Selfie examinations: Applying computer vision, hashtag scraping and sentiment analysis to finding and interpreting selfies

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ABSTRACT
In this preliminary investigation of selfies (self portraits in social media), we assess methods for identifying selfies and examine selfies as a form of emotional expression. We compare the accuracy of hashtags and computer vision in discriminating selfies form other images, using human ratings as a reference. Customized software was used to scrape (acquire from social media feeds) 2700 probable selfies and randomly select a sample of 100 images. To describe the emotional attributes of selfies we classified photos using customized sentiment analysis software and qualitatively examined photos. Although the majority of the selfies are upbeat, approximately 20% contain negative emotion words, with some reflecting isolation, disengagement and despair. Our examination shows promise for automatic detection of selfies using a blend of metadata, sentiment analysis and computer vision. The observation of selfies associated with despair and disengagement suggests opportunities to naturalistically assess and immediately address psychosocial needs.

Author Keywords
Identity; Self-expression; social media; sentiment analysis; metadata; Computer vision; emotion; loneliness.

ACM Classification Keywords
H.5.m.

INTRODUCTION
Our analysis of selfies was initially motivated by drive to eliminate them from artistic displays of social media. In these public art installations, we wanted to highlight content that reflected shared interests rather than the depiction of individuals' hair, dress, shoes and physical posture. But in the quest to eliminate selfies, we became interested in their defining features. We also sought to learn about the emotional states and needs of the people who post them.

Selfies are increasingly prevalent in social media and a central topic of discussion in the popular press. It is frequently observed that a large portion of images on Instagram are selfies, and a poll indicates 30% of photos taken by individuals between 18 and 24 in the UK are selfies [1]. Interest in selfies is evidenced in the addition of the term to the Oxford Dictionaries Online with the definition "a photograph that one has taken of oneself, typically one taken with a smartphone or webcam and uploaded to a social media website."

Opinions of journalists and the experts they interview vary about whether selfies reflect an epidemic of narcissism, creative self-expression and social broadcasting, the fulfillment of social expectations, or a developmentally important means of identity construction. Identities are constructed throughout life as one explores new social roles [2]. Identity exploration can occur through action, verbal expression, artistic creation, or manipulation of one's appearance. Through this lens, self-portraiture on Instagram and other social media appears as a contemporary means of identity play and construction.

In addition to the forms of identity expression above, we questioned whether some selfies indicated a desire for interpersonal connection. By its essential criteria – a picture that one has taken of oneself – the selfie implies aloneness. The immediate sharing of a solitary picture may in some cases reflect isolation or despair. Such emotional states may be observable through the qualities of images and metadata. Services and support could conceivably be offered based on this detection.

METHODS
In this preliminary investigation we used a layered approach to identify and describe selfies. This approach involved visual inspection and heuristic classification of

selfies, scraping of Instagram by hashtags, sentiment analysis, computer vision and qualitative analysis of images and captions.

We considered many different options for a computer vision algorithm including basic face detection, emotion detection, scene analyzers and GIST algorithms [6]. We sought to distinguish standard "head shot" portrait photos from selfies and decided to use an algorithm that used similarity characteristics rather than absolute characteristics.

Our algorithm was inspired by the "Kind of Like That" [4] algorithm described in a blog post. This algorithm uses a reference or training set of photos that represent typical types of selfies encountered in social media streams. The algorithm reduces the size of the two photos to be compared to eliminate high frequency components, reduces the color to grey scale, computes a brightness gradient and then computes the hamming distance of the resulting gradients.

An initial visual inspection and heuristic categorization of selfies was conducted to identify common features and inform the CV algorithms. This training set was generated by manually selecting 54 photos from a random set of 200 photos that had been tagged as selfies by the person that posted the photo to Instagram.

We developed a custom set of tools to scrape and analyze Instragram stream. These tools allowed us to develop simple algorithms that used photo captions and tags to perform categorize photos. These algorithms produced a set of key words that were used as seeds for scraping Instagram feeds. This generated a sample set of 2700 photos with metadata that were used for the analysis described in this paper. The following terms were generated from these algorithms: me, myself, selfies, selfie, selfy, selfiemode, mirrorpic, self-portrait, morningselfie, selfphotography, instaselfie, selfietime, selfiepic.

We emotionally classified the 2700 images by running custom sentiment analysis software on the metadata. Approximately 10% of these photos contained emotion words that triggered the sentiment analysis software. Emotion words were associated with four quadrants of the circumplex model: 1) negative emotion/high arousal, 2) positive emotion/high arousal, 3) positive emotion/low arousal and 4) negative emotion/low arousal.

We report on the sentiment analysis in three fashions: analysis of all words across all identified selfies, analysis of photos based on the sentiment analysis of captions such that one photo could be classified in all four quadrants, and lastly analysis of photos that contained only emotion terms in only one of the four quadrants. Additionally, we rank the common terms associated with each quadrant.

Qualitative observations were made about the expression of identity and emotional states.

RESULTS

Visual categorization of selfies to inform a computer vision algorithm

To develop a CV alogorithm, we began by visually examining selfies for defining features. The following three categories emerged: 1. Selfies taken in the mirror. These photos may include a full person, part of the person or more than one person, the phone is visible. The arm is typically in an outstretched position and text or images are reflected in the mirror (see Figure 1a). 2. Photos that focus on body parts such as feet, typically taken from a downward facing perspective (see Figure 1b). 3. Photos taken with a self-facing camera, which typically show part of an extended arm. The person or people in these photos may be cut off or decentered, but the eyes are typically focused (see figure 1c). We ruled out pictures taken by others, or photos of photos (e.g. a photo of a childhood photo).

