공학석사학위논문

An Exploratory Analysis of User's Behavior on Image-based Social Network and Levels of Narcissism

이미지 기반 소셜 네트워킹 사이트 사용행태를 통한 나르시시즘 성향 파악 연구

2017 년 8 월

서울대학교 대학원
인지과학 협동과정
이 준 영

Abstract

With the widespread adoption of Internet and smartphone, image-based social networking platforms have now become one of the most prominent virtual forums where users engage in photographic self-presentations. Recently, there has been a surge in scholarly interest in exploring the association between social media behaviors and narcissism. Provided that narcissists use interpersonal interactions for self-enhancement, social media is considered an ideal environment for narcissists to reinforce their ideal self. Instagram in particular, seem like a fertile ground for identifying user's narcissistic traits, given that people often engage in photo sharing activities to satisfy their social interaction needs, such as self-expression and self-presentation.

While previous studies provide sufficient evidence for a positive relationship between narcissism and social media usage, they lack an empirical approach with more quantitative analysis. The majority of psychological studies were conducted solely based on self-report surveys, which are known to pose limitations regarding respondent's untruthfulness and lack of retrospective ability. Therefore, the current study uses Instagram API and machine learning algorithm for image analysis to obtain raw data of user's social media behavior.

The main goal of this exploratory study was to examine how narcissistic personality traits are exhibited in an image-based social media network. Based on the collected quantified data on user's online behavior and photo content, the research illustrates how narcissistic tendencies are manifested through observable behaviors on Instagram. This study represents the first known attempt to find the association between narcissism and social media use by conducting an exploratory data analysis on a broader set of pictures posted by each Instagram users.

Keywords: narcissism, grandiose narcissism, vulnerable narcissism, social media, Instagram, image analysis

Student Number: 2015-20108

Table of Contents

Table Index

Figure Index

1. Introduction

We are in the midst of a ‘narcissistic epidemic,’ wrote Twenge and Campbell (2009) in their book on modern-day narcissism. According to the text, the rise of narcissism has accelerated since the 1980s, with an increase in materialism, self-promotion, entitlement, and public aggression. Past research has found that the Millennials, those in college from the early 2000s to late 2010s, are more narcissistic compared to the older generations (Twenge, Konrath, Foster, Campbell, & Bushman, 2008a, 2008b).

With the widespread use of social technologies available to the Internet and smartphone users, social networking platforms have now become powerful means of self-presentation and communication. It stands to reason that narcissism would be a major factor in determining how people approach social networking, provided that social media inherently involve managing self-presentation and receiving feedback from others (Barry et al., 2015).

Such technological development and social phenomena warrant further academic research on exploring the relationship between narcissism and uses of social media. In fact, there has been a tremendous amount of scholarly attention in examining the expression of narcissism in social media platforms. Past studies have revealed

correlations between users' levels of narcissism and narcissistic-like patterns of self-promoting behaviors on social networking sites (DeWall, Buffardi, Bonser, & Campbell, 2011; Mehdizadeh, 2010; Panek, Nardis, & Konrath, 2013). For instance, users high in narcissism were more likely to upload larger quantity and more self-promoting photos of themselves (Bergman, Fearrington, Davenport, & Bergman, 2011; Dewall et al., 2011). Multiple studies have looked at user's selfie-posting behavior and its relationship with narcissism, finding that those scoring high on narcissism tend to spend more time in editing photos of themselves and selecting photos that highlight their physical attractiveness (Fox & Rooney, 2015; Kapidzic, 2013).

While these studies provide sufficient evidence for a positive relationship between narcissism and social media usage, they lack an empirical approach involving more data-driven analysis (Preotiuc-Pietro, Carpenter, Giorgi, & Unger, 2016). The overwhelming majority of research in psychology has used multiple sets of self-reported surveys as the sole measure to assess user's online behaviors, rather than including naturalistic observations. Thus, the current study aims to add a systematic, data-driven analysis of online behaviors to further examine the impact of narcissistic personality on social media use. Moreover, the majority of research on social media and narcissism have been limited to exploring Facebook and Twitter behaviors. Therefore,

this study focuses on Instagram[1], a popular image-based social networking service, to examine social media behaviors and analyze social media content. Instead of using a self-report survey about user's behavioral tendencies, the research uses Instagram API and machine learning algorithm for image analysis to obtain raw data of user's social media behavior. This study represents the first known attempt to find the association between narcissism and social media use by conducting an exploratory data analysis on a broader set of pictures posted by each Instagram users.

[1] https://www.instagram.com

2. Related Works and Research Questions

Narcissism has been a long-standing fascination in the field of psychological research, and recently a significant portion of scholarly interests has shifted to its association with online social media behaviors. This section provides definitions and assessments used in the study and illustrates the existing research on the relationship between trait narcissism and social media use.

2.1. Defining and measuring narcissism

The meaning and the construct of narcissism's defining characteristics have been hotly debated among many clinical and social-personality psychologists. According to past literature, narcissism is a complex, multifaceted trait consisting of various psychosocial dimensions (Weiser, 2015).

A majority of theories suggest that narcissism consists of both normal and pathological expressions reflecting socially adaptive and maladaptive components (Pincus et al., 2009). Nonpathological narcissism can be conceptualized as maintaining one's high self-esteem by having a sense of self-entitlement regarding positive appraisals from others and longing to be the center of attention (Barry et al., 2015). Past research found that such individuals tend to be ambitious, satisfied with their lives, and relatively successful (Pincus et al., 2009). The

Narcissistic Personality Inventory (NPI; Raskin & Hall, 1979) has been widely used in psychological research as the primary self-report measure of narcissism, frequently used to assess "nondistressed adaptive expressions" of narcissistic traits (Pincus et al., 2009). Earlier studies found that high NPI scores were negatively associated with traits of neuroticism and depression, and positively associated with self-esteem and achievement motivation (Lukowitsky, Roberts, Lehner, Pincus, & Conroy, 2007; Watson, Little, Sawrie, & Biderman, 1992).

A pathological form of narcissism includes significant maladaptive strategies when coping with disappointments and threats to one's positive self-image (Pincus, Cain, & Wright, 2014). As stated in the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed. [*DSM-V*]; American Psychiatric Association, 2013), narcissistic personality disorder (NPD) involves pervasive pattern of grandiosity, need for admiration, and inflated sense of self-importance. Pathological narcissists typically demand attention and admiration from others, yet react to self-esteem threats with feelings of anger, shame, and humiliation (Morf & Rhodewalt, 2001). Also, they often hold a sense of entitlement and unreasonable expectations of being treated as especially favorable, while being unwilling to give back to others (Bergman et al., 2011). Narcissistic grandiosity is often expressed behaviorally through exploitative acts, indifference, intense envy,

aggression, and exhibitionism (Pincus & Lukowitsky, 2010). Such descriptions reflect the self-entitled, arrogant, and conceited dimensions of the narcissistic trait, which could be addressed by the term *grandiose narcissism* (Buss & Chiodo, 1991; Pincus et al., 2009).

While narcissistic grandiosity is indeed a fundamental component of pathological narcissism, the other core dimension, *vulnerable narcissism*, has received much less attention compared to its grandiose aspect (Paramboukis, Skues, & Wise, 2016). The vulnerable aspects of narcissism reflect the conscious experience of inadequacy, helplessness, emptiness, low self-esteem, and shame (Pincus et al., 2014). These individuals are often addressed as "shy narcissists" (Ronningstam, 2005) who engage in grandiose fantasy while also feeling intensely ashamed of their internal needs and ambition (Pincus & Lukowitsky, 2010). When coping with threats to self-esteem, narcissistic vulnerability is associated with the use of interpersonal avoidance, in which the individual shamefully withdraws from social situations when ideal self-presentation or desired admirations are not achievable (Pincus & Lukowitsky, 2010).

