Personality Assessment Through the Situational and Behavioral Features of Instagram Photos

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Table 1. Descriptive Statistics.
Table 2. Bright Side Personality Correlations to Situational and Behavioral Features of Instagram Photos.
Table 3. Dark Side Personality Correlations to Situational and Behavioral Features of Instagram Photos.
Table 4. Expected results from randomization tests compared to actual correlation results.

Abstract

This study explores whether photos posted on online social networks can be used to assess personality. We have demonstrated that personality is connected to human- and machine-detected situational cues, characteristics, classes, behavior, and affect displayed in Instagram photos. Observations of individual relationships between normal or dark side personality characteristics and situational features of photos give insight into the various aspects of online portrayal of oneself and the personality behind the photos.

Online social networks (OSNs) have become a popular method for studying personality, behavior, and emotions (e.g. Gosling, Gaddis, & Vazire, 2007; Schwartz et al., 2013; Golbeck, Robles, & Turner, 2011; Park et al., 2015; Seidman, 2013; Back et al., 2010). Through posts, "likes," and interactions on OSNs such as Facebook, Twitter, and Instagram, individuals leave behind a digital footprint that reveals intimate details about who they are and how they behave. Indeed, recent OSN assessment literature has illustrated the capabilities of user photos to predict personality characteristics (e.g. through photo features, such as hue, brightness, and saturation: Ferwerda, Schedl, and Tkalcic, 2016), narcissism (through selfies and self-presentation: Moon et al., 2016; Barry et al., 2017; McCain et al., 2016), and depression (through computer-detected features; Reece and Danforth, 2017).

Although these studies are insightful, their focus on specific details of the image rather than a holistic view of the contents of the photo limit the amount of variance in personality that can be explained by the images. An OSN photo can contain information about where someone was, what they were doing, who they were with, and how they were feeling at that given moment. In essence, each photo is a detailed snapshot of a situation and behavior, essential components of the personality triad (Funder, 2006). Thus, an OSN assessment approach that accounts for the situation, behavior, and affective features of the individual's photo will allow researchers to obtain a richer understanding of that individual's personality.

Therefore, the purpose of the current study is to explore how the situational and behavioral content of photos posted on OSNs can be used to assess components of the personality of an individual. Due to the photo-centric nature of Instagram, this study will use this OSN to answer three questions: (1) Can Instagram photos be used to reliably assess personality?

(2) Are certain features of Instagram photos particularly useful over others for assessing personality? and (3) Are some personality characteristics more related to the situational features of Instagram photos than others? We address our approach to each of these questions in turn.

Can Instagram photos be reliably used to assess personality?

Individuals have a host of motives for choosing to post photos on OSNs (Lee, Lee, Moon, & Sung, 2015). The photos that social media users choose to post are often carefully selected and can go through an extensive editing process, indicating one key motivation for OSN use – self-expression (Utz, Tanis, & Vermeulen, 2012). Thus, photos posted to OSNs likely contain a wealth of information about an individual poster, some of which may be unconsciously relevant or undetectable to the individual posting them (Ferwerda, Schedl, and Tkalcic, 2016). For instance, while it's likely that those who post photos can identify the psychological features of their photos, such as how happy they were in the photo, it's less likely that they pick up on subtle, but equally relevant, cues in the photo, such as whether the photo alludes to athletic ability. OSN posters may also be unaware of specific themes of their photos until prompted to do so and will likely be subjective in their appraisal of their own photos. To address the potential for subjectivity in describing photo content, we propose that photos posted on Instagram be assessed from a variety of perspectives.

As each photo can be considered a unique snapshot into a situation that the individual deemed important enough to share, we sought an assessment of situational features that can be used to compare photo situations between and within participants in a cumulative and coherent manner. Rauthmann, Sherman, and Funder (2015) establish terminology for defining and measuring situational information through three basic features: *cues*, *characteristics*, and *classes*.

Cues are the composition of situations and contain objectively quantifiable information about the environment and physically present stimuli in a situation. They answer questions such as who is with you in the situation, what sort of objects or environmental features are around you, what is happening, where you are located, and when the situation is occurring. Because they are independent of cognitive and perceptual processes of observers of the situation, they are objectively quantifiable, and thus can be detected and measured through computer vision.

Characteristics contain the psychological meaning of situations. They represent features of the situation that have been processed by human perception, and thus reflect individual differences in personality (e.g. Sherman et al., 2015, Rauthmann & Sherman, 2017, Jones et al., 2017). The foremost standardized and validated taxonomy of situation characteristics is the "Situational Eight" DIAMONDS: Duty (Does something need to be done?), Intellect (Is deep information processing required?), Adversity (Is someone being overtly threatened?), Mating (Is the situation sexually and/or romantically charged?), pOsitivity (Is the situation pleasant?), Negativity (Do negative things taint the situation?), Deception (Is someone deceptive?), and Sociality (Is social interaction and relationship formation possible, desired, or necessary?).

Classes represent broad types of situations and are categorized based on similar cues (such as all situations at school) or similar profiles of characteristics (such as all situations at a certain level of one or more of the DIAMONDS characteristics). While work has put forth suggestions of categories of classes for a variety of uses (Endler et al., 1962, Pervin, 1976; ten Berge & de Raad, 2001, 2002; van Heck, 1984), there is no currently updated taxonomy of classes in OSN posts. Thus, we relied on the personal OSN experience of our research team to establish a set of classes a priori on which to evaluate photo situations. These included Selfie, Quote, Advertisement, Nature, Landscape, Animal, Food, Fashion, Drawing, Meme, Partly

Clothed, Accomplishment, Sports, Fitness, Transport, and Politics. See Electronic Supplemental Materials Table 1 for class definitions.

Combined, cues, characteristics, and classes allow us to assess a situation in objective and subjective terms, providing us with a comprehensive indicator to predict the personality of the individual. Additionally, since patterns of behavior and emotion across a variety of situations reflect individual differences in personality (Sherman et al., 2015; Jones et al., 2017), we assessed behavioral and affective expressions of personality in photos. Collecting data on these behavioral and affective expressions also served a practical function: it provided an additional dimension through which to detect personality. Overall, the collection of self-report, machine vision cues, and person-detected classes provides insight into how these variables may be useful in assessing personality traits in the future.

To determine whether there are theoretically reasonable and consistent relationships between situational features of photos and personality, we also measured personality through participant self-assessments on a variety of measures, including bright side personality characteristics, using the Hogan Personality Survey (HPI: Hogan, 1995) and Self-Esteem, and dark side personality characteristics, using the Hogan Development Survey (HDS: Hogan, 1997) and Narcissism.

Are certain features of Instagram photos particularly useful over others for assessing personality?

