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Body like an idol: K-pop fitspiration on Tumblr – an analysis of texts and images

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Abstract

Eating disorders are a major health issue in societies today which oftentimes remain untreated. In social media, such as Tumblr, people build communities to exchange information and connect to each other using specific hashtags. Some of these trends which emerge around these hashtags, are related to eating disorders. This study in information science addresses how inspiration for fitness (Fitspiration) inspired by music fandom (in particular K-pop) can be characterized on Tumblr by automatically analyzing text and images of posts. Images are evaluated based on their colorfulness and emotional measures, texts undergo a sentiment and readability analysis, as well as an evaluation of their psycho-linguistic features. Furthermore, a qualitative content analysis of K-pop Fitspiration posts (n=119) is performed and they are compared to the K-pop Thinspiration posts, regular Thinspiration and control group posts. Results reveal, that K-pop Fitspiration posts are oftentimes more similar to posts from the control group than to Thinspiration posts, but that they also share psycho-linguistic features with posts of eating disordered users.

Keywords: social media, data mining, feeding and eating disorders, computer-assisted image analysis, exercise, psycholinguistics

Introduction

The use of social media is considered to be linked to mental health struggles such as the development of eating disorders. For instance, Mabe et al. [1] showed in their study that young girls were negatively influenced in regards to their body perception by typical Facebook consumption patterns. Watching idealized photos on social media also caused higher body dissatisfaction in study participants than watching the non-edited version of the same photo [2]. This trend is popular on Instagram and is called 'Instagram vs. Reality' [3]. Further trends appear on social media. Some are related to diseases such as anorexia nervosa. For instance, the hashtag 'Thinspiration' is used to share inspirational content to lose weight [4], while 'Fitspiration' shall inspire to become fit and healthy [5]. Both hashtags appear in the context of K-pop (Korean popular music) and fans of K-pop bands share their favorite idols' very restrictive diets [6] as well as their intense workouts [7]. K-pop diets and workout plans are popular online and the phenomenon of K-pop

Thinspiration was investigated previously [8]. Following our previous study, the goals of the present work are to

1) automatically analyze K-pop related Fitspiration posts on Tumblr, which contain images and texts by using the image measures colorfulness, pleasure, arousal and dominance, as well as analyzing the texts using sentiment and readability analyses besides using the psycholinguistic features of linguistic inquiry word count (LIWC) [9],
2) perform a manual content analysis of the K-pop related Fitspiration posts to better understand what the images show and the texts discuss,
3) compare the K-pop Fitspiration content to K-pop Thinspiration, regular Thinspiration and average Tumblr content to understand how it is embedded as a trend into the eating disorder related social media content.

K-pop idols' eating and sports routines are oftentimes discussed by their fans [6,7], sometimes resulting in dangerous outcomes [10]. It is important to understand K-pop Fitspiration content and how it is different from other eating disorder related social media posts to prevent users from consuming potentially harmful content leading towards serious diseases such as eating disorders.

Related work

Eating disorders are a major health issue for our societies. Anorexia Nervosa, for instance, is, among mental disorders, the one with the highest mortality rate. The prevalence is highest amid young women [11]. Those affected have a very high comorbidity with other diseases such as depression, anxiety disorders and dysthymia [12], combined with an increased risk of suicide [11]. The group of young women are also the main consumers of the K-pop industry which defines the youth and perfect bodies of their idols as the biggest commercial potential. Consequently, young people identify with their idols [13]. Some fans were so inspired by their favorite artists, that they became hospitalized after trying the same diet [10]. Among the eating disorder trend hashtags on social media, variations with relation to K-pop appeared, namely K-pop Thinspiration and K-pop Fitspiration, which can be related to two of the diagnostic criteria of Anorexia Nervosa: Restriction of food and excessive exercise [11].