Although many self-report measures of narcissism have been introduced thus far (Campbell, Bonacci, Shelton, Exline, & Bushman, 2004; Hendin & Cheek, 1997), only a few are known to include assessments of both narcissistic grandiosity and vulnerability (Pincus &

Lukowitsky, 2010). Moreover, a vast majority of studies that investigated the relationship between narcissism and social media have focused on using only the NPI, limiting their assessments to grandiose aspects of narcissism. To supplement these shortcomings, this study included a multidimensional measure of narcissism, Pathological Narcissism Inventory (PNI), which comprehensively evaluates both grandiose and vulnerable aspects of narcissism (Pincus et al., 2014).

2.2. Personality manifestation on social media

Social networking services such as Facebook, Twitter, and Instagram provide an ideal environment for impression management, offering a highly controlled condition for self-presentational behaviors (Mehdizadeh, 2010; Vazire & Gosling, 2004). A widely held assumption is that communication via social media offers a unique opportunity for users to strategically think about which parts of their personalities should be presented to others (Ellison, Heino, & Gibbs, 2006). Yet, a contrasting view holds that users are unable to enjoy the freedom of tailoring their self-presentations to the specific communication partner, since – in contrast to face-to-face interactions – they are addressing a broader audience. Thus, bargaining with different self-presentational goals is required in the process of creating online persona, consequently prompting the significance of regarding stable

personality traits as indicators of self-presentation (Kramer & Winter, 2008). Considering that most users of social media tend to share postings relating to themselves or their thoughts (Naaman, Boase, & Lai, 2010), it is plausible to assume that online communication behaviors should reflect users' personality characteristics offline. Also, past research has shown that social networking sites reflect the expression of users' real personality, rather than promoting an "idealized virtual identity" (Back et al., 2010).

Over the past decade, a large thread of research in psychology has focused on detecting human personality from social networking platforms (Buffardi & Campbell, 2008). For example, studies on online self-presentation have shown that viewers were able to successfully judge others' personality traits based on their Facebook profile information (Evans, Gosling, & Carroll, 2008; Gosling, Gaddis, & Vazire, 2007). Marcus, Machilek, and Schütz (2006) found that viewers' impressions of the social website owners' Big Five personality traits were associated with the content features of social networking sites relevant to each of the Big Five personality traits.

One avenue of inquiry deals with building a prediction model based on users' social media behavior tendencies. Kosinski, Stillwell, and Graepel (2013) developed a model that automatically predicted users' personality traits, by collecting users' Facebook profile

information and their “likes” data. Likewise, profile pictures of 100 Facebook users, self-assessed personalities, and their interaction styles were combined to automatically classify users as being high or low in each personality traits. Results showed that smiling pictures or pictures taken with other people were more likely to be found among extroverted and emotionally stable users (Celli, Bruni, & Lepri, 2014). Another study extracted visual features from Sina Weibo user’s selfies to develop a personality prediction model based on the Big Five personality traits (Guntuku, Qiu, Roy, Lin, & Jakhetiya, 2015). Recently, enhancements in computer vision have enabled robust localization and identification of human faces and objects of interest in an image automatically (Liao, Chang, & Wu, 2017). Liu, Preotiuc-Pietro, Samani, Moghaddam, and Ungar (2016) conducted a study on Twitter profile images and extracted general facial features using the Face++ API, which used deep learning methods to identify faces in images. The study found significant differences in user’s choice of profile pictures between personality traits and predicted user’s personality with considerable accuracy (Liu et al., 2016).

Thus far, studies on automatic personality detection have focused on using user’s profile images as the only set of data for feature extraction and personality analysis. In their discussion, Liu et al. (2016) raised the need for using a wider set of photos that users post or curate

in social media for future studies. Thus, this paper aimed to focus on analyzing a broader set of pictures of each user's Instagram account to capture a more in-depth analysis on the associations between user's personality traits and observable online behaviors.

2.3. Narcissism and social media

Many studies in social-personality psychology have developed theoretical models of narcissism in relation to forming social relationships. Researchers argue that narcissists tend to engage in interpersonal relationships to manage their self-esteem, self-promotion, and self-concept positivity (Campbell, Brunell, & Finkel, 2006; Morf & Rhodewalt, 2001; Wallace & Baumeister, 2002). Rather than focusing on interpersonal intimacy, emotional warmth, or long-term relational consequences, narcissists use social relationships as effective means to achieve their desired, ideal self-presentation (Buffardi & Campbell, 2008). For instance, when afforded an opportunity for public glory, narcissists would utilize social interactions to bolster their self-concept by bragging and boasting about themselves (Wallace & Baumeister, 2002). In sum, narcissists partake in this dynamic process of "self-construction" or "self-regulation" by seeking constant affirmation of their narcissistic esteem (Buffardi & Campbell, 2008; Morf & Rhodewalt, 2001).

Given that narcissism is associated with using social interactions for self-enhancement, social media seem like an especially fertile ground for narcissists to buttress their ideal self. Most social networking services tend to encourage superficial "friendships" with broader group of individuals rather than close connections (Buffardi & Campbell, 2008). Narcissists were found to function well in the context of shallow relationships, as they are skilled at initiating multiple relationships and strategically managing impressions they convey to others (Morf & Rhodewalt, 2001; Buffardi & Campbell, 2008). Also, various attributes of social networking sites provide a "virtual arena" in which users can publicize their self-expressions and anticipate desired response from a wide audience (Mehdizadeh, 2010; Panek et al., 2013). Users can access quantitative measures of their popularity and expect timely and frequent feedback from others via metrics such as "likes," "shares," "followers," and "comments." These features tend to embody the types of communication that are trivial or emotionally detached. Ellison, Steinfield, & Lampe (2007) found that social networking sites enable users to maintain "weak ties," loose connections between individuals that are without emotional support. In sum, social media platforms offer an ideal forum for narcissists, who make less emotional investments and easily achieve attention-seeking goals in them.

In accordance with this notion, multiple studies have shown a positive relationship between social media use and levels of narcissism. Past research primarily focused on exploring associations between the levels of narcissism and Facebook usage, including the amount of time spent, number of "friends," numbers of photos, and frequency of status updates (Buffardi & Campbell, 2008; Deters, Mehl, & Eid, 2014; Medizadeh, 2010; Ong et al., 2011; Ryan & Xenos, 2011). In one of the earliest studies that explored subscales of narcissism in relation to Facebook usage, Carpenter (2012) assessed through a survey a number of self-promoting behaviors (e.g., updating profile information, posting status updates and photos) and antisocial behaviors (e.g., seeking social support, getting angry for not receiving comments on status updates, retaliating against negative comments). The narcissistic trait was assessed using the two main subscales identified by Ackerman et al. (2011) from the Narcissistic Personality Inventory. Results showed that "Grandiose Exhibitionism" (i.e. self-absorption, vanity, and exhibitionistic tendencies) is associated with self-promoting behaviors and number of friends, whereas "Entitlement/Exploitativeness" (i.e. a sense of deserving respect) is related to more anti-social behaviors such as retaliating against mean comments. Consistent with these findings, additional research has shown that users with higher levels of narcissism tend to upload more postings, self-referential statements,

and location check-ins (Bergman et al., 2011; DeWall et al., 2011; Wang & Stefanone, 2013). Also, several studies have revealed that there is a positive correlation between degree of narcissism and frequency of posting selfies (Fox & Rooney, 2015; Weiser, 2015).

Preotiuc-Pietro et al. (2016) explored the relationship between user's social media behavior and the so-called "Dark Triad" of personality traits, which include narcissism, psychopathy, and Machiavellianism. This study aimed to take a solely data-driven approach via extracting features that capture user's various online behaviors: use of text, profile picture, and general profile information. Analysis of 863 Twitter users who took a questionnaire of the dark triad revealed that narcissism is associated with displaying facile and sanguine language, posting geo-enabled tweets, and setting profile pictures that are more likely to feature a single face (Preotiuc-Pietro et al., 2016). Moreover, based on the collected data set, the researchers were able to develop a machine learning algorithm that predicts the user's personality traits with considerable accuracy.