A number of studies have demonstrated that specific features of posted photos are correlated with personality traits, and there has been a strong focus on selfies (a photo *cue* and *class*). For instance, selfies of all forms have been consistently linked to narcissism (e.g., Barry et al., 2017; Sorokowski et al., 2015), while studies generally demonstrate that self-esteem is

unrelated to selfie posting behavior (e.g., McCain et al., 2016; Sorokowska et al., 2016). However, selfies are just one feature of a photo, which may limit the information they reveal about the user. Moreover, other features of photos may tell us more about the poster, especially with regard to traits that may be of interest to scientists, employers, and educators (e.g. Van Iddekinge, Lanivich, Roth, & Junco, 2016). Because the current study explores photos from a variety of perspectives, we explicitly investigate whether more subtle, and seemingly irrelevant, features of photos (e.g., fitness, animals, situational Duty) demonstrate stronger relationships with traits that have, so far, been undetectable via OSN posts (e.g., Sociability, Self-Esteem). By expanding the retinue of measured photo features and making direct comparisons between cues, characteristics, and classes, we aim to shed light on which features of the photo can tell us the most about personality, thus narrowing the focus for future research and applied endeavors.

Are some personality characteristics more related to the situational features of Instagram photos than others?

We also explored whether certain personality characteristics are more salient in posted photos than others. Based on literature cited above, it is clear that narcissism is evident from photo content across multiple OSNs. However, other traits, or groups of traits (i.e., bright side and dark side), may be equally evident from the cues, characteristics, and classes of posted photos. We believe this research question is of particular importance to understanding the nature of traits and how they are manifested in a modern behavioral context, such as an OSN. For instance, it's possible that dark side characteristics are especially salient on Instagram, given the platform's reinforcement of conscious self-presentation (i.e. likes on posts).

Hypotheses

Based on previous work involving OSNs, we expect that personality traits will relate to the corresponding behavioral and affective expressions for each dimension. For instance, the HPI dimension of Adjustment is analogous to the Big Five dimension of Emotional Stability (Hogan, 1995). We expect that an individual who scores highly on the personality characteristic of Adjustment would similarly exhibit the Big Five behavioral expression of Emotional Stability in the photos that they post. Self-esteem will be related to socially desirable behavioral expressions of personality – higher Agreeableness, Conscientiousness, Extraversion, Openness, and Honesty/Humility, and lower Emotionality (e.g. Donnellan, Trzesniewski, 2005).

Based on continuous evidence that personality is related to situational experience (e.g. Sherman et al., 2015, Rauthmann & Sherman, 2017, Jones et al., 2017), we expect that personality will be related to situation characteristics in photos. DIAMONDS situation characteristics can be mapped onto bright side HPI personality characteristics. Particularly, we expected that Adjustment will be related to situations of higher pOsitivity and lower Negativity, Ambition will be related to higher Duty and Adversity, Sociability will be related to higher Sociality, Interpersonal Sensitivity will be related to higher pOsitivtiy, Prudence will be related to higher Duty, and Inquisitive and Learning Approach will be related to higher Intellect. Self-esteem should be related to the positively-valenced situation characteristics – higher Duty, Intellect, Mating, pOsitivity, and Sociality, and lower Negativity, Adversity, and Deception.

The Dark Side HDS characteristics are not as straightforward to map, but we expected a few relationships. Specifically, Excitable and Skeptical will be related to higher situational Negativity, Reserved will be related to lower Sociality, Colorful will be related to higher Negativity and Sociality, Imaginative will be related to higher Intellect, Dutiful will be related to higher Duty, and Unlikely Virtues will be related to lower Deception. Overall, the dark side

characteristics will have stronger relationships to the negatively-valenced characteristics: Adversity, Negativity, Deception, and low pOsitivity.

Hypotheses regarding cues and classes are largely exploratory. Based on situation theory and the definitions of cues and classes, we further expect that personality will be related to cues and classes that afford expression of those personality characteristics. For example, from prior research (Moon et al., 2016; Barry et al., 2017; McCain et al., 2016), we expect that Narcissism will be related to more selfies, but we do not have any a priori expectations for other dimensions.

Method

Participants

For course credit, 222 undergraduate students participated in a two-part study. Of those, 208 completed both parts (Ethnicity: 14.90% African American/Black, 6.73% Asian/Pacific Islander, 19.71% Hispanic/Latino, 2.88% Multiracial, 51.92% Caucasian/White, 1.92% Not Listed, 1.92% Prefer Not to Respond; Gender: 34.62% Male, 65.38% Female; Ages 18 to 29, M = 18.83). Participants who did not complete the second part of the study were not included in the current analysis.

Measures

Personality assessment

HPI (bright side). The 82-item version of the Hogan Personality Inventory (HPI: Hogan, 1995) is a self-report assessment of normal personality characteristics based on the Five Factor Model (McCrae & Costa, 1987; McCrae & John, 1992). Each item was rated as True (1) or False (0). The dimensions (*and the Big Five dimension they are most similar to*) include Adjustment (*Emotional Stability*), Ambition (*Assertiveness aspect of Extraversion*), Sociability (*Enthusiasm aspect of Extraversion*), Interpersonal Sensitivity (*Agreeableness*), Prudence

(*Conscientiousness*), Inquisitive (*Openness aspect of Openness*), and Learning Approach (*Intellect Aspect of Openness*). All descriptive statistics are provided in Table 1.

RSES (bright side). The 10-item Rosenberg Self-Esteem Scale (RSES: Rosenberg, 1965) measures global self-worth. Each item was rated on a 5-point Likert-type scale (1 = *strongly disagree*, 5 = *strongly agree*).

HDS (dark side). The 72-item version of the Hogan Development Survey (HDS: Hogan, 1997) is a self-report assessment of the dark side of 11 personality characteristics associated with managerial failure and career derailment. These characteristics can be loosely mapped on to the 11 personality disorders identified in the DSM-III (see Hogan, 2007); however, the HDS is designed to capture dysfunction at the sub-clinical level and is not a tool for clinical diagnoses. The dimensions include Excitable (moody, easily annoyed, emotionally volatile), Skeptical (distrustful, cynical, focused on the negative), Cautious (unassertive, resistant to change, risk-averse), Reserved (aloof, indifferent to the feelings of others, uncommunicative), Leisurely (overtly cooperative, but privately irritable and stubborn), Bold (overly self-confident, arrogant, inflated self-worth), Mischievous (charming, risk-taking, excitement-seeking), Colorful (dramatic, attention-seeking, interruptive), Imaginative (creative, but thinking and acting in unusual or eccentric way), Diligent (meticulous, precise, hard to please), Dutiful (eager to please and reluctant to act independently), and Unlikely Virtues (cautious, conforming, moralistic). Each item was rated as True (1) or False (0).