Social media users share e.g. pictures of very thin bodies under the hashtag Thinspiration or its abbreviation Thinspo to remain or become very thin. The term is an amalgamation of the words thin and inspiration [5]. Research could show a link between Thinspiration content and the downplaying of anorexia as a legitimate lifestyle choice instead of a mental disease [14]. A different study [15] also found Thinspiration present in 25% of the analyzed data, that was retrieved using anorexia related hashtags like #ana (ana = personification of the disease Anorexia Nervosa). Large proportions of Thinspiration posts discuss dieting and the limitation of food [5,16]. Another behavior to counteract weight gain among anorectic patients is intense exercising [11]. A different trend focuses more on the promotion of being healthy by eating well and exercising along with the message of strength and empowerment. This content is shared under the hashtag Fitspiration [5]. Albeit being more a positive counterpart to Thinspiration, Talbot et al. [17] found in their comparison of Thinspiration, Fitspiration and Bonespiration (inspiration to have protruding bones), that a small group of Fitspiration posts depicted extremely thin bodies and therefore were similar to the Thinspiration content. Wick and Harriger [16] also found that only very few Tumblr posts showed muscular people or discussed

exercise. Achilles et al. [8] reached a similar result: K-pop related Thinspiration posts also only rarely showed a visible muscle tone or addressed exercising. Furthermore, they could show through their automatic image and text analyses that the K-pop related content is more similar (in terms of e.g. the images' colorfulness, or the texts sentiments) to the posts of the control group, instead of the posts shared under the regular Thinspiration hashtag.

Different studies tried to distinguish between eating disorder related content and posts of a control group. Uban et al. [18] used LIWC features to train a classifier that successfully differentiates between anorectic and control users. De Choudhury [19] used LIWC to classify different communities within eating disorders. Tumblr as a tool to support recovery was researched by Chancellor, Mitra and De Choudhury [20]. They also used LIWC to gain more insight into cognitive, affective and linguistic processes of social media users suffering from anorexia.

The study of Achilles et al. [8] showed the role of K-pop idols in the context of Thinspiration. Their extremely restrictive diets and the pressure to look absolutely perfect, can be influencing to their mostly young audience. For instance, while limiting the calorie intake for female girl group members to not more than 800 and having entertainment company rules such as 'no food', the trainees undergo intense dance practice and additional gym sessions. One member of a girl group for example answered in an interview, that she worked hard with a personal trainer in addition to her stage performances after the groups debut, to lose weight and improve the shape of her body [13].

Fitspiration inspired by K-pop idols therefore can inspire fans to put themselves in intense workouts paired with little caloric intake combining the two risk factors of Anorexia Nervosa. This work addresses this gap in research.

Material and methods

As the basis for this study, four data sets were assembled from Tumblr. The automatic approaches for analyzing images and texts (goal 1) and the procedure of the content analysis (goal 2) is explained. The comparison (goal 3) is done in the results section.

Data collection

To study the differences between K-pop Fitspo, K-pop Thinspo, regular Thinspiration and 'normal' Tumblr content four different data sets were constructed, three of which (K-pop Thinspo, Thinspo and Control) were taken from Achilles et al. [8]. All collections consist of the posts' texts and the images that were published with them. The K-pop Fitspo data set was newly assembled applying the same method as that for the K-pop Thinspo collection. The same hashtags were used, replacing the keyword "thinspo" or "thinspiration" by "fitspo" or "fitspiration" respectively. This process led to three hashtags (#kpop fitspiration, #kpop fitspo, #kpop-fitspo) which were extended by two more relevant hashtags (#kpop fitblr, #kpop fitness). Before processing the texts markup language like e.g. HTML tags were removed.

The four data sets can be characterized as follows:

1. K-pop Fitspo: Contains posts of K-pop inspired Fitspiration, retrieved with the hashtags described above.
2. K-pop Thinspo: Consists of K-pop Thinspiration posts. Tags like #K-pop Thinspiration were used to retrieve these posts [8].
3. Thinspo: Contains posts, shared under the hashtag #Thinspiration, removing those

which co-appeared in the K-pop Thinspo set [8].

4. Control: Was assembled using the tag #love and serves as a collection of posts that are not related to eating disorders [8].

Table 1 shows the basic statistics for all data sets.

Automatic image analysis

It was found that K-pop Thinspiration images are similar to control posts instead of being close to regular Thinspiration content [8]. Therefore, K-pop Fitspo images are analyzed in the same way calculating colorfulness, pleasure, arousal and dominance values.