A new line of research has shifted its attention to exploring the role of narcissism in online photo sharing communities (e.g. Instagram) that have grown exceedingly popular, such as Instagram. Instagram is a mobile photo-sharing and video-sharing social network site, which has attracted more than 300 million users, who post an average of 70

million photos per day (Lee, Lee, Moon, & Sung, 2015). Unlike Twitter and Facebook, Instagram offers an entirely image-focused platform, which facilitates users the selection and editing of photos. By doing so, Instagram allows its users to advertise idealized snippets of their lives and promote specific impressions of themselves to a broad audience. Functions such as “liking” and “commenting” do not require the formation of a deeper, emotional formation of relationship among users (Paramboukis, Skues, & Wise, 2016).

Barry et al. (2015) examined the association between individual differences in narcissism and the actual display of selfies on Instagram. For the assessment of narcissistic traits, both measures of the Narcissistic Personality Inventory (NPI) and the Pathological Narcissism Inventory (PNI) were used. In the study, the researchers observed each of the 128 participants’ Instagram accounts for 30 days and manually recorded the frequency of uploading posts, the overall number of uploaded photographs, the number of followers gained within the 30-day period, the number of selfies posted within the 30-day period, the total number of selfies, and theme/situations of the selfies. The results indicated that the posting of selfie collages was associated with the NPI Vanity and Superiority subscales, while posting selfies that emphasize one’s physical appearance was correlated with vulnerable narcissism (Barry et al., 2015). While this study

provided some insightful findings, their "naturalistic observation" conducted in analyzing participants' online behavior pose significant methodological limitations. Setting a 30-day period for real-time data collection may have caused the participants to change their style of Instagram use since they were aware of the fact that their account was being monitored. Therefore, the current study took an alternative approach of tracing back the Instagram user data, by collecting a set of previously uploaded photos from each participant's account, as they complete the online questionnaire for narcissistic trait assessment. Moreover, while many studies have captured user's personality on social media behavior, most research was conducted by focusing on the observation of user's activity logs. Thus, this study attempted to enrich the understanding of user personality by analyzing the content of the uploaded photos themselves.

2.4. Photographic self-presentation on social media

Previous research on digital photo sharing has found that individual's motivations behind sharing photos tend to lie in fulfilling both their intrinsic and extrinsic needs (Nov, Naaman, & Ye, 2010). People engage in photo sharing activities to meet their social interaction needs, such as self-expression and self-presentation (Goh, Ang, Chua, & Lee, 2009; Van House, Davis, Ames, Finn, &

Viswanathan, 2005). Other motivations for online photo-sharing include receiving feedback, public approval, attention, recognition, and social rewards in the form of “comments” or “likes” from a wider audience on the web (Ames & Naaman, 2007; Frohlich, Kuchinsky, Pering, Don, & Ariss, 2002; Malinen, 2011; Nov, Naaman, & Ye, 2010). Moreover, when used for sharing information about oneself, photos are deemed to be an essential form of content that could adequately fulfill one’s self-disclosure desires (Lee, 2009).

With the affordability, better imaging quality, and widespread use of mobile devices, sharing personal photos on social networking sites has become one of the most popular online activities (Malik, Dhir, & Nieminen, 2016). As of 2015, approximately 2 billion photos are shared on Facebook per day, and 70 million photos are posted on Instagram per day (Lee et al., 2015; Malik, Dhir, & Nieminen, 2016). One study analyzed a random sample of 5,000 Facebook pages and found that features related to photos comprise 93% of activities done on Facebook (“Socialbakers,” 2013). Thus, the need for having an in-depth understanding of user’s personality traits behind this popular photo-sharing activity is becoming increasingly significant.

Many studies have examined the association between personality traits and the self-presentation activity of online photo sharing. Eftekhar, Fullwood, and Morris (2014) addressed the correlation

between Facebook user's photo-related activities and the Big Five personality traits by employing a content analysis approach. They found that neuroticism and extraversion predicted more uploads of photos, while conscientiousness predicted more self-generated albums and video uploads. The trait agreeableness was predictive of receiving more number of "likes" and "comments" on profile pictures (Eftekhar et al., 2014). Kapidzic (2013) found that Facebook users who scored high on narcissism were more inclined to set their profile pictures that accentuate their physical attractiveness. Fox and Rooney (2015) conducted an online survey among nationally representative sample of U.S. men to examine the relationship between the dark triad personality trait and photo-related social media usage behaviors. They argued that trait narcissism was predictive of selfie posting behavior and photo editing behavior (e.g., cropping parts of oneself out of pictures, using photographic filters, or using picture editing applications) (Fox & Rooney, 2015). Sheldon (2015) also found positive correlation between levels of narcissism and the frequency of posting personal photos on Facebook, as well as liking and commenting on friends' photos.

Although previous studies on social media have shown the association between narcissism and photographic self-representation on social media, more research is still needed to analyze the user behavior beyond observing and assessing user's activity logs. More precisely,

inquiry into the content of the uploaded photos themselves in general, and Instagram in particular, has not gained the attention warranted. To bridge this gap, the current study aimed to conduct an image content analysis and establish a relationship between narcissism and social media behavior on Instagram.

2.5. Research Questions

Past research suggests that exploring narcissism through user's online behavior requires more attention for the following reasons. First, since engaging in social media inherently involves managing self-presentation and receiving feedback, narcissism would be a major factor in determining how people approach social networking (Barry et al., 2015). Second, online behaviors on social networking sites tend to reflect the true personality characteristics of users. Such attempts on detecting human personality traits from social media platforms have produced fairly accurate results (Celli, Bruni, & Lepri, 2014; Guntuku et al., 2015; Kosinski, Stillwell, & Graepel, 2013; Liu et al., 2016). Given that narcissism is associated with using social interactions for self-enhancement, an entirely image-focused social media platform such as Instagram provides users with photo sharing features that could satisfy their social interaction needs including self-expression and self-presentation (Goh et al., 2009; Van House et al., 2005).

While these studies provide insightful findings, several methodological limitations exist in terms of assessing participants' behavioral tendencies via self-report surveys and making predictions of user's personality traits solely based on user's profile pictures. The overwhelming majority of psychology research has used numerous sets of self-reported questionnaires (e.g., asking participants to report their recalled photo posting activities), rather than naturalistic observations or data-driven analysis, in order to assess user's online behavior. The participants answering these self-report questionnaires may respond untruthfully or lack retrospective ability to answer accurately, in either case rendering the outcome less reliable and significant. Moreover, acquiring an understanding of the photos shared by users is more comprehensively done through a data-driven content analysis of the photos than through mere self-report surveys of these photos, which are secondary source of information at best.

Meanwhile, in the field of computer science research, most studies have focused on building a prediction model based on thousands of users' profile pictures. Studies on automatic personality detection (Celli, Bruni, & Lepri, 2014; Guntuku et al., 2015; Kosinski, Stillwell, & Graepel, 2013; Liu et al., 2016) have been limited to using user's profile images as the single set of data for feature extraction and personality analysis. Such methodological approach can reveal only a

limited aspect of user's personality because researchers are unable to access the user's entire collection of photo postings accumulated over time. Also, the studies mentioned above mainly focused on finding the correlation between user's choice of profile pictures and the Big Five personality traits. However, narcissism is a multifaceted trait developed from various psychosocial dimensions, ranging from overt exhibitionistic display to conscious experience of helplessness (Morf & Rhodewalt, 2001; Weiser, 2015); therefore an approach consisting solely of profile picture analysis to evaluate such complex trait seems a bit far-fetched.

Despite the current scholarly interest in finding the relationship between narcissism and photo postings on social media, there has been limited experimental work that gathered a wider set of user's personally curated photos. Thus, the current study extended prior research in photo content analysis by conducting an exploratory data analysis on a broader set of pictures posted by each Instagram users. Also, the study aimed to assess the multiple facets of narcissistic trait using both nonclinical and pathological measures of narcissism. Therefore, the study posits the following research questions: ***RQ1. Is narcissism manifested through observable behaviors on Instagram? RQ2. How is Instagram behavior related to each of the subtypes of narcissism?***

3. Method

3.1. Participants and procedure

A total of 135 Instagram users were recruited from an Instagram advertisement account created for research participation. All participants were of Korean nationality. In return for a small payment, participants granted access to their fifty most recent posts and completed an online questionnaire on narcissistic trait assessment developed through Typeform[2]. To qualify as a participant, Instagram users were required to be at least 18 years of age and have an active, public account with at least 50 postings uploaded on their personal feed. Among the recruited participants, thirty-one Instagram users failed to meet the above requirements and were excluded from the analysis. With the final sample (N=100, 23 male), a total of 5,000 images were collected for content analysis. For each participant, narcissistic trait scores and Instagram behavior data were recorded using the Instagram API, and their latest 50 postings were analyzed using Amazon Rekognition API. In order to investigate the accuracy of using visual features and platform usage data to predict the narcissistic traits, multiple regression models were constructed for each NPI, PNI-Grandiosity, and PNI-Vulnerability scores.