NPI (dark side). The 13-item Narcissistic Personality Inventory (NPI-13: Gentile et al., 2013) is a self-report assessment of trait narcissism intended to measure narcissistic tendencies in the non-clinical population. For each item, participants were instructed to pick the attribute they most agree with, and narcissistic attributes were totaled.

Photo assessment

Cues. A total of 3363[1] available photos images from 201 subjects were analyzed using the computer vision software Clarifai (https://www.clarifai.com). This commercial software uses a trained neural network to detect and provide up to 20 unique objects within each image. Because the objects are objectively detected by the software and represent physical, identifiable features of the photos, we consider them to be situational *cues* as defined by Rauthmann and colleagues (2015). However, we acknowledge that some objects detected by Clarifai's algorithm (e.g. "love") may blur the conceptual lines between cues, characteristics, and classes. To reconcile this, we categorized all objects detected by Clarfai's algorithm as objective cues because there is no subjective psychological meaning (that we know of) that the computer algorithm is using to detect objects in images. For instance, a human rater detecting love in an image will use their subjective psychological experience to identify love which will vary from person to person (Rauthmann et al., 2015). In contrast, Clarifai's algorithm will detect love the same way it does in every photo based on how the detection model is trained (i.e. objectively based on mathematical model). Therefore, we justify the categorization of all objects detected by Clarfai's algorithm as situational cues based on the objective nature in which these objects in images were detected.

The software returns the top 20 cues of each photo from its repository of over 11,000 objects. Thus, each photo can have a different set of 20 cues. In total, our set of photos resulted in a total of 2,000 unique cues across all images and participants. We then calculated an aggregate frequency count for each participant across the 2,000 cues. We removed objects that appeared in less than one percent of the total cues detected per participant (similar to Blake, Lee,

De La Rosa, & Sherman, in press), leaving 294 cues remaining. We then used principle components analysis with varimax rotation as a dimension reduction method on the remaining cues to improve interpretability for subsequent analysis. For component extraction, we used a step-approach in which two rotated components are extracted, then three, and so on until the overall coherency of each set of components diminishes based on the cue component loadings. We chose this approach as it enabled us to systematically analyze each set of components to reduce the risk of having to many or too few components (Rosenthal & Rosnow, 2008). This approach yielded 13 orthogonal components which represents groups of similar cues the we labeled based on the cues they contain. Thus, the cues used in the final analyses represent categories (components) of all cues, and each participants' component score was used for all analyses. Electronic Supplemental Materials Table 2 shows the five highest cue loadings for each component.

Characteristics. Each photo was self-rated by participants using the S8-I (Rauthmann & Sherman, 2016) to assess the major dimensions of psychological situation characteristics. Each item, rated on a seven-point Likert-type scale (1 = *extremely uncharacteristic,* 7 = *extremely characteristic),* measures one dimension of the Situational Eight DIAMONDS - Duty, Intellect, Adversity, Mating, pOsitivity, Negativity, Deception, and Sociality (Rauthmann et al., 2014).

Classes. Trained coders assessed each participant photo and its caption on a set of preestablished photo classes. They include several dichotomous categories, rated on a scale of 1 (yes) or 0 (no) for each photo. Class categories were not mutually exclusive.

In many cases, the cue components have similarities to the categories of classes, like the "Selfie" cue component and the "Selfie" class. According to situational theory, classes are comprised of a variety of cues, and thus, it is possible that some cue components at the aggregate

level will reflect features of classes. As well as theoretical differences, the current study distinguishes between cues and classes in that cues were detected through computer vison and classes were identified by human raters. A photo endorsed by human raters as belonging to the Selfie class could also contain Selfie cues, such as "facial expression."

Behavioral and Affective Expressions of Personality. Each photo was self-rated by participants on a seven-point bipolar adjective scale based on the Big Five Aspect Scales (DeYoung, Quilty, & Peterson, 2007), and include the Honesty/Humility dimension of the HEXACO (Lee & Ashton, 2004). The behavioral expression items were composed of two items for each aspect of the six HEXACO dimensions – Honesty/Humility (H), Emotionality (E), Extraversion (X), Agreeableness (C), and Openness (O). The scale assessed the following aspects: H – Honesty, H – Humility, E – Volatility, E – Withdrawal, X – Enthusiasm, X – Assertiveness, A – Compassion, A – Politeness, C – Industriousness, C – Orderliness, O – Intellect, and O – Openness. State authenticity, state happiness, and state self-esteem were also measured using a similar one-item bipolar scale.

Procedure

For the first part of the study, participants took a variety of self-report surveys about their personality, including the HPI, RSES, HDS, and NPI. Then, participants provided us access to their Instagram accounts through the Instagram API, through which we scraped the most recent photos and their associated captions (up to 20 photos per participant). In the second part of the study, participants were first allowed to delete any photos they did not want to share. They then assessed the situational characteristics of each photo using the S8-I (Rauthmann & Sherman, 2016; Rauthmann et al., 2014), their own state expressions of HEXACO personality

characteristics, happiness, self-esteem, and authenticity (Sherman et al., 2015; Cooper et al., 2018; Jones et al., 2017).

We used participant self-rating of situation characteristics because there is reason to suggest that an individual's own understanding of the situation is most valid for understanding the psychological characteristics (Rauthmann et al., 2015). However, it is possible that relationships between personality and situation characteristics are due to contact (in which an individual's personality are associated with objective situation characteristics) or construal (in which an individual's personality is associated with subjective perceptions of situation characteristics; Rauthmann, Sherman, Nave, Funder, 2015). Thus, a person who scores highly on the HPI dimension of Sociability could find themselves in situations that afford more socialization (the DIAMONDS dimension of Sociality) either because they were drawn to that situation due to its objective social features or because they subjectively perceived more possibility for social interaction in the existing situation. Thus, a person's perceptions of a situation are the most proximal cause of their behavior (whether or not they are accurate), positioning the person in the largest role for causation of behavior.