The colorfulness measure is derived from the opposing color spaces' mean and standard deviation and was empirically determined [21]. The higher the colorfulness measure C, the more colorful the image is. C ranges between 0 (not colorful) and 109 (extremely colorful). The following equation shows how C is calculated:

$$C = \sigma_{rgyb} + 0.3 \cdot \mu_{rgyb}$$

Besides, the emotional image measures pleasure, arousal and dominance were calculated for each image. Valdez and Mehrabian [22] conducted a series of empirical experiments linking the saturation and brightness of colors to an emotional impact on the participants. They derived formulas based on the average saturation (S) and brightness (B) values of an image to calculate the emotional measures as it is shown in the three following equations:

$$Pleasure = 0.69 \cdot B + 0.22 \cdot S$$

$$Arousal = -0.31 \cdot B + 0.60 \cdot S$$

$$Dominance = -0.76 \cdot B + 0.32 \cdot S$$

Not only the study by Achilles et al. [8] utilized this method, but also a study on affective image analysis [23] as well as work on analyzing self-harm social media content [24]. Furthermore, it was used to investigate images of another eating disorder related trend [25].

Table 1. Basic descriptive statistics of the four data sets, partly from a previous study [8]. Numbers are rounded to two decimal places.

	K-pop Fitspo	K-pop Thinspo	Thinspo	Control
Number of posts	119	431	3,707	4,000
Number of posts containing images	87 73.11%	361 83.76%	1,493 40.28%	2,804 70.1%
Number of images	156	886	2,824	3,229
Number of unique users	28	162	1,121	9,975
Mean posts per user	4.25	2.66	3.31	1.34

Automatic text analysis

To automatically analyze the texts of the Tumblr posts, a sentiment and readability analysis as well as an evaluation utilizing the LIWC lexicon [26] were performed on post level.

Sentiments in the context of eating disorders have been successfully analyzed in different studies [e.g. 8,25,27]. For this study the tool VADER [28] was used. Developed for social media content it can interpret elements like emojis or words written in capital letters. VADER's score ranges between extreme negative (-1) and extreme positive sentiment (+1) with a neutral area between -0.05 and +0.05 [29].

The readability of posts was found to be a significant feature in identifying an eating disorder trend [25]. The formula used to evaluate the readability of the posts is the Flesch Reading Ease Score (FRES) [30] which has no minimum score while the maximum value is 121.22. The reading difficulty ranges from very easy (high FRES) to very confusing (low FRES) [31]. The following equation shows the calculation of FRES:

$$206.835 - 1.015\left(\frac{total\ words}{total\ sentences}\right) - 84.6\left(\frac{total\ syllables}{total\ words}\right)$$

Previous studies successfully applied the LIWC lexicon to differentiate between communities of eating disorders [19] or anorectic social media users and those of a control group [18]. LIWC maps English words to categories such as syntactic, affective or thematic features. The lexicon was assembled by human experts ensuring high quality of the automatic analyses. The latest version, LIWC-22 [32], was applied to all four data sets.

Content analysis

The content analysis was performed using the same methodology from previous studies [8,16]. Due to the limited amount of K-pop Fitspo posts, it was decided that all 119 posts in this data set are analyzed. Each post consisted of text or one or more images or both. If multiple images appeared, only the first one was represented in the content analysis. Two coders rated all posts following a classification scheme used by Wick and Harriger [16], who developed it based on previous studies in the context of eating disorders [33,34]. Image and text variables that appeared in the analyzed post were coded with a '1', those that did not appear were coded with '0'. Table 3 shows the possible variables taken from Achilles et al. [8]. Both annotators discussed unclear cases and the scheme before they started coding. The inter-rater agreements show an overall good agreement (see also Table 3).

Results

This section discusses the results of image, text (goal 1), content analyses (goal 2) and the comparison of the different data sets (goal 3). Table 2 provides a summary of all features used to compare the data sets. The numbers represent statistical significance testing based on Kruskal-Wallis tests [35] and post-hoc Dunn tests [36]. The tests are based on a sample of 70 for the texts and 150 for the images to have similar group sizes.

Automatic analyses of texts and images

Figure 1 shows the results of the visual analysis. The K-pop Fitspo images are similarly colorful as the K-pop Thinspo ones. They are significantly more colorful than the regular Thinspo images (see Table 2). They also have the highest values in the emotional measure pleasure, which means that the brighter and more saturated colors of the K-pop Fitspo images cause more pleasure in the observer. There is a significant difference in K-pop Fitspo and the other collections' images in this measure. The same

is true for the dominance values. The arousal values show that K-pop Fitspo images differ from the ones of the control group and that social media users watching the images feel only little aroused. However, also the Thinspiration data sets can be differentiated from the control group images.