[2] https://www.typeform.com

3.2. Measures

3.2.1. Narcissism

Narcissistic Personality Inventory (NPI)

Raskin and Hall (1979) first developed the NPI for the assessment of narcissistic trait based on the definition of narcissistic personality disorder found in the DSM-III. The original version of NPI was further reduced from 54 items to 40 items through factor analyses (Raskin & Terry, 1988). As the most widely used measure of the narcissistic personality, NPI assesses grandiose or overt aspects of narcissism (Campbell & Miller, 2011). As presented in Table 1, NPI consists of seven different subscales: Authority, Entitlement, Exhibitionism, Exploitativeness, Self-sufficiency, Superiority, Vanity. (DuBrin, 2012; Raskin & Terry, 1988). In this study, the translated Korean version of the 40-item NPI adapted by Han (1999) was used to assess participants' narcissism. Respondents were required to select one of two statements for each item (e.g., "My body is nothing special" versus "I like to look at my body"; Raskin & Terry, 1988).

Pathological Narcissism Inventory (PNI)

PNI (Pincus et al., 2009) consists of 52 self-report measures of both vulnerable and grandiose narcissism with responses made on a 6-point Likert scale ranging from 0 to 5. As shown in Table 2, PNI is

comprised of Grandiose Narcissism dimension which includes *Grandiose*, *Self-sacrificing Self-enhancement*, and *Exploitativeness* subscales and a Vulnerable Narcissism dimension which consists of *Contingent Self-esteem*, *Devaluing Others/Need for Others*, *Hiding the Self*, and *Entitlement Rage* subscales (Maxwell, Donnellan, Hopwood, & Ackerman, 2011; Pincus et al., 2009). This study used a translated Korean version of 35-item PNI developed by Yang and Kwon (2012). Yang and Kwon (2012) adapted and reduced the original PNI into a 35-item questionnaire, omitting the *Hiding the Self* subscale based on the results of factor analyses.

Table 1. *Descriptions of NPI Subscales*

NPI Subscales	Descriptions
Authority	Enjoying being a leader and being seen as an authority
Entitlement	Holding expectation of special favors without assuming reciprocal responsibilities
Exhibitionism	Having the need to be the center of attention even at the expense of the needs of others
Exploitativeness	Manipulating and exploiting others and expecting favors from others
Self-sufficiency	Relying on his or her own abilities to meet his or her needs in life
Superiority	Feeling he or she is superior compared to others
Vanity	Believing in one's own superior abilities and attractiveness

Table 2. *Descriptions of PNI-Grandiosity and PNI-Vulnerability Subscales*

	Descriptions
PNI-Grandiosity	
Grandiose Fantasy	Fantasies of success and admiration
Self-sacrificing Self-enhancement	Engaging in altruistic acts to buttress a positive self-image
Exploitativeness	Manipulativeness
PNI-Vulnerability	
Contingent Self-esteem	Fluctuating levels of self-esteem
Devaluing Others/Need for Others	Lack of interest in others who will not bolster the self-image
Hiding the Self	Hiding flaws and interpersonal needs from others
Entitlement Rage	Anger in response to unmet desires

3.2.2. Image analysis

The latest advances in deep learning and computer vision methods have allowed robust localization and object recognition for automated image analysis (Liao et al., 2017). For instance, since 2010, the ImageNet project has hosted an annual visual recognition competition, where research teams submit programs that detect objects and classify images (Krizhevsky, Sutskever, & Hinton, 2012). Also, multiple open-source image analysis software solutions have been introduced. In this study, Amazon Rekognition API[3] was used to analyze the images obtained from each participant's Instagram accounts.

Amazon Rekognition API

Amazon Rekognition API is a deep learning-based image recognition software that detects objects, scenes, concepts, and facial components of an image. The current study used object detection feature, facial analysis feature, and image moderation feature to analyze Instagram contents. As illustrated in Figure 1, the API returns multiple object labels associated with the photo with a confidence score between 0 and 1. The collected photos were classified into nine categories (*Portrait / Food / Activity / Plant / Publication / Gadget / Fashion /*

[3] https://aws.amazon.com/rekognition/

Animal / Others) according to the content (see Table 3). More detailed information on the classification scheme will be further discussed in the Results section.

Figure 2 shows an example of facial attribute analysis, including confidence scores. Besides the variables used in this study, Rekognition API provides multiple face-detection features, such as detection of face bounding boxes (left, top, and width of a face's position in a photo) and facial landmarks. These features were excluded in the current study because such information seemed unnecessary in terms of speculating a person's personality trait from a photo. Table 4 provides a brief description of each variable used to capture the facial features of the collected photos. With the face posture parameters (*poseLowPitch, poseAbsYaw, poseAbsRoll*), the research could capture information that is difficult to be obtained through self-report questionnaires. For *poseLowPitch*, the average ratio of faces with a negative pitch value was calculated among the detected faces. For example, the average ratio of lowered faces or faces of a photo taken above the face position were calculated among the total detected faces. For *poseAbsYaw* and *poseAbsRoll*, the average absolute values of the yaw and the roll value were calculated in degrees. Figure 3 provides examples of the head pose orientations in terms of pitch, yaw, and roll.

Souza et al. (2015) extracted selfies from the collected Instagram photo data using hashtags related to the word ‘selfie.’ In this study, the API’s *numberPhotosSingleFace* and *meanFaceSize* variables were used to detect photos of a face taken from a closer distance. The *meanFaceSize* variable calculated the average ratio of the detected face’s height to the total height of the photo. The higher the ratio, the greater the possibility the photo is taken at a closer proximity.

With its image moderation feature, the API can also automatically detect explicit or suggestive adult content on images and provide confidence scores (“Amazon Rekognition”). This study used the following variables provided by Amazon Rekognition API: *Female Swimwear or Underwear, Male Swimwear or Underwear, Revealing Clothes, Nudity, Graphic Male Nudity, Graphic Female Nudity, Sexual Nudity,* and *Partial Nudity* (“Amazon Rekognition”).

Figure 1. *Object Label Extraction by Amazon Rekognition API*

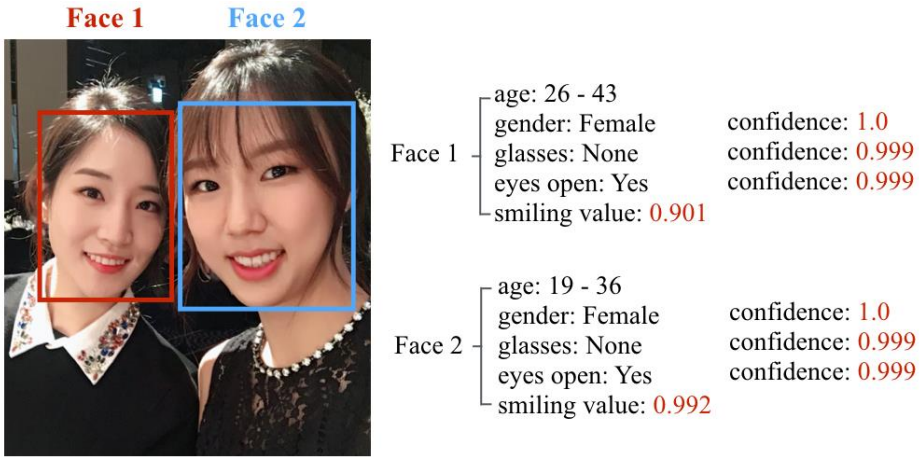

Figure 2. *Facial Analysis by Amazon Rekognition API*

Table 3. *9 Photo categories*

Category	Examples of Combined Labels	Exemplary Photos	# of Photos in Category
Portrait	Person, People, Human, Female, Woman		2534
Food	Meal, Beverage, Breakfast, Pizza, Alcohol		299
Activity	Outdoors, Building, Housing, Furniture, Concert		569
Plant	Potted Plant, Flower, Blossom, Tree, Rose		455
Publication	Text, Poster, Flyer, Brochure		218
Gadget	Vehicle, Electronics, Car, Bike, Automobile		95
Fashion	Shoes, Clothing, Swimwear, Suit, Maillot		149