However, it is also possible that third party raters would provide a valid assessment to situation characteristics. To determine the plausibility of this, we randomly selected a subsample of 400 photos from 33 participants, which were then rated on the DIAMONDS dimensions by four trained, independent raters. The intraclass correlation (ICC) between raters varied across dimensions (Duty ICC = .44, Intellect ICC = .40, Adversity ICC = .07, Mating ICC = .57, pOsitivity ICC = .32, Negativity ICC = .28, Deception ICC = .05, Sociality ICC = .45), as did the correlation between the average ratings of the four raters and the self-ratings of the participants (Duty r = .30, Intellect r = .34, Adversity r = .10, Mating r = .53, pOsitivity r = .21, Negativity r

= .23, Deception r = -.03, Sociality r = .33). Thus, it seems that while some characteristics are highly perceptible by all parties (Duty, Intellect, Mating, and Sociality), others show weaker agreement (pOsitivity, Negativity), and some are barely agreed upon at all (Adversity, Deception). The characteristics with emotional valence seem to be more difficult to objectively identify and are likely a result of certain cognitive-affective processes on behalf of the individual and other stimuli in the situation that are not visible in the photo itself. This demonstrates that self-ratings of photos are useful for all dimensions to gather the psychological characteristics that were present in the situation, but dimensions that are emotionally valenced may not be immediately apparent to independent observers of the photo. As for behavioral and affective expressions of personality, most dimensions exhibited moderate agreement among raters (ICC between .15 and .44, M = .29, SD = .10) except for E - Withdrawal (ICC = .01), A - Politeness (ICC = .07), X – Enthusiasm (ICC = .02), and Authenticity (ICC = .02). However, there was not consistent agreement between self-assessment of behavior and emotions and average independent rater assessment (r: M = -.03, SD = .33). Therefore, we conclude that independent raters cannot provide completely valid assessments of behavioral and affective expressions of personality in Instagram photos, so participant self-ratings of photos are used for behavioral, affective, and situation characteristics.

For assessing cues, the use of machine-detected cues has a practical advantage; it allows a consistent, automatic assessment of the objective features of situations. If photos can be automatically coded for their objective content, and provided that relationships exist between cues and personality, we can immediately deduce various probabilistic insights about an individual based on the cues in the photos they post. From a practical standpoint, this can be done without any actual assessment of the individual's personality or human intervention.

In total, participants provided 3,803 Instagram photos, an average of 18.28 photos per participant (*SD* = 4.37, median = 20). Because we are concerned only with between-person differences in predictors of personality, we aggregated all variables to the level of the individual. For classes, we first calculated the frequency of each photo being endorsed as belonging to a particular class and divided that by the total number of photos. However, because some individuals provided a relatively low number of photos (four participants provided less than five photos, and three more provided less than 10), the final proportions may have been misrepresentative. To correct for this, we updated proportions using Empirical Bayes estimation (Jiang & Zhang, 2010).

Since the current study is largely exploratory beyond the previously stated hypotheses, all analyses examine possible relationships between every personality dimension and every situation or behavioral expression dimension. All analyses were performed in R (R Core Team, 2015).

To identify relationships between personality and situational or behavioral features of photos, we performed one correlation between each personality characteristic and each cue, characteristic, class, and behavioral expression. Beyond examining significance values, we performed a randomization test (rand.test() in R; Sherman & Serfass, 2015) to ensure that the structure of the data and issues of non-independence did not interfere with probability assumptions. In all cases, the actual average absolute effect size and number of significant correlations exceeded the number expected by chance (see results in Table 4). We then recalculated significance values using Holm's adjustment for multiple tests (Holm, 1979), and a substantial number of significant effects disappeared, leaving only correlations above |.27| significant. However, based on the exploratory nature of this study, our goal is to investigate broad patterns that emerge from the data to inform future research in personality assessment.

Therefore, we were less concerned with detecting the "family-wise" error rate and acknowledge that a small amount of the associations detected may not replicate in future research. Thus, we provide the uncorrected correlations in Table 2-3.

Results and Discussion

As this study involved a large number of exploratory analyses, we provide the results and discussion simultaneously for each of three research questions below. It is important to note that the majority of the correlations displayed a relatively small effect size, suggesting that the findings may suffer from reliability or stability issues. We recognize that because there are a large number of correlations, it is possible that many of the individual effects may not replicate. Thus, our discussion focuses only on directionality of effects, overall trends in effects, and findings that support our initial hypotheses rather than giving extreme emphasis to individual correlations.

Can Instagram photos be used to reliably assess personality?

The randomization procedures for correlations between personality and cues, characteristics, classes, and behavior suggest that it is indeed possible to assess individual differences in personality through the situational features of photos on Instagram, beyond that expected by chance. We have demonstrated this through both subjective and objective ratings and through both human- and machine-detected features in photos. This contributes to methods of assessing the personality triad of persons, situations, and behavior (Funder, 2006) and provides evidence that the three are interrelated.

Overall, there is merit to the idea that Instagram photos can be used to assess personality. This study is the first step in determining whether relationships exist between personality situational features of Instagram photos. It is alternatively possible to take a Big Data approach

to this question. For instance, researchers may use machine learning to predict personality scores from Instagram photo cues detected by computer vision. To explore whether that might be a practical approach, we employed a genetic algorithm to build predictive models of each personality dimension from photo cues using the 'GA' package (Scrucca, 2013) in R (R Core Team, 2015). The results show some promise for prediction, but the adjusted multiple R for the best fitting models for each dimension were quite low (average R = .22, range = .13 to .36), and cross validation on a hold-out sample had weak performance (average R = .06, range = -.19 to .32). The current approach using situational cues, characteristics, and classes is grounded in personality theory and therefore takes a more theoretically driven and comprehensive approach.

Previous studies (e.g. Sherman et al., 2015; Jones et al., 2017; Rauthmann, Jones, & Sherman, 2016) have shown that personality characteristics are related to the corresponding behavioral expressions of personality and situational characteristics that afford expression of those personality characteristics. A detailed examination of the relationships between each personality characteristic (e.g., HPI, HDS, etc.) and photo cues, characteristics, and classes generally support existing literature. In terms of the relationship between personality and behavioral and affective expressions of personality in Instagram photos, we see general support for our hypotheses. Bright side HPI characteristics were mostly related to the corresponding HEXACO aspect as rated by the participant in their own photos.

Additionally, we see general support for and partial contradiction of our hypotheses by examining HPI personality dimensions that correspond to situational DIAMONDS dimensions. For bright side personality's relationship to situation characteristics, correlations were in the hypothesized direction for the dimensions of Ambition, Sociability, Inquisitive, and Learning Approach. However, correlations were in the opposite direction than we hypothesized for

Adjustment, Interpersonal Sensitivity, and Prudence. The contradictions in our hypotheses may stem from self-presentation behavior and the need to display a positive image of oneself (e.g., Seidman, 2013), a practice especially salient on OSNs. For dark side personality's relationship to situation characteristics, most relationships were in the hypothesized direction. In general, dark side personality shows stronger relationships in the hypothesized direction to negatively-valenced situation characteristics. That is, those who exhibit dark side tendencies post photos that are higher in Adversity, Negativity, and Deception, and lower in pOsitivity.