The text analysis shows that there is only a significant difference in sentiments between regular Thinspo posts and the ones of the control group. However, their distributions look very different (see Figure 2). The K-pop Fitspo sentiments are rarely negative but have, besides the peak in the neutral area, a second peak in the extreme positive. On the other hand, the readability analysis shows that all data sets differ from the control data set. The Fitspo posts are easiest to read with over 50% of posts being in this category.

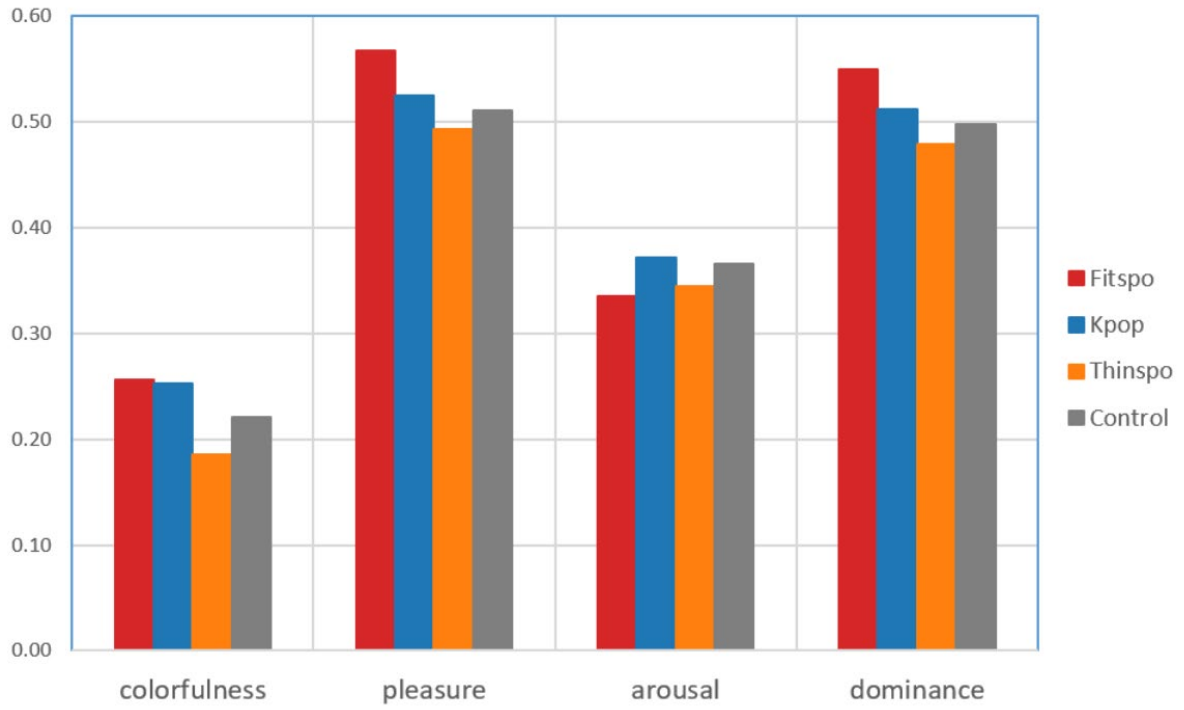

Figure 1. Results of the visual analysis of the images of the four different data sets. Bars represent the normalized means of the measures.