Animal	Mammal, Pet, Canine, Dog, Cat		64
Others	Art, Toy, Ticket, Teddy Bear, Tin		131

Table 4. *Description of Facial Feature Variables*

Variable	Descriptions
genderFemale	The ratio of faces judged as women among the total faces extracted from user's photos
smile	The ratio of faces detected as smiling face among the total faces extracted from user's photos
eyeglasses	The ratio of faces detected as having glasses on among the total faces extracted from user's photos
sunglasses	The ratio of faces detected as having sunglasses on among the total faces extracted from user's photos
eyeOpen	The ratio of faces detected as having both eyes opened among the total faces extracted from user's photos
mouthOpen	The ratio of faces detected as having mouth opened among the total faces extracted from user's photos
age	The average value of user's detected age
brightness	The average brightness value of the face area
sharpness	The average sharpness value of the face area
poseLowPitch	The average ratio of faces with a negative pitch value among the total faces (i.e. photos of a person lowering his/her head or photos taken at a higher position than the face)
poseAbsYaw	The average absolute value of the yaw value in degrees (i.e. photos of a person's head turned left/right or photos with only the lateral side of the face)
poseAbsRoll	The average absolute value of the roll value in degrees (i.e. photos of a person's head turned front/back)
meanFaceSize	The average ratio of the face's height to the total height of the photo
numberMeanFaces	The average number of faces per photo
numberPhotosSingleFace	The number of photos with a single face among the total photos collected from a user

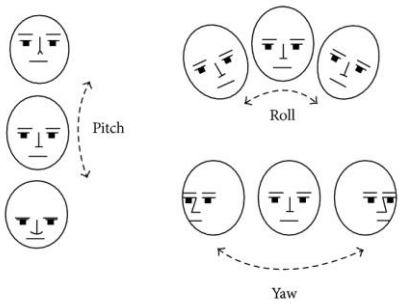

Figure 3. *Orientation of the Head in terms of Pitch, Roll, and Yaw*
(Saneiro, Santos, & Salmeron-Majadas, 2014)

3.2.3. Platform usage

Following the methodology of Preotiuc-Pietro et al. (2016), a series of features on user's platform usage were extracted using Instagram API. The total number of Instagram posts uploaded by a user was extracted. The study also quantified basic social attributes of the users, including the number of followers and the number of accounts users follow. Further, the average number of likes, comments, and hashtags were quantified. The average length of caption and the average posting frequency were also encoded. Note that the data relating to *numberPosts*, *numberFollowing*, and *numberFollowers* were directly collected from participant's account information, whereas *numberMeanLikes*, *numberMeanComments*, *numberMeanTags*, *numberMeanLength*, and *numberMeanIntervals* were obtained and

averaged from each participant's photo data. Table 5 provides a list of variables used to capture user's platform specific usage.

Table 5. *Description of Platform Usage Variables*

Variable	Descriptions
numberPosts	The total number of posts uploaded by user
numberFollowing	The total number of accounts followed by user
numberFollowers	The total number of accounts following user
numberMeanLikes	The average number of likes
numberMeanComments	The average number of comments
numberMeanTags	The average number of hashtags
numberMeanLength	The average length of caption
numberMeanIntervals	The average posting frequency

4. Results

4.1. Data analysis

4.1.1. Narcissism scale intercorrelations and statistics

Descriptive statistics for NPI and PNI scales and their subscales are shown in Table 6. The NPI subscales include *Authority*, *Self-sufficiency*, *Superiority*, *Exhibitionism*, *Exploitativeness*, *Vanity*, and *Entitlement*. The PNI consists of Grandiose Narcissism, which consists of *Self-sacrificing Self-enhancement* (SSSE), *Grandiose Fantasy* (GF), and *Exploitativeness* (EXP) subscales, and Vulnerable Narcissism composed of *Contingent Self-Esteem* (CSE), *Entitlement Rage* (ER), and *Devaluing* (DEV). The median values of the NPI total score and the PNI total score were both approximately at the midpoint of the scoring.

Table 6. *Descriptive Statistics for the NPI and PNI Scales*

Variable	*M*	*SD*	Median	Min	Max
NPI Total	18.84	6.70	18	4	34
Authority	4.44	2.09	4	0	8
Self-sufficiency	1.87	1.46	2	0	5
Superiority	3.33	1.39	4	0	5
Exhibitionism	3.56	1.79	4	0	7
Exploitativeness	1.54	1.32	1	0	5
Vanity	1.74	1.12	2	0	3
Entitlement	2.36	1.38	2	0	6
PNI Total	84.44	27.35	87	17	145

Grandiosity Total	40.58	11.72	42.5	5	67
SSSE	8.56	4.84	9	0	18
GF	21.93	7.14	23	1	35
EXP	10.09	3.48	10	1	20
Vulnerability Total	43.86	18.62	44	0	86
CSE	21.74	10.26	23	0	43
ER	12.71	5.31	13	0	25
DEV	9.41	5.74	10	0	25

As illustrated in Figure 4, the grandiose dimension of PNI exhibited positive correlations with the NPI total score ($r=0.48$, $p<.05$), while the vulnerable dimension of PNI showed insignificant correlation with the NPI total score. All PNI-Grandiosity, PNI-Vulnerability, and NPI scores showed bell-shaped curves, suggesting approximate normal distributions. Table 7 presents Pearson correlations among the subscales of NPI, PNI-Grandiosity, and PNI-Vulnerability. EXP and GF subscales of PNI-Grandiosity showed positive correlations with NPI subscales, while DEV, ER, and CSE subscales of PNI-Vulnerability exhibited very small, mostly insignificant correlations with the NPI subscales. These results are consistent with past research, which found moderately positive correlations between NPI and the grandiose dimensions of PNI (Pincus et al., 2009). Overall, a positive correlation was shown within each NPI, PNI-Grandiosity, and PNI-Vulnerability subscales. The PNI-Vulnerability subscales (CSE, ER,

DEV) showed significantly strong positive correlations. Yet, NPI's *Vanity* subscale showed insignificant correlations with most of the other subscales, except for NPI's *Exhibitionism* subscale.

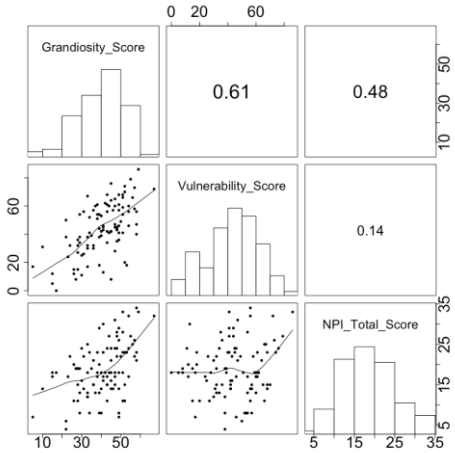

Figure 4. *Scatterplots, Frequency Histograms, and Correlations of PNI and NPI Total Scores*

Table 7. *Pearson Correlation Matrix among Subscales of the PNI-Grandiosity, PNI-Vulnerability, and NPI*

	Variables	1	2	3	4	5	6	7	8	9	10	11	12
1	*SSSE*												
2	*GF*	.45**											
3	*EXP*	.14	.31**										
4	*CSE*	.65**	.53**	.06									
5	*ER*	.57**	.44**	0	.68**								
6	*DEV*	.48**	.39**	-.09	.62**	.54**							
7	*Authority*	-.06	.22*	.55**	-.07	-.06	-.20*						
8	*Self-sufficiency*	.03	.23*	.39**	-.01	-.03	.01	.45**					
9	*Superior*	.10	.28**	.31**	.06	.11	-.10	.39**	.35**				
10	*Exhibitionism*	.25*	.39**	.32**	.33**	.39**	.09	.39**	.36**	.49**			
11	*Exploitativeness*	.16	.19	.58**	.15	.04	-.05	.43**	.22*	.28**	.25*		
12	*Vanity*	-.01	-.06	-.03	.04	.09	-.09	.06	.08	.17	.44**	.03	
13	*Entitlement*	.21*	.43**	.29**	.27**	.34**	.18	.36**	.24*	.23*	.36**	.11	.03

Note. * p < .05, ** p < .01, *** p < .001

4.1.2. Feature Analysis

Table 8 shows descriptive analysis on the variables of object detection, facial analysis, image moderation, and platform usage.