Our findings on self-concept also mirror previous studies (e.g. Barry et al., 2017; Robins et al., 2001; Sorokowski et al., 2015). Narcissism was positively associated with Selfie posts (cues and classes), and self-esteem was related to socially desirable behavioral expressions of personality, such as athletics (cues) and sports and fitness (classes).

To our knowledge, the rest of the findings are novel. As for the relationship between personality and situational cues and classes in Instagram photos, while we cannot determine rationale for each individual relationship, we can begin to identify a pattern in which individuals post photos with cues and classes that allow for expression of their personality characteristics. For example, the negative relationship between HPI Sociability and Animals (classes) and Pets (cues) may indicate that those low on Sociability prefer to surround themselves by animals rather than people. The negative relationship between HPI Interpersonal Sensitivity and Political (classes) may demonstrate that more Interpersonally Sensitive individuals prefer to post less politically charged content that would incite arguments online. The negative relationship between HPI Prudence and Partly Clothed (classes) may be an artifact of professionalism. Future studies may highlight the nuances and motivations of each individual relationship, as we have only begun to scratch the surface with the current study.

The current study should also broaden our understanding of the relationship between mental health and social media behaviors. While previous studies (e.g. Guntuku et al., 2017; De Choudhury et al., 2013) have indicated that it is possible to detect mental illness—particularly depression—through social media activity, we know of no studies that have examined the relationship between a comprehensive profile of dark side personality characteristics and the content of social media posts. The current study demonstrates that it is possible to go even further; we have the ability to identify a broad portrait of less extreme features of clinical personality disorders through the situational content of photos posted on Instagram. This has implications for mental health detection and early intervention strategies. For instance, classes of Selfies or Quotes, and cues of Modeling show relationships in the positive direction to dark side characteristics, while classes of Nature, Animal, Drawing, Transport, and Political, and cues of Beach and Leisure, Landscape, and City show mostly relationships in the negative direction. This suggests that people who are more introspective are focused on the self in their social media posts may be at higher risk for dark side tendencies.

Are certain features of Instagram photos particularly useful over others for assessing personality?

All three situational features (cues, characteristics, and classes) that we used were related to bright side and dark side personality characteristics, and in some cases, overlap. For instance, the dark side traits of Cautious and Reserved were both inversely related to the cue of athletics and the class of sports. This further underscores the utility of both machine and person-detected features of situations in personality assessment.

Within each category of situational features (*cues, characteristics, and classes*), some had stronger relationships to personality than others, but there was not a situational feature that

consistently displayed stronger relationships. Some situational features appeared to do a better job of discriminating between the participant's possession of bright and dark side traits. For instance, Selfie (*cues*) was related more strongly to dark side traits than to bright side traits. Among the situational *characteristics*, pOsitivity had stronger relationships to bright side traits than dark side traits. Within situational *classes*, Sports was more strongly related to dark side traits than bright side traits. These nuances help illustrate the complexity of photo content and how specific situational features may be more useful than others detecting personality features of the poster.

The strongest relationships were found between behavioral expressions of personality and bright and dark side traits, but the difference between the average absolute effect size in behavioral expressions and the other situational features is minimal. There were also several cases where a *cue* and/or *class* (machine-and person-detected respectively) was associated with a bright or dark side trait, but a behavioral or affective expression of personality was not. This was the case for three bright side traits (Interpersonal Sensitivity, Inquisitive, and, Learning Approach) and three dark side traits (Excitable, Skeptical, and Leisurely). There were no cases where a behavioral or affective expression predicted a trait in the absence of a relationship with a *cue* or *class*. Taken together, this suggests that both behavioral and affective expressions of personality and the situational features of photos provide unique and useful information for determining a comprehensive personality profile.

Are some personality characteristics particularly salient in photos?

Some personality characteristics do tend to show more relationships to situational features of photos. For the bright side of personality, Adjustment, Sociability, Learning Approach, and Self-Esteem returned the strongest effects. For the dark side, Reserved, Bold,

Diligent, Dutiful and Narcissism returned the strongest effects. However, the differences in average absolute effects size are minimal compared to other dimensions of personality, suggesting that all characteristics are equally as detectable through the current approach.

Overall implications

There are several practical implications of this study. For example, trained viewers could deduce the likelihood of an Instagram user's most prevalent personality characteristics (normal and dark side) by simply viewing a selection of recent photos. Perhaps an even more expedient application is the possibility of preforming this same task instantaneously through computer-assisted cue detection. Indeed, if situational and behavioral features of Instagram photos can produce a likely personality profile for an individual, this profile is also likely related to key outcomes in everyday life (Sherman et al., 2015; Jones et al., 2017), in relationships (Solomon & Jackson, 2014; Weidmann, Ledermann & Grob, 2016), in the workplace (Hogan & Foster, 2013; Higgins et al., 2007), at school (Poropat, 2009), and more. Future applications of this personality assessment approach can use Instagram photos as talent signals for job performance, persistence in university, or leadership potential. Equally important, the relationship of Instagram photos to dark side personality characteristics and the self-concept can also be used for detection of mental health risks or adverse behavioral tendencies.

Limitations and future directions

A few limitations of the current study open the door for future OSN research. For example, the self-rated nature of situation characteristics and behavioral expressions of personality characteristics may allow for a more detailed and accurate representation of photo content, but it falls short of providing a completely objective portrait. Future efforts could introduce an algorithm that automatically deduces characteristics from computer-detected classes

and cues. Furthermore, the use of self-rated situational characteristics and self-rated personality variables may introduce self-rating bias (e.g., Baird, Lucas, & Donnellan, 2017; Soto, John, Gosling, & Potter, 2008), which may account for some of the effects. Additionally, whereas the overall relationship between personality and corresponding situational and behavioral characteristics indicates that people generally post photos that are consistent with their personalities on Instagram, the small number of contradictory findings suggest that there may be traces of self-censorship or self-presentation in certain personality dimensions (Das & Kramer, 2013). Future efforts could explore the moderators of the mismatch between personality and corresponding behavioral and situational characteristics.

Conclusion

We have demonstrated that personality is connected to human- and machine-detected situational cues, characteristics, classes, behavior, and affect displayed in Instagram photos. Observations of individual relationships between normal or dark side personality characteristics and situational features of photos give insight into the various aspects of online portrayal of oneself and the personality behind the photos.

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Table 1. Descriptive Statistics.