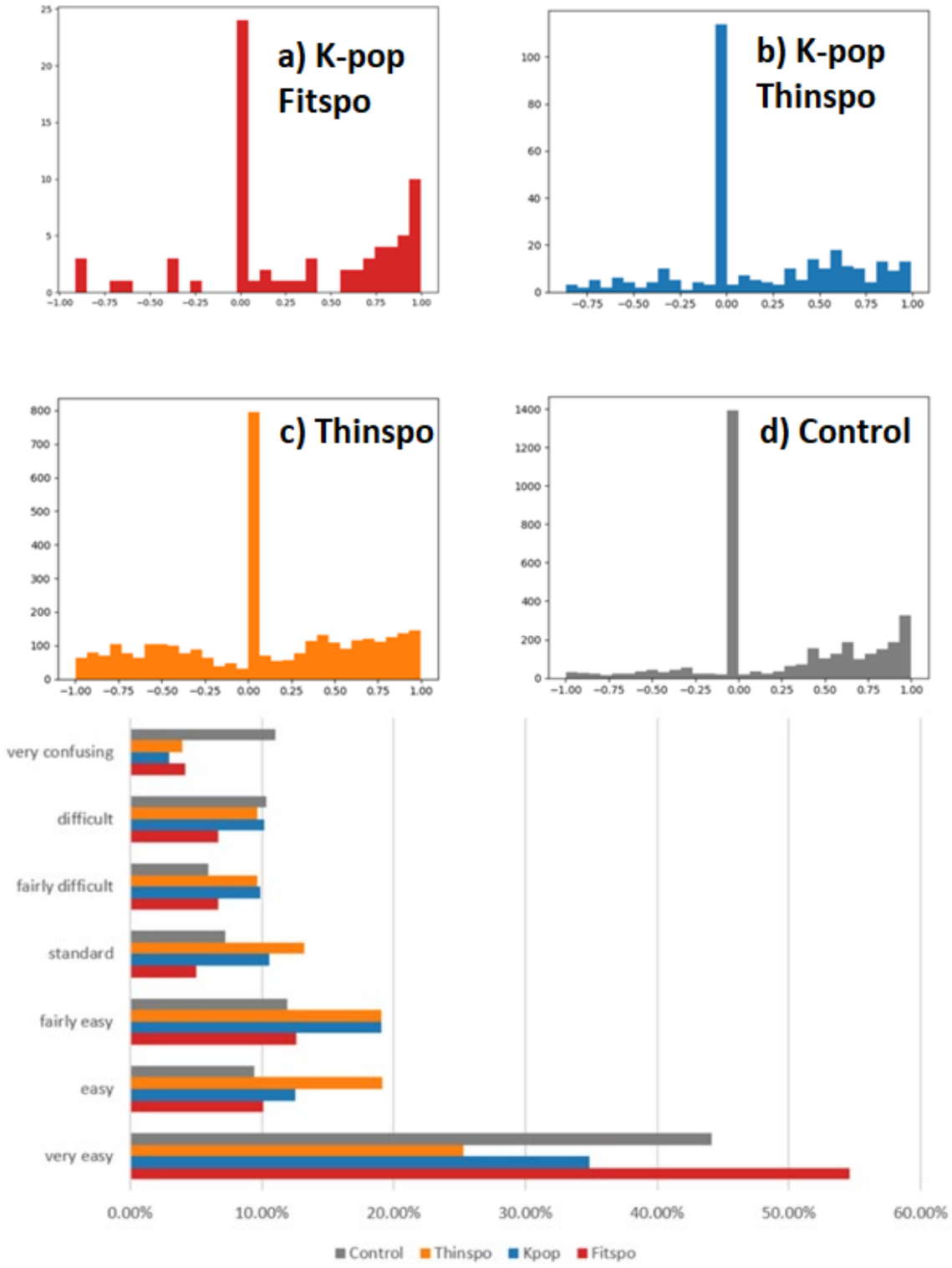

Figure 2. Top: Results of the sentiment analysis. X axis represents the sentiment values, Y axis depicts the frequency of posts. Bottom: Results of the readability analysis. X axis shows the proportion of posts per data set, Y axis depicts the readability category.

LIWC-22 contains 117 features of which 73 were significantly different. However, for this analysis the categories that represent anorexia symptoms were chosen (see Table 2 'Physical') as well as the Linguistic Dimensions and Culture & Lifestyle topics Uban et al. also found to be relevant in their study [18]. The LIWC features represent percentages of total words in the analyzed context (post level). LIWC's summary variables were also included. They are computed by summarizing various features based on findings from previous empirical research. The values represent standardized scores that were converted to percentiles which range between 1 and 99 [37].

Table 2. Mean values for each measure per data set. Significant difference between [1] K-pop Fitspo and K-pop Thinspo; [2] K-pop Fitspo and Thinspo; [3] K-pop Fitspo and Control; [4] K-pop Thinspo and Thinspo; [5] K-pop Thinspo and Control; [6] Thinspo and Control.