Using Rekognition API, a maximum number of 10 tags were obtained from an image. All the obtained labels had at least 90% confidence scores. Previous studies have proposed methods to label and classify photos posted on social networking sites into multiple categories (Hu, Manikonda, & Kambhampati, 2014; Liao et al., 2017). Liao et al. (2017) employed computer vision techniques such as face detection, scene understanding, and saliency map identification to gather information for automated image classification. Following the methods proposed in past studies, the current research combined the obtained labels with similar meanings, such as “person,” “people,” “human,” “female,” “woman,” and “portrait”; or “animal,” “mammal,” “pet,” “dog,” and “cat,” into a single label. Labels appearing more than once were retained. The collected Instagram photos were classified into the following nine categories: *Portrait, Food, Activity, Plant, Publication, Gadget, Fashion, Animal, Others* (see Table 3). As explained in Table 3 and Table 8, results indicated that among the detected objects, the *portrait* category accounted for the most

common features extracted from the collected photos. The zero frequency of each category's minimum value indicated that there was at least one participant who did not include any of the categorized object features in a photo. Results from the facial analysis variables showed that the average age of the detected faces in the collected data was 27.82. It turned out that the average number of faces per photo was .78 and that 67% of faces were identified as females among the total detected faces. According to the results on image moderation analysis, explicit or suggestive adult contents were rarely detected from the collected sample. Regarding platform usage, participants had an average of 321.41 posts on their account and uploaded photos every 3.18 days.

Table 8. *Descriptive Statistics for Object Detection, Facial Analysis, Image Moderation, and Platform Usage Variables*

	Variable	*M*	*SD*	Median	Min	Max
Object Detection	*portrait*	25.34	12.10	25	0	47
	plant	2.99	2.99	2	0	15
	food	5.69	4.48	5	0	25
	activity	4.55	2.99	4	0	15
	publication	2.18	2.84	1	0	16
	gadget	.95	.99	1	0	5
	fashion	1.49	2.20	1	0	12
	animal	.64	1.22	0	0	6
	others	1.31	1.32	1	0	7
Facial Analysis	*genderFemale*	.67	.21	.72	.20	1
	smile	.67	.16	.68	.26	1
	eyeglasses	.18	.15	.13	0	.83
	sunglasses	.05	.08	.03	0	.56
	eyeOpen	.68	.15	.67	.25	.96
	mouthOpen	.15	.1	.15	0	.50
	age	27.82	4.04	27.82	7.39	47.10
	brightness	43.35	5.09	44.08	27.84	55.97

	sharpness	91.86	7.83	93.66	51.43	100
	meanFaceSize	.22	.09	.2	.08	0.60
	poseLowPitch	.52	.19	.52	.10	0.94
	poseAbsYaw	15.86	5.09	15.64	7.40	30.43
	poseAbsRoll	13.73	5.84	12.25	3.20	36.29
	numberMeanFaces	.78	.52	.70	.08	2.48
	numberPhotosSingleFace	15.63	10.69	13	2	41
Image Moderation	*revealing_clothes*	.22	.91	0	0	7
	partial_nudity	.10	.39	0	0	2
	graphic_female_nudity	.15	.41	0	0	2
	nudity	.48	.85	0	0	4
	sexual_activity	.52	.81	0	0	4
	female_swimwear_or_ underwear	1.17	2.84	0	0	13
	graphic_male_nudity	.49	.77	0	0	3
	male_swimwear_or_ underwear	.02	.14	0	0	1
Platform Usage	*numberPosts*	321.41	340.33	216.5	50	1768
	numberFollowing	427.95	621.32	328	18	4853
	numberFollowers	5809.39	18995.01	426	16	137735
	numberMeanLikes	162.64	354.26	50.31	2.28	2403.18
	numberMeanComments	8.77	12.63	5.07	.76	68.52
	numberMeanTags	5.66	5.82	4.10	0	28.76
	numberMeanLength	77.05	67.5	60.45	3.98	388.44
	numberMeanIntervals	3.18	3.41	1.98	.27	20.18

As presented in Table 9 and Table 10, Pearson correlations were computed between each variable and narcissistic trait measures. It should be noted that natural log transformations were applied to the platform usage variables due to the skewness of the distribution. Table 9 shows correlations between NPI's subscales and each variable. NPI's *Authority* subscale showed significant correlation with the face wearing both types of glasses (reading and sunglasses). Also, *Authority* was correlated with faces with less *sharpness* value, indicating that those who scored high on *Authority*

measures tended to have low sharpness value in the face area. It was also shown that participants high in *Authority* tended to post photos that have more than one face present. Participants high in *Self-sufficiency* were more likely to post images of male wearing swimwear or underwear. *Superiority* and *Exhibitionism* subscales exhibited significant correlations with posting photos of animals. *Exploitativeness* was strongly associated with posting photos that contain smiling faces. *Vanity* was observed as having strong correlation with multiple variables across the feature categories. Participants with high *Vanity* scores were more likely to post photos that belong to *portrait* image category, photos with a single face, photos of a female, and photos of a female wearing swimwear or underwear. Also, they tended to post fewer pictures of a person wearing eyeglasses. Regarding platform usage, the total number of followers and the average number of "likes" showed significant correlations with the *Vanity* subscale. *Vanity* also showed negative correlation with *numberMeanIntervals* feature, indicated that those with higher levels of *Vanity* tended to upload Instagram postings more frequently.