Personality Assessment			
Bright Side	M	SD	Med
HPI			
Adjustment	.66	.16	.69
Ambition	.55	.16	.58
Sociability	.67	.17	.70
Interpersonal Sensitivity	.81	.13	.80
Prudence	.69	.16	.71
Inquisitive	.58	.19	.58
Learning Approach	.50	.22	.50
Self-Esteem	3.85	.76	4.00
Dark Side			
HDS			
Excitable	.57	.25	.50
Skeptical	.60	.23	.67
Cautious	.47	.27	.50
Reserved	.57	.26	.50
Leisurely	.54	.23	.50
Bold	.63	.29	.67
Mischievous	.62	.27	.67
Colorful	.45	.25	.50
Imaginative	.62	.25	.60
Diligent	.61	.24	.67
Dutiful	.59	.22	.67
Unlikely Virtues	.42	.19	.50
Narcissism	.39	.20	.42
Photo Assessment			
Situation Cues			
Cars	.04	17.90	-4.02
Meme	.07	16.19	-4.35
Selfie	.07	15.96	-2.82
Beauty/Fashion	-.04	15.87	-1.64
Love/Family	.05	15.36	-1.95
Beach/Leisure	.02	14.34	-3.23
Athletic	.08	14.37	-4.22
Landscape	.05	12.17	-4.14
Pets	.06	8.80	-2.50
Live Music Event	.03	9.57	-2.24
City	.06	7.69	-.78
Graduation Ceremony	.01	7.43	-1.83
Events (General)	-.03	6.96	-.58

Photo Assessment (Continued)				
Situation Characteristics	M	SD	Med	ICC1(2)
Duty	2.24	1.33	1.90	.46 (.93)
Intellect	1.99	1.17	1.55	.46 (.93)
Adversity	1.23	.60	1.00	.34 (.88)
Mating	2.01	1.18	1.55	.30 (.87)
pOsitivity	5.89	1.09	6.17	.38 (.90)
Negativity	1.42	.75	1.20	.33 (.88)
Deception	1.25	.65	1.00	.44 (.92)
Sociality	4.34	1.73	4.65	.48 (.93)
Dichotomous Classes (Yes Counts)				
Selfie (708)	.23	.42	.15	.17 (.74)
Quote (755)	.24	.43	.05	.67 (.96)
Advertisement (84)	.03	.16	.01	.15 (.71)
Nature (358)	.11	.32	.05	.12 (.68)
Landscape (343)	.11	.31	.03	.19 (.77)
Animal (129)	.04	.20	.01	.09 (.61)
Food (72)	.02	.15	.01	.01 (.13)
Fashion (544)	.17	.38	.06	.18 (.76)
Drawing (107)	.03	.18	.01	.12 (.68)
Meme (24)	.01	.18	.00	.28 (.84)
Partly Clothed (313)	.10	.30	.05	.17 (.75)
Accomplishment (297)	.09	.29	.05	.11 (.65)
Sports (205)	.06	.25	.01	.12 (.67)
Fitness (101)	.03	.18	.01	.12 (.67)
Transport (131)	.04	.20	.01	.28 (.84)
Politics (12)	.00	.06	.00	.04 (.42)
Behavioral and Affective Expressions of Personality				
H – Honesty	5.97	.97	6.11	.59 (.95)
H – Humility	5.68	1.16	5.90	.54 (.95)
E – Volatility	1.60	.64	1.40	.27 (.85)
E – Withdrawal	1.62	.68	1.40	.27 (.85)
X – Enthusiasm	6.14	.78	6.25	.30 (.87)
X – Assertiveness	5.02	1.18	4.75	.54 (.95)
A – Compassion	5.75	1.04	5.90	.43 (.92)
A – Politeness	5.89	.98	6.05	.52 (.94)
C – Industriousness	5.66	1.06	5.68	.47 (.93)
C – Orderliness	5.56	1.05	5.65	.48 (.93)
O – Intellect	5.14	1.11	4.83	.55 (.95)
O – Openness	5.63	.96	5.63	.46 (.95)
Authenticity	6.70	.55	6.90	.42 (.92)
Happiness	6.65	.51	6.85	.23 (.82)
Self-Esteem	6.67	.53	6.85	.31 (.88)

Note: *M* = Mean of individual means. *SD* = Standard Deviation of individual means. *Yes Counts* = Number of times a photo was endorsed as belonging to that class. Results containing categories with low "Yes" counts should be interpreted with caution. ICC1(2) = Within-person intraclass correlations for unaggregated situational features: ICC1, followed by (ICC2).

Table 2. Bright Side Personality Correlations to Situational and Behavioral Features of Instagram Photos.

	Adjustment	Ambition	Sociability	Interpersonal Sensitivity	Prudence	Inquisitive	Learning Approach	Self Esteem
Behavioral Expressions of Personality								
E - Volatility	-.09	.02	-.01	.00	-.07	-.05	.04	-.08
E - Withdrawal	.06	.08	-.09	-.06	-.07	-.05	-.01	**-.20**
A - Compassion	.03	-.09	.07	.07	.11	.01	-.05	**.15**
A - Politeness	.09	.00	.11	.05	.10	.03	.04	.12
C - Industriousness	.09	.09	**.16**	.05	.13	.07	.09	**.15**
C - Orderliness	**.14**	.06	**.17**	.08	.14	.05	.07	.11
X - Enthusiasm	.02	.01	**.18**	.05	.04	.02	.01	**.15**
X - Assertiveness	**.15**	**.19**	**.26**	.01	**.22**	.04	.12	**.14**
O - Intellect	**.18**	.13	**.24**	.01	**.16**	.08	.13	.01
O - Openness	.13	.08	**.19**	.03	**.17**	.11	.05	-.01
H - Honesty	.08	.04	.10	.07	.13	.08	.10	.11
H - Humility	.13	.02	.07	.03	.08	.03	.03	.06
Happy	.03	-.08	.06	.01	-.01	.01	-.08	**.17**
Self-esteem	-.02	-.10	.12	.05	.00	.03	-.07	**.16**
Authentic	-.01	-.07	.10	.03	-.01	.02	-.04	.13
Cues								
Cars	-.12	-.08	**-.17**	-.09	-.05	.03	.03	.08
Meme	.01	-.07	-.06	-.02	.05	.03	.06	-.06
Selfie	.06	.10	.14	.06	.01	.00	.12	.02
Beauty/Fashion	.13	.03	.11	.06	.07	-.04	-.02	**-.15**
Love/Family	.05	.07	.09	.07	.02	-.10	-.08	-.03
Beach/Leisure	.00	.09	-.02	.08	-.11	-.08	**-.17**	-.01
Athletic	-.08	.05	.01	.01	-.02	.08	.03	.13
Landscape	.01	.13	**-.18**	-.01	-.02	.08	-.07	-.06
Pets	.01	.03	**-.21**	-.12	-.02	-.06	.08	-.06
Live Music Event	-.04	.03	.01	-.02	.00	.02	-.01	.05
City	-.06	.07	**-.19**	-.04	-.06	.03	-.11	-.04
Graduation Ceremony	-.02	-.02	.06	-.04	.06	.02	.10	.08
Events (general)	.01	-.02	.12	.00	-.07	**-.22**	-.10	.06
Characteristics								
Duty	-.06	.05	.01	-.03	-.08	.11	.00	.03
Intellect	-.04	.05	.08	-.03	.03	**.21**	**.15**	.04
Adversity	.06	.07	.08	.06	.05	**.14**	.12	-.02
Mating	.00	.03	-.04	-.04	-.02	-.01	**.14**	.10
Positivity	**-.19**	**-.19**	-.10	-.09	**-.16**	-.03	-.14	.10
Negativity	.11	**.15**	.08	.09	-.01	-.03	**.16**	-.06
Deception	.11	.11	.12	.00	.09	**.18**	**.20**	.04
Sociality	**-.14**	-.10	.05	.08	-.13	.00	-.09	.06
Classes								
Selfie	.04	-.02	.03	-.10	.08	-.06	**.17**	-.01
Quote	.12	.03	-.11	-.08	-.04	**-.16**	.03	**-.15**
Ad	-.05	-.06	.00	-.08	-.02	.00	-.01	.07
Nature	.03	.05	-.06	.07	-.12	.07	-.09	-.07
Landscape	.03	.08	-.08	-.03	-.02	-.05	-.07	-.09
Animal	-.08	.00	**-.15**	**-.15**	-.06	-.06	.09	.06
Food	-.09	-.05	-.07	**-.16**	.01	.03	.07	.07
Fashion	.06	.05	**.25**	**.15**	.01	.02	-.01	.04
Drawing	-.14	-.08	-.05	-.13	-.03	-.05	.03	.13
Meme	**.16**	.00	.06	.07	-.06	.01	-.03	**-.16**
Partly Clothed	.09	.00	-.03	.00	**-.15**	**-.14**	-.13	-.11
Accomplishment	-.05	-.02	-.04	-.06	.03	-.02	.04	.06
Sports	-.11	.02	.02	-.01	-.09	.00	-.03	**.14**
Fitness	-.06	-.02	.00	.06	-.07	.00	-.06	.12
Transport	-.13	-.08	-.11	-.11	.00	.00	.04	.09
Political	-.14	-.06	-.06	**-.25**	-.03	-.03	.05	.06