	K-Pop Fitspo	K-Pop Thinspo	Thinspo	Control
Images				
Colorfulness[2,4,6]	41.54	41.05	29.49	38.85
Pleasure[1,2,3]	128.31	118.25	115.05	115.66
Arousal [3,4,6]	-7.46	0.19	-11.72	6.34
Dominance [1,2,3]	146.90	136.18	131.17	133.88
Text				
Sentiment [6]	0.31	0.17	0.11	0.3
Readability [3,5,6]	57.41	69.45	66.53	22.95
LIWC Features				
Physical				
Health [1,3,4,6]	2.16	0.94	3.70	0.39
Illness [6]	0.03	0.10	0.37	0.0
Wellness [1,3]	0.85	0.17	0.53	0.15
Mental [4,6]	0.08	0.0	0.51	0.02
Food [6]	1.60	1.85	3.01	0.45
Linguistic Dimensions				
Function words [6]	43.55	41.42	47.40	30.07
Personal pronoun [6]	8.68	11.04	11.59	8.31
1st person sing [3,4,6]	6.78	7.10	9.22	3.53
3rd person sing [4,5]	0.60	2.89	0.41	0.41
Culture & Lifestyle				
Technology [3,5,6]	0.82	0.10	0.12	1.36
Leisure [1,2]	0.80	0.20	0.15	0.96
Work [1,3]	1.03	0.11	0.37	0.46
Summary Variables				
Analytical Thinking [3,5,6]	45.75	43.32	37.94	63.88
Clout [3,4,5,6]	25.13	33.07	20.28	51.08
Authentic [3,4,6]	56.95	38.61	62.76	28.78
Emotional tone [2,5,6]	42.84	35.14	31.97	55.37

The K-pop Fitspo posts differ in terms of first person singular pronoun usage (almost double) but also the K-pop related Thinspo posts show similar percentages. For the third person singular pronouns a differentiation between K-pop Thinspo and regular Thinspo, as well the control group content can be observed (about seven times more often). Regular Thinspo and K-pop Thinspo content have in general a higher usage of personal pronouns compared to the control group or the K-pop Fitspo posts. In almost all physical topics, Thinspiration content differs from control posts. The topics health, illness, mental and food appear significantly more often. Only wellness is predominantly discussed in the K-pop Fitspo group. Addressing conversations about health it becomes clear that the Fitspo and regular Thinspo posts share a higher interest compared to the other two groups. Coming to the culture and lifestyle topics, we can observe differences between K-pop Fitspo and control group posts in technology and work-related discussions. The leisure category differs among the K-pop and the Thinspo data sets. Looking at the summary variables it becomes clear that the Fitspo posts are different from the ones in the control data set (besides emotional tone). Also, the K-pop related Thinspiration, as well as the regular Thinspiration content differs from the control posts in all summary variables. Analytical thinking represents the usage of words that express formal, logical and hierarchical thinking. Lower scores indicate a more personal style; higher values suggest an academic setting [37]. The K-pop Fitspo score is in between both extremes, close to the K-pop Thinspo analytical thinking value. However, the control posts tend to be significantly less formal than the K-pop Fitspo posts. The same applies for the clout measure, which refers to the relative social status, confidence or leadership qualities [37]. K-pop Fitspo posts express these topics much less (approximately half) than posts taken from the control group. Authentic users write more spontaneously and without self-regulating their posts [37]. The highest average values in the four data sets can be found in the regular Thinspo posts, followed by K-pop inspired Fitspiration posts. The emotional tone with scores below 50 suggests a more negative tone, while above 50 refers to more positive tone [37]. The only data set expressing on average positive emotions is the control data set.

Content analysis

Table 3 summarizes the content analysis. As already found in the K-pop Thinspiration posts [8] the two most prominent categories for images were ‘thin’ (83.91%) and ‘culturally based beauty ideals’ (87.36%). These two categories are followed by ‘thin pose’ (58.62%), ‘sexual objectification’ (17.65%), ‘muscular’ (17.24%), ‘bathing suits’ (4.61%), ‘curvy/overweight’ (3.45%) and ‘before/after’ (1.15%). There were no people depicted wearing only underwear and the category ‘image other’ (5.88%) contained images of food, as well as images of workout plans or playlists for K-pop inspired workouts.

There were no textual sexual objectifications as well as no objectifying messages found among the K-pop Fitspo posts. Instead the most prominent category among the texts was ‘exercise for appearance’ (31.94%), closely followed by ‘losing weight or fat’ (29.17%), ‘thin praise’ (22.22%), ‘dieting/restraint’ (20.83%) and ‘food guilt’ (13,89%). ‘Fat stigma’ as well as ‘body/weight guilt’ only appeared rarely (6.94% and 4.17%) and there were no sexual objectifying or objectifying messages. The ‘text other’ category (21.85%) contained mostly only the names of K-pop idols as an addition to a photo of those.

