diet: Review of recent prevalence and impact data. *Pediatr Diabetes*. 2015;16(5):331-337. doi:10.1111/pedi.12278
 33. Montgomery KC, Chester J. Interactive Food and Beverage Marketing: Targeting Adolescents in the Digital Age. *J Adolesc Heal*. 2009;45(3 SUPPL.):S18-S29. doi:10.1016/j.jadohealth.2009.04.006
 34. Emond JA, Sargent JD, Gilbert-diamond D. Patterns of Energy Drink Advertising Over US Television Networks Television Advertisements for. *J Nutr Educ Behav*. 2015;47(2):120-126.e1. doi:10.1016/j.jneb.2014.11.005
 35. Emond JA, Fleming-Milici F, McCarthy J, et al. Unhealthy Food Marketing on Commercial Educational Websites: Remote Learning and Gaps in Regulation. *Am J Prev Med*. 2020;000(000):1-5. doi:10.1016/j.amepre.2020.10.008
 36. Khan I. Twitch Is Having a Political Renaissance. Wired. Published 2021. Accessed October 3, 2021. <https://www.wired.com/story/politicians-twitch-voters-georgia-election/>
 37. Stephen B. Twitch is going to fund new reality programming. The Verge. Published 2020. Accessed October 3, 2021. <https://www.theverge.com/2020/5/7/21250545/twitch-live-programming-reality-tv>
 38. Wulf T, Schneider FM, Beckert S. Watching Players: An Exploration of Media Enjoyment on Twitch. *Games Cult*. 2020;15(3):328-346. doi:10.1177/1555412018788161
 39. Nguyen TT, Hui PM, Harper FM, Terveen L, Konstan JA. Exploring the filter bubble: The effect of using recommender systems on content diversity. *WWW 2014 - Proc 23rd Int Conf World Wide Web*. Published online 2014:677-686. doi:10.1145/2566486.2568012
 40. Zhou R, Khemmarat S, Gao L. The impact of YouTube recommendation system on video views. *Proc ACM SIGCOMM Internet Meas Conf IMC*. Published online 2010:404-410. doi:10.1145/1879141.1879193
 41. Murphy G, Corcoran C, Tatlow-golden M, Boyland E, Rooney B. See, Like, Share, Remember: Adolescents' Responses to Unhealthy-, Healthy- and Non-Food Advertising in Social Media. *Int J Environ Res Public Health*. 2020;17(2181):1-25.
 42. Edwards CG, Pollack CC, Boyland EJ, Evans RK, Gilbert-Diamond D, Masterson TD. Online Food Marketing in the Livestream Environment: What Is the Role of Censorship? *Ann Nutr Metab*. 2020;16802. doi:10.1159/000512118