Note. Bold correlations indicate p-values < .05; Behavioral expressions of personality N = 208; Cues N = 199; Characteristics N = 208; Classes N = 203.

Table 3. Dark Side Personality Correlations to Situational and Behavioral Features of Instagram Photos.

	Excitable	Skeptical	Cautious	Reserved	Leisurely	Bold	Mischievous	Colorful	Imaginative	Diligent	Dutiful	Unlikely Virtues	Narcissism
Behavioral Expressions of Personality													
E - Volatility	-.02	-.07	-.01	**-.17**	-.08	-.09	.00	-.03	.04	-.08	.02	-.10	-.04
E - Withdrawal	.05	.09	.11	-.11	-.04	**-.19**	-.11	-.11	-.05	-.01	.02	-.09	-.13
A - Compassion	-.10	-.03	.02	.10	-.04	.13	-.05	-.04	-.05	.08	.04	**.14**	.03
A - Politeness	-.10	.01	.01	**.15**	.05	**.17**	-.03	.02	.01	.11	.04	.13	.09
C - Industriousness	-.12	.03	-.09	**.18**	.05	**.22**	-.04	.06	.07	**.20**	.09	.05	**.18**
C - Orderliness	-.06	.03	-.06	**.20**	.06	**.21**	-.08	.03	.01	**.23**	.11	.12	**.14**
X - Enthusiasm	-.09	-.03	-.06	.07	.04	.13	.02	.04	.07	.12	.10	.09	.09
X - Assertiveness	-.01	.09	**-.15**	.10	.01	**.17**	**.20**	**.21**	.05	.03	**.16**	-.07	**.19**
O - Intellect	-.05	.06	-.04	**.15**	.06	**.18**	.04	.12	.10	**.14**	.07	-.02	.07
O - Openness	-.08	.08	.04	**.16**	.07	**.14**	.03	.10	**.18**	**.19**	.05	.08	.08
H - Honesty	-.09	.02	.02	**.18**	.02	**.21**	-.06	.09	.08	.12	.01	.10	.14
H - Humility	-.07	.02	.08	**.22**	.07	**.14**	-.12	-.06	.00	**.20**	.06	**.18**	.04
Happy	.01	-.03	-.13	.06	.06	.07	.07	-.05	-.05	.02	.04	.11	.08
Self-esteem	-.03	-.11	**-.18**	.04	.03	.13	.05	.01	.01	.00	.04	.12	.12
Authentic	.00	-.07	-.11	.09	.05	**.14**	.00	-.05	.03	-.01	.04	.12	.09
Cues													
Cars	-.09	.00	-.02	-.13	.00	-.09	-.06	.00	.06	-.01	.03	-.11	-.12
Meme	.06	-.14	.08	.12	-.05	-.01	-.10	.02	**.18**	.11	**-.14**	-.03	-.08
Selfie	.08	.13	-.11	-.14	.11	.09	**.15**	.09	.00	-.10	**.15**	-.13	**.19**
Beauty/Fashion	.12	.01	.05	**.17**	-.04	.07	-.05	-.10	-.09	**.27**	.03	**.16**	.00
Love/Family	.04	.10	.02	-.02	.02	.05	.03	-.05	**-.14**	.10	**.17**	.05	.02
Beach/Leisure	-.12	.08	-.03	-.09	-.11	-.10	.09	-.07	-.13	-.10	.10	.02	-.08
Athletic	-.01	.12	**-.18**	**-.19**	.03	.07	**.20**	.13	.09	**-.15**	.13	**-.15**	.06
Landscape	-.09	-.02	.09	.03	**-.21**	-.09	.01	-.01	.14	-.07	-.06	.01	**-.19**
Pets	.07	-.08	.08	.11	-.11	.00	-.02	.10	.09	.00	-.12	-.13	.03
Live Music Event	.02	.10	-.07	-.10	.03	.00	**.18**	.04	.05	-.13	**.15**	-.12	.04
City	.09	-.04	-.02	-.02	-.08	-.08	-.07	-.05	-.06	.00	-.04	-.07	-.03
Graduation Ceremony	.07	.05	-.06	.02	.00	.13	.03	.00	.00	**.21**	**.22**	-.06	.05
Events (general)	-.08	.00	.07	-.02	-.02	.04	.02	-.03	-.10	.01	.11	.03	.05
Characteristics													
Duty	-.07	.02	-.02	.01	.06	.02	-.05	.01	.11	-.03	.05	-.02	-.02
Intellect	-.09	.02	-.05	-.02	.02	.05	.04	.09	**.19**	-.06	.09	-.04	-.01
Adversity	.09	.04	-.03	.07	.05	.13	.01	.12	.06	.00	.14	-.14	.03
Mating	.00	.01	-.03	-.01	-.01	.07	-.06	.06	.02	-.06	.08	-.02	.06
Positivity	-.04	-.09	-.02	-.04	-.13	-.04	-.10	**-.16**	-.04	-.09	-.08	.03	-.10
Negativity	.02	**.19**	.02	-.04	.10	.03	.09	.12	.04	-.01	.10	**-.14**	.05
Deception	-.04	.07	-.10	.02	.08	.04	.10	**.20**	.11	-.05	.13	**-.18**	.05
Sociality	-.10	-.04	-.01	**-.18**	-.01	-.06	.00	-.03	.03	-.12	.07	-.05	-.07
Classes													
Selfie	.10	.04	-.05	.11	.08	.08	.10	.00	-.05	.01	-.03	.08	**.18**
Quote	**.16**	.07	.12	**.14**	.03	-.09	.02	.07	**.18**	.04	-.01	-.08	-.06
Ad	-.08	-.07	.04	-.02	.00	-.02	-.07	.00	.05	-.02	.04	**-.15**	-.02
Nature	-.10	.03	.05	-.10	-.12	**-.15**	.06	-.02	-.01	-.11	.06	.00	-.10
Landscape	.03	.10	.04	.00	-.01	-.11	.12	-.07	.06	-.05	.09	-.01	**-.18**
Animal	-.03	-.12	-.03	.03	**-.16**	-.01	-.04	.05	.06	-.11	-.12	-.07	.01
Food	-.07	.01	.01	.07	.00	.05	.01	**.14**	**.21**	-.02	-.07	-.13	.08
Fashion	-.09	.03	-.06	**-.15**	-.01	.06	.11	-.07	-.05	.12	**.28**	.07	.07
Drawing	**-.14**	-.13	.02	-.05	.00	-.04	-.12	-.10	.01	.02	.05	-.09	-.02
Meme	.13	-.04	.14	.09	-.04	.03	-.02	-.02	.08	.12	-.04	-.05	-.01
Partly Clothed	.06	.12	.04	-.03	-.02	**-.14**	.08	.02	-.02	-.07	.11	-.06	.02
Accomplishment	-.02	.13	-.04	-.08	-.02	.02	.03	-.01	.09	**.16**	.07	-.02	-.07
Sports	-.06	**.18**	-.14	**-.15**	-.01	**.14**	.12	.10	.06	**-.18**	.13	-.12	-.01
Fitness	.01	.08	-.11	-.06	.02	-.08	.07	-.01	-.01	-.07	.03	-.01	.04
Transport	**-.14**	-.03	.01	-.11	.01	-.10	-.05	.00	.04	-.02	.08	-.03	-.10
Political	-.12	-.05	-.01	-.05	-.03	-.07	**-.19**	-.10	-.05	-.04	-.06	.00	-.11