Table 3. Description of text and image variables used to classify the K-pop Fitspiration posts as introduced by Wick and Harriger [16] and as extended by K-pop descriptions by Achilles et al. [8]. Summary of the results from the content analysis. Frequencies are based on the annotators' averages.

Variable	Description	Frequency	Cohen's Kappa
Image variables (87)			
Thin	Showing very thin bodies, corresponding to figures 1-2 on Swami's photographic figure rating scale [42]	73 83.91%	0.77
Muscular	Visible muscle tone	15 17.24%	0.85
Curvy/Overweight	Corresponds to figures 6-10 on Swami's photographic figure rating scale [42]	3 3.45%	0.81
Culturally Based Beauty Ideals	Shows persons with blemish free skin, neat and shiny hair, symmetrical features, white and straight teeth, lithe figure, supple breasts, or other culturally based beauty norms; For K-pop features like idols on stage or photo shooting pictures were also included into this category	76 87.36%	0.93
Bathing Suits	Wearing only a bathing suit	4 4.61%	0.74
Underwear	Wearing only underwear	0	-
Sexual Objectification	Wearing little clothing (including underwear or bathing suit) or displayed in a sexual context	21 17.65%	0.73
Before/After	Before/after photo of the same person, demonstrating weight loss	1 1.15%	1.00
Thin pose	Posed to appear smaller (e.g., angling body at 45°, putting hands on hips, crossing one leg over the other etc.	51 58.62%	0.73
Image other	Images that do not fit in one of the other categories	7 5.88%	0.85
Text variables (72)			
Sexual Objectification	Promotes person as object of sexual pleasure	0	-
Fat Stigma	Implies negativity in regard being overweight	5 6.94%	0.79
Thin Praise	Implies positivity in regard to being thin	16 22.22%	0.74
Exercise for Appearance	Encourages exercise for appearance related reasons	23 31.94%	0.75
Food Guilt	Guilt-inducing messages about food	10 13.89%	0.71
Dieting/Restraint	Discusses dieting or restraint around food	15 20.83%	0.62
Loosing Weight or Fat	Discusses loosing weight or fat	21 29.17%	0.88
Objectifying Messages	Encourages viewership of the body as an observable object	0	-
Body/Weight Guilt	Guilt-inducing messages about body or weight	3 4.17%	0.66
Text other	Texts that do not fit in one of the other categories	26 21.85%	1.0

In comparison to the findings of Achilles et al. [8] it can be observed, that K-pop Fitspiration shows a stronger fixation on the body and its appearance. The image variables 'thin' and 'culturally based beauty ideals' appear approximately 10- 15% more often and the bodies depicted are more muscular (+17%) and are shown in poses to appear thinner more often (+ 23.59%). Similarly, guilt inducing categories decreased in frequency (body/weight guilt: - 14.35%; food guilt: - 2.16%). The focus seems to be more on being healthier than just on being thin ("[@blogname] tries to redefine the kpop diet giving it her own touch and thinking about diet as a healthy lifestyle rather than just doing it for the 'perfect' body"). There is also a strong focus on exercise (+ 27%), which often goes along with the expression of positivity towards being fit: "I officially can run for the entirely of Drunk-Dazed. I'm so impressed with and proud of myself" (Drunk-Dazed = Song of the band Enhypen). Apart from one exception, no irony was expressed in these posts. In the K-pop Thinspiration content analysis, the researchers found many eating disorder related memes in the 'image other' category. Pictures of this kind were not found in the K-pop Fitspiration posts.

Comparison between K-pop Fitspiration, K-pop Thinspiration, regular Thinspiration and average Tumblr content