Table 9. *Pearson Correlations between NPI Measures and Features*

Feature	NPI Measures							
Object Detection	Authority	Self.Suff.	Superior	Exhibit.	Exploit.	Vanity	Entitle.	NPI Total
portrait	-.251*	.020	-.071	.202*	-.026	.405***	-.036	.021
plant	.190	.053	.069	.144	.065	.141	.052	.171
food	.117	-.222*	-.043	-.079	.015	-.212*	-.006	-.076
activity	.061	.037	-.059	-.049	.080	-.041	-.097	-.009
publication	.017	.069	.054	-.189	-.096	-.156	-.042	-.073
gadget	.138	.079	.056	-.052	-.049	-.248*	.102	.028
fashion	-.136	.036	-.020	.048	.023	.138	-.052	-.009
animal	.023	-.049	-.274**	-.300**	.047	-.150	-.174	-.193
others	.151	.052	.086	.015	.134	-.013	-.051	.095
Facial Analysis	Authority	Self.Suff.	Superior	Exhibit.	Exploit.	Vanity	Entitle.	NPI Total
genderFemale	-.242*	-.245*	.013	.122	-.106	.409***	-.155	-.078
smile	.187	.069	.188	.097	.364***	-.010	-.042	.200*
eyeglasses	.240*	-.007	.136	-.131	.179	-.265**	-.050	.047
sunglasses	.274**	.041	.069	-.030	.225*	-.058	-.074	.120
eyeOpen	-.218*	-.129	-.071	.087	-.091	.190	.211*	-.030
mouthOpen	.193	.004	.095	-.060	.080	-.114	-.003	.060
age	.190	.151	.091	.006	.008	-.063	.180	.141
brightness	-.067	.046	-.020	-.023	-.125	-.053	-.022	-.059
sharpness	-.305**	-.192	-.035	-.095	-.187	.095	-.092	-.210*
meanFaceSize	-.085	-.073	-.047	-.015	.057	-.001	.101	-.025
poseLowPitch	-.030	.001	.049	.202*	.041	.211*	-.027	.093
poseAbsYaw	.160	.014	-.026	.113	-.033	.108	-.010	.087
poseAbsRoll	.098	.072	.194	.107	.116	.055	-.106	.125
numberMeanFaces	-.103	.094	.131	.143	.107	.179	-.088	.087
numberPhotosSingleFace	-.265**	-.046	-.069	.213*	-.025	.383***	.019	.013
Image Moderation	Authority	Self.Suff.	Superior	Exhibit.	Exploit.	Vanity	Entitle.	NPI Total
revealing_clothes	-.164	-.070	-.106	-.089	-.176	.136	-.088	-.142
partial_nudity	-.142	-.030	-.211*	-.009	-.106	.152	.008	-.091
graphic_female_nudity	-.007	-.051	.054	.063	-.076	-.024	.028	.001
nudity	-.069	.010	-.076	.101	-.153	.132	.067	-.002
sexual_activity	-.071	-.019	-.046	-.008	-.133	.172	-.025	-.040
female_swimwear_or_underwear	-.222*	.010	-.068	.043	-.138	.333***	-.085	-.059
graphic_male_nudity	.028	.147	.102	-.040	-.005	-.154	-.186	-.014
male_swimwear_or_underwear	.073	.258**	-.137	-.085	-.113	-.222*	.015	-.029
Platform Usage	Authority	Self.Suff.	Superior	Exhibit.	Exploit.	Vanity	Entitle.	NPI Total
numberPosts	-.030	.196	.030	.161	.085	.164	-.014	.124
numberFollowing	.006	.058	.031	.057	-.054	.003	.050	.037
numberFollowers	-.070	.044	-.011	.235*	.026	.391***	-.004	.118
numberMeanLikes	.011	.058	.004	.289**	.047	.383***	.023	.173
numberMeanComments	-.064	-.091	-.041	.096	-.030	.249*	-.096	-.006
numberMeanTags	.041	.088	.157	.072	-.033	.098	.221*	.139
numberMeanLength	.045	.134	.190	.112	-.046	.131	.123	.151
numberMeanIntervals	.034	-.206*	.100	-.178	-.143	-.255*	.076	-.117

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

As can be seen in Table 10, *EXP* subscale of PNI-Grandiosity was significantly correlated with *smile* variable, indicating that those with higher levels of exploitativeness tended to post pictures with more smiling faces. This result is consistent with the significant correlation found between NPI's *Exploitativeness* subscale and *smile* feature, as shown in Table 9. *The* overall PNI-Grandiosity score showed significant negative correlation with uploading photos with partial nudity. Regarding PNI's Vulnerability dimension, *ER* showed significant negative correlation with uploading pictures of animals. *CSE, ER,* and *DEV* subscales of PNI-Vulnerability showed significant correlation with *eyeOpen* feature, suggesting that those who score high in *CSE, ER,* and *DEV* tended to upload photos with both of their eyes opened. Overall, PNI-Vulnerability scale was negatively correlated with posting animal photos and positively correlated with posting photos with *eyeOpen* facial features.

Table 10. *Pearson Correlations between PNI Measures and Features*

Feature	PNI Measures								
Object Detection	SSSE	GF	EXP	Grandiose Total	CSE	ER	DEV	Vulnerable Total	PNI Total
portrait	.095	-.115	-.096	-.059	.141	.199*	.128	.174	.093
plant	.020	.098	.188	.124	-.066	.050	-.030	-.031	.032
food	.021	.075	.035	.065	.032	.084	.103	.073	.078
activity	-.103	-.076	.000	-.089	-.077	.018	.004	-.036	-.062
publication	-.008	.134	.046	.092	-.100	-.066	-.050	-.089	-.021
gadget	-.131	.115	.063	.035	-.006	-.070	-.116	-.059	-.025
fashion	-.150	-.166	-.057	-.180	-.077	.061	-.065	-.045	-.108
animal	-.135	-.142	.131	-.103	-.254*	-.285**	-.163	-.271**	-.229*
others	-.013	.111	.303**	.152	-.126	-.187	-.178	-.177	-.055
Facial Analysis	SSSE	GF	EXP	Grandiose Total	CSE	ER	DEV	Vulnerable Total	PNI Total
genderFemale	.077	-.147	-.194	-.116	.092	.061	.039	.080	.005
smile	.093	.006	.278**	.125	-.077	-.110	-.137	-.116	-.026
eyeglasses	-.238*	-.030	.180	-.063	-.212*	-.244*	-.192	-.246*	-.194
sunglasses	-.123	-.073	.162	-.047	-.095	-.106	-.156	-.131	-.109
eyeOpen	.182	.111	-.112	.109	.229*	.200*	.266**	.265**	.227*
mouthOpen	-.053	.043	.015	.008	-.045	-.082	.008	-.046	-.027
age	-.225*	-.007	.105	-.066	-.179	-.225*	-.148	-.209*	-.170
brightness	.069	.000	-.196	-.030	.111	.057	.173	.130	.076
sharpness	.044	-.138	-.113	-.099	.023	.026	.177	.075	.008
meanFaceSize	.169	.010	.004	.077	.112	.088	.200*	.148	.134
poseLowPitch	.027	-.076	.146	.008	.037	.017	-.044	.012	.011
poseAbsYaw	.016	-.111	-.001	-.062	.019	.055	-.054	.010	-.020
poseAbsRoll	-.060	-.002	.092	.002	-.121	-.069	-.119	-.123	-.083
numberMeanFaces	.121	.096	.010	.112	.075	.130	.073	.101	.117
numberPhotosSingleFace	.078	-.077	-.101	-.045	.221*	.182	.161	.223*	.133
Image Moderation	SSSE	GF	EXP	Grandiose Total	CSE	ER	DEV	Vulnerable Total	PNI Total
revealing_clothes	.050	-.030	-.157	-.045	.169	.018	.037	.110	.056
partial_nudity	-.148	-.227*	-.252*	-.274**	-.145	-.010	-.118	-.119	-.199*
graphic_female_nudity	.094	-.010	-.045	.019	.072	.062	.029	.066	.053
nudity	.060	.011	-.121	-.005	-.006	-.045	-.022	-.023	-.018
sexual_activity	.147	.064	-.074	.078	.007	.038	.075	.038	.059
female_swimwear_or_underwear	-.150	-.217*	-.145	-.237*	-.050	.064	-.098	-.040	-.129
graphic_male_nudity	-.050	.039	.025	.011	-.081	-.076	-.055	-.083	-.052
male_swimwear_or_underwear	.028	-.009	.058	.024	-.024	-.073	.040	-.022	-.005
Platform Usage	SSSE	GF	EXP	Grandiose Total	CSE	ER	DEV	Vulnerable Total	PNI Total
numberPosts	.111	.190	.150	.206*	.144	.121	.023	.121	.171
numberFollowing	.168	.243*	.005	.218*	.155	.106	.061	.134	.185
numberFollowers	.014	-.083	.049	-.030	.077	.080	-.189	.007	-.008
numberMeanLikes	.046	-.038	.096	.024	.090	.080	-.178	.017	.022
numberMeanComments	-.006	-.165	.035	-.092	-.020	.026	-.179	-.059	-.080
numberMeanTags	-.080	-.076	.040	-.068	-.110	-.128	-.092	-.125	-.114
numberMeanLength	-.126	-.074	.123	-.060	-.159	-.102	-.183	-.173	-.144
numberMeanIntervals	-.093	-.076	-.145	-.128	-.128	-.057	-.002	-.087	-.114

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

4.1.3. Multiple Linear Regression

In order to investigate the accuracy of using visual features and platform usage data to predict the narcissistic traits, multiple regression models were constructed for each NPI, PNI-Grandiosity, and PNI-Vulnerability scores. Prior to the analysis, Variation Inflation Factors (VIF) was computed to help detect multicollinearity. In general, VIFs exceeding 10 is considered evidence of serious multicollinearity (Slinker & Glantz, 2008). Following the repetitive process of removing and measuring the highly correlated variables, *numberFollowers* (VIF = 29.948), *numberMeanLikes* (VIF = 12.850), and *portrait* (VIF = 11.584) were excluded from the full model. After the removal of these three variables, the initial full model included a total of 37 independent variables. Finally, using stepwise backward elimination, multiple regression models were developed for each NPI, PNI-Grandiosity, and PNI-Vulnerability scores.