Figure 1. Seflies (a) in the mirror, (b) of body parts (c) with self-facing camera.

Agreement between CV, hashtags and human ratings

We randomly sampled 100 photos that included the thirteen selfie terms above, and 100 photos that did not include these terms in the metadata. Four judges rated all images as either selfie, not a selfie or borderline based on the three categories above (see table below). Approximately 20% of the photos were explicitly categorized as borderline by the raters and an additional 5% were classified differently across raters, indicating some ambiguity in what constitutes a selfie despite the provided criteria. There was approximately 80% agreement between the classifications of the CV algorithm and hashtag based identifications.

	Hashtags include selfie terms (total 100 photos)	Hashtags do not include selfie terms. (total 100 photos)
Rated by people as selfies	67	27
Rated by CV as selfies	54	24

Table 1. Agreement between selfie classification by hashtags and computer vision algorithm.

Sentiment analysis

To understand the emotions associated with selfies, we ran sentiment analysis on the metadata of the 2700 photos that were scraped using the thirteen selfie associated terms. This

customized sentiment analysis software, built upon the foundation of LIWC [7], classified emotion terms into the four quadrants of the circumplex model [8]. The circumplex model organizes emotional states according to positivity-negativity and hi arousal-low arousal, resulting in four quadrants that can be characterized through the example terms of excited, serene, sad and angry. This software is further described in a previous paper [5].

We analyzed the sentiment of selfie photos in three ways: (1), an analysis of terms collapsed from all identified selfies; (2) a per-photo analysis by photo that confined representation of each quadrant to one count (for any words associated with each quadrant) and thereby captured "mixed emotions"; and (3) an analysis restricted to photos that contained emotion terms in only one of the four quadrants.

The sentiment of selfies was generally very positive, with 85% of the words being positive (either high or low arousal). Across all analyses, almost one half of the emotion was positive-high arousal, approximately 1/3 was positive-low energy, and approximately 1/6th was negative-low energy and approximately 1/12th was negative-high energy (see percentages in table 2). The two most frequently occurring terms in each quadrant are shown in table 3.

	Words across photos		Photos with mixed emotions		Photos with one emotion	
	Neg	Pos	Neg	Pos	Neg	Pos
High arousal	6%	47%	8%	42%	7%	45%
Low arousal	10%	38%	13%	37%	16%	33%

Table 2. Selfie metadata classified into the four quadrants of the circumplex model of emotion.

	Negative	Positive
High arousal	Fuck, hate	love, happy
Low arousal	Bored, vain	smile, cute

Table 3. Top ranked selfie metadata terms in each quadrant of the circumplex model of emotion.

Qualitative observations on emotional state and identity

We were struck by the positive sentiment of most selfies. The vast majority reflected a determination to be seen and appreciated. The photos with negative emotion terms were split between those that used negative terms to express neutral or positive feelings, those that used terms such as "bored" to indicate varying degrees of disengagement, and those that seemed to reflect more severe despair and isolation. An example is the image below of a feet on a scale with the caption "Goodnight everyone. Just showing you that scales lie. My apparently fat ass broke it. …. Tattoos. Bulimia. #Youre perfect. #Depresion #Suicide #Anorexia. #You #are #worth #it #tomtan." Other selfies posted from this user ID reveal an emaciated young man.

Figure 2. Selfies that express distress.

The selfies above express the individual's emotional pain and conflicted self-image in a way that seems intentional. In contrast, are seflies that reveal both an intentional self-image and a background that challenges it. Examples include photos that showcase one's physical form in in flattering clothing with seemingly unintentional backgrounds elements such as shopping bags, an overabundance of beauty products, and a childlike bedroom. These elements reveal the "behavioral residue" [3] – effort and spending to create that image of attractiveness – as well as domestic situations that may be antithetical to the intended representation of independence, ease, and sophistication.

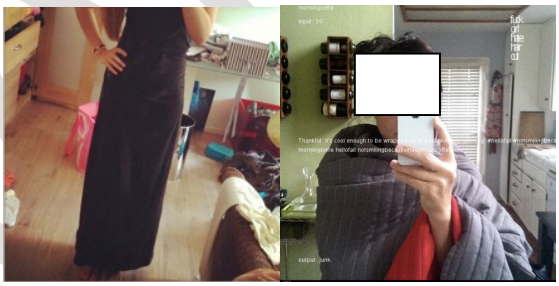

Figure 3. Background revelations.

CONCLUSION

In this preliminary study, we sought to identify and describe selfies. The investigation suggests an integrated approach to identifying selfies and particular subtypes of selfies that includes hashtag scraping, computer vision, and sentiment analysis. Although tagging of selfies as such by users is impressively accurate, reliance on this tagging alone is limited the tendency to use selfie terms to attract viewers, regardless of a photo's content. Additionally, many selfies are not labeled as such. The ambiguity regarding exactly what constitutes a selfie suggests utility in an overarching term such as meesie.

It is clear that selfies are a diverse and ambiguous collection of images that serve a variety of purposes. In addition to identity exploration, and self-promotion, selfies are a medium for emotional expression. Although most selfies are positive, others express significant distress, isolation

and disengagement. We also comment on the behavioral residue in photos that may undermine intended self-representation. Future research should examine the psychological expression in selfies and the opportunities to provide help, connection or other services based on the needs implicit in their photos and captions.

ACKNOWLEDGMENTS

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