Note. Bold correlations indicate p-values < .05. Behavioral expressions of personality N = 208; Cues N = 199; Characteristics N = 208; Classes N = 203.

Table 4. Expected results from randomization tests compared to actual correlation results.

	Expected by Chance		Actual	
Correlation between personality and:	Average absolute r	Number of Significant Correlations	Average absolute *r* (SD)	Number of Significant Correlations
Cues	.06	13.68	.07 (.05)	28
Characteristics	.06	8.42	.07^ (.05)	18
Classes	.06	18.5	.07 (.05)	40
Behavioral and Affective Expressions	.06	15.45	.08 (.06)	54

Note: Standard deviation and p-value of the observed average absolute *r*; $p < .001$, $p < .01$, $p < .05$, ^$p < .10$

Electronic Supplemental Materials

Table 1. Class category definitions.

Selfie	*Is the picture a selfie, defined as an obviously self-taken photo of oneself?*
Quote	*Is the picture only or mostly quoted material or words, such as an inspirational quote or saying?*
Advertisement	*Is this an ad promoting a product or service?*
Nature	*Is this a photo mostly focused on nature or something naturally occurring?*
Landscape	*Is this a photo of a broad landscape like mountains, a series of houses, etc.*
Animal	*Is this photo mostly focused on an animal?*
Food	*Is this photo mostly focused on food or a food display?*
Fashion	*Is this photo focused on a fashion style or a particular outfit?*
Drawing	*Is this photo mostly a drawing, painting, cartoon, or artwork (does not have to be created by participant)*
Meme	*Is this photo a recognized internet meme?*
Partly Clothed	*Is the person in the photo partially or fully unclothed, such as topless, bottomless, belly exposed, or fully naked?*
Accomplishment	*Is this photo aimed at demonstrating an accomplishment?*
Sports	*Does the photo focus on aspects of a sport, such as a particular sport, sporting event, sporting equipment, or athlete?*
Fitness	*Does this photo focus on aspects of fitness or exercise?*
Transport	*Is the main focus of this photo a method of transportation, such as a car, train, or plane?*
Politics	*Is this photo political in nature, such as a politician, political movement, or voting?*

Table 2. Highest loading cues for each cue component.

Cars	***r***	**Meme**	***r***	**Selfie**	***r***	**Beauty/ Fashion**	***r***	**Love/Family**	***r***
Automotive	.96	illustration	.90	facial	.88	hair	.84	love	.77
wheel	.95	symbol	.84	facial expression	.88	model	.83	fun	.72
drive	.95	text	.84	expression	.88	glamour	.82	togetherness	.70
car	.95	graphic	.82	wear	.78	fashion	.80	happiness	.69
transportation system	.93	paper	.81	interaction	.67	cute	.76	couple	.67

Beach/Leisure	***r***	**Athletic**	***r***	**Landscape**	***r***	**Pets**	***r***	**Live Music Event**	***r***
beach	.85	athlete	.85	dawn	.81	mammal	.91	performance	.82
vacation	.84	game	.78	sunset	.79	pet	.91	concert	.80
water	.83	stadium	.78	evening	.77	dog	.87	band	.75
sea	.80	sports equipment	.78	sky	.76	canine	.85	stage	.69
leisure	.80	equipment	.75	dusk	.75	animal	.84	nightclub	.65

City	***r***	**Graduation Ceremony**	***r***	**Events (general)**	***r***
urban	.61	university	.71	pop	.57
building	.60	graduation	.70	popularity	.56
house	.58	accomplishment	.66	famous	.53
architecture	.55	ceremony	.64	event	.53
city	.51	school	.57	entertainment	.49

Note: *r* indicates the correlation between the specific cue component (e.g., automotive) and the cue (e.g., Cars).