Interestingly, the quantitative analysis (see Table 2) shows, that the K-pop Fitspiration posts at first sight seem to be, from their outward appearance, closer to the control data set. For instance, the colorfulness of both K-pop data sets is significantly higher than the one of the Thinspiration imagery, but not to the control posts' images. But the texts show traits of eating disorder related posts. For example, the more frequent usage of first person singular pronouns, which implies a greater focus on oneself and so a higher degree of social isolation, was also observed in past research, but can also be observed in this study. De Choudhury [19] found anorectic users also to have higher usage of first person singular pronouns compared to pro-recovery users and Uban et al. [18] observed the same characteristic when comparing users suffering from anorexia and users of a control group. This is also true of the K-pop Fitspo and regular Thinspiration postings' common increased emphasis on talking about health-related issues. This higher interest on health was also observed in anorectic users before [18], and this shows another linkage between eating disorder traits and K-pop content inspired to be(come) fit. Another similar feature is the higher usage of wellness words in the Fitspiration posts, which is significantly different from K-pop Thinspo and control posts (but not from Thinspiration posts). This represents again a shared trait with posts related to eating disorders. Especially interesting is also the discussion of food. The only statistically significant difference was observed between regular Thinspiration posts and the ones from the control group, which suggests that the K-pop inspired posts do not differ much from the eating disorder related Thinspiration posts again. The higher focus on food was again also described in previous work [18] in comparison of anorectic users and others.

Discussion and conclusion

The results show that the K-pop Fitspiration posts appear at first sight to be similar to content of the control group, but they also share many psycho-linguistic features with posts from people who suffer from eating disorders. This adds to previous findings of similarities between Thinspiration and Fitspiration imagery [17] and confirms the results of Achilles et al. [8]. Implications concluded from these findings can be of technological, clinical and ethical nature.

Understanding trends such as K-pop Fitspiration or Thinspiration could help identifying characteristics within related posts, that can serve as predictive factors. Table 2 gives a first idea what kind of traits could be useful for differentiating between harmful and not risky social media posts. For example, as mentioned above, the frequency of first person pronouns is much higher in the three groups that have a relation to Fitspiration or Thinspiration and could therefore serve as an indicator in automatically evaluating posts. But also the qualitative insight on the texts and images (see Table 3) bears the potential to help machines understand problematic posts in the future. An early evaluation of these different characteristics could prevent social media users at risk from spiraling into eating disorder communities and could lead to opportunities in designing user interface elements, that can be displayed to social media users at risk when consuming problematic content or preventing the posting of it. Software tools of this kind could be implemented into mobile versions of the social media site and could serve as early warning mechanisms that can provide personalized risk reports about potentially damaging behaviors of social media users and can suggest for instance other activities to the users at risk. Research has already addressed the effect on how tailoring elements of reports of dieting and fitness apps can improve the nutrition of users and help them to reach their health goals [38]. Especially on mobile devices, monitoring software could be linked to other applications, such as those who help people monitoring and strengthening their mental health (e.g. diary apps) or social media sites could suggest a different activity to a consumer of potentially harmful content like for instance going for a walk or meditating.

Technical linkage to other (e.g. mental health diary) apps can help clinicians to find out, in cooperation with their patients, what kind of content makes the patient feel stressed for instance. They can identify triggers and build strategies to circumvent self-damaging behavior. One study found that engaging in online communities thematizing self-injuring behavior can trigger these actions offline [39]. And also the consumption of eating disorder content online can trigger problematic behavior [40]. Finding strategies for people affected can lead to a faster and more sustainable therapy, which is, knowing that only one out of three patients with diagnostic criteria of anorexia nervosa receives treatment [41], beneficial for the patients and society itself. Research that helps understanding fan communities forming around trends, like K-pop Fitspiration or Thinspiration, can help establishing recovery communities, run by clinicians or organizations exposing people potentially at risk to healthy ways of being inspired by their idols, for instance by promoting healthy ways of eating or working out.

The sensitive nature of the social media data analyses evokes information ethical questions. Applications like those described above must follow strict privacy rules and the insights gained from the data analysis must be made available only to the individual who owns the social media profile. It is a challenging task to find a reasonable balance between data protection and intervention. It is important to raise awareness of a potential problem, in this case a tendency to eating disorders for the person affected. On the other hand, the vulnerability of a social media user could be shared with trusted others, like for instance parents or therapists. This is particularly important when the disease is already at an advanced stage and the patient is at risk of suicide. Furthermore, this way of observing someone's mental health carries the risk of discrimination and stigma. Protecting social media users from these potential consequences is important to consider in designing interventions resulting from the

knowledge we gained from K-pop inspired Fitspiration and Thinspiration analyzes.

Future research in this area should further explore non K-pop inspired Fitspiration content and address solutions for technical interventions and the involvement of health professionals in alignment with privacy norms.

Conflict of interest

The authors declare no conflict of interest.

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