As shown in Table 11, results indicated that *plant* ($\beta = .660$, $p = .003$), *animal* ($\beta = -1.767$, $p = .000$), and *sharpness* ($\beta = -.360$, $p = .000$) showed strong statistical significance on predicting NPI score. NPI's multiple regression model consisted of 14 variables.

Table 11. *NPI Model*

Feature		β	Std. Error	p-value
	(Intercept)	36.787	10.301	.001***
Platform Usage	*numberMeanTags*	1.764	.757	.022*
	numberMeanIntervals	-1.997	.948	.038*
Image Moderation	*revealing_clothes*	-1.713	.682	.014*
	partial_nudity	-2.778	1.563	.079
Object Detection	*plant*	.660	.215	.003**
	activity	-.370	.226	.105
	animal	-1.767	.483	.000***
Facial Analysis	*smile*	5.730	3.913	.147
	age	.364	.157	.023*
	brightness	-.245	.128	.059
	sharpness	-.360	.093	.000***
	meanFaceSize	28.787	8.592	.001**
	poseAbsYaw	.262	.130	.046*
	numberMeanFaces	3.240	1.307	.015*

Note. * p < .05, ** p < .01, *** p < .001 df = 85 R^2_{adj} = .306

Table 12 shows PNI-Grandiosity's multiple regression model composed of 16 variables. Results indicated that *numberPosts* (β = 4.868, *p* = .000), *animal* (β = -2.582, *p* = .004), and *eyeOpen* (β = 31.520, *p* = .003) showed statistical significance on predicting PNI-Grandiosity score.

The multiple regression model of PNI-Vulnerability was constructed with 13 variables. As presented in Table 13, *numberMeanLength* (β = -7.028, *p* = .002), *animal* (β = -4.280, *p* = .001), *eyeOpen* (β = 39.093, *p* = .003), and *numberPhotosSingleFace* (β = .613, *p* = .006) variables showed statistical significance on predicting PNI-Vulnerability score.

Table 12. *PNI-Grandiosity Model*

Feature		β	Std. Error	p-value
	(Intercept)	-5.709	14.828	.701
Platform Usage	*numberPosts*	4.868	1.355	.000***
	numberFollowing	2.994	1.329	.027*
	numberMeanLength	-2.829	1.412	.048*
Image Moderation	*partial_nudity*	-6.649	2.927	.026*
	nudity	2.967	1.334	.029*
	female_swimwear_or_underwear	-.885	.465	.061
Object Detection	*food*	.369	.263	.164
	animal	-2.582	.869	.004**
	others	1.809	.850	.036*
Facial Analysis	*genderFemale*	-11.240	6.307	.078
	smile	12.406	7.075	.083
	eyeOpen	31.520	10.326	.003**
	brightness	-.555	.243	.025*
	poseAbsYaw	.300	.227	.190
	poseAbsRoll	.473	.207	.025*
	numberMeanFaces	3.762	2.301	.106

Note. * p < .05, ** p < .01, *** p < .001 df = 83 R^2_{adj} = .315

Table 13. *PNI-Vulnerability Model*

Feature		β	Std. Error	p-value
	(Intercept)	-20.522	24.665	.408
Platform Usage	*numberPosts*	7.092	3.017	.021*
	numberFollowing	4.467	1.996	.028*
	numberMeanComments	-6.317	2.453	.012*
	numberMeanLength	-7.028	2.240	.002**
	numberMeanIntervals	6.876	3.938	.084
Image Moderation	*partial_nudity*	-11.094	4.406	.014*
Object Detection	*plant*	-.857	.579	.142
	food	.969	.392	.015*
	animal	-4.280	1.295	.001**
Facial Analysis	*eyeOpen*	39.093	12.881	.003**
	age	-.625	.410	.131
	poseAbsYaw	.968	.373	.011*
	numberPhotosSingleFace	.613	.217	.006**

Note. * p < .05, ** p < .01, *** p < .001 df = 86 R^2_{adj} = .353

5. Discussion

The goal of this exploratory study was to examine how user's narcissistic personality traits are expressed in an image-based social media network. With the measurements for both subclinical and pathological forms of narcissism, the study aimed to investigate user's online behavioral tendencies from a multi-dimensional perspective. Using Instagram API and deep learning-based image recognition software, the study could gather a significant amount of quantified data on user's online behavior and photo content.

In regard to the study's research questions, findings revealed that narcissism was associated with several online behavioral manifestations. The Pearson correlation results between measures of NPI's subscales and the collected features provided some interesting observations. NPI's *Authority* and *Self-sufficiency* subscales showed significant negative correlations with *genderFemale* variable, suggesting that those with high *Authority* and *Self-sufficiency* scores were more likely to post photos of men's faces. *Authority* subscale was also negatively correlated with the image moderation variable that detected female wearing swimwear or underwear. *Self-sufficiency* subscale showed significant positive correlation with *male_swimwear_or_underwear* variable, indicating

that users with high *Self-sufficiency* scores tended to post photos of men wearing swimwear or underwear. On the other hand, *Vanity* scores were very indicative of posting photos including female faces and photos of female wearing swimwear or underwear. Also, *Vanity* subscale showed significant negative correlation with the variable that identified male wearing swimwear or underwear. Such findings imply that *Authority* and *Self-sufficiency* subscales were more likely to be found among male users, while *Vanity* subscale was more likely to be associated with female users. The present results fit well within the past findings on gender differences among narcissistic traits at the facet level. Among the three-facet NPI structure developed by Ackerman et al. (2011), the *Leadership/Authority* facet is known to be associated with measuring the *Authority* subscale used in the present study. Eagly, Karau, Miner, and Johnson (1994) found that men tend to score higher in *Leadership/Authority* facet than women, suggesting that men are more motivated to prefer having authority over people. Also, a meta-analytic review on 355 independent samples of past research on narcissism revealed that gender differences in narcissism was driven by the *Leadership/Authority* facet, suggesting that compared to women men are more likely to exhibit narcissistic

components related to desires for authority and power (Grijalva, Newman, Tay, Donnellan, & Harms, 2014). Regarding NPI's *Vanity* subscale, the current study's findings on the association between female and the *Vanity* facet somewhat contradicted the results from past studies, thereby calling for additional research. While earlier studies have found that women tend to show greater frequency of expressing narcissistic traits centered around physical appearances, such as showing off one's figure and wearing revealing clothes (Buss & Chiodo, 1991), more recent study revealed that NPI's facets representing vanity and exhibitionism showed almost no gender difference (Grijalva et al., 2014).

According to the Pearson correlation results, *Vanity* scores and *Exhibitionism* scores were also very indicative of platform usage variables, including number of followers and number of mean likes. It is worth noting that these platform usage behaviors were related to the narcissistic traits derived from individual's motivations associated with self-promotion. These results provided some support for Carpenter's (2012) contention that narcissistic traits driven by user's belief that he or she deserves other's admiring attention predict their self-promoting behaviors on Facebook. Carpenter (2012) predicted that individuals high in

“Grandiose Exhibitionism” aspect of narcissism, which include “vanity, self-absorption, and exhibitionistic tendencies,” satisfy their needs for attention by desiring high friend count and posting status updates and pictures of themselves more frequently (Ackerman et al., 2011, p.6). In the current study, those who scored high in *Vanity* showed negative correlation with *numberMeanIntervals* variable, suggesting that they tend to upload postings more frequently. As suggested by other earlier research that discovered positive correlations between active social media platform usage and narcissism (Panek et al., 2013; Winter et al., 2014), the current study confirms that narcissism is associated with the heightened use of social networking sites and provides some insight into the subscale level analysis of the related narcissistic traits.

Interestingly, among all of the subscales of both NPI and PNI, *Vanity* was observed as having the strongest correlations with multiple variables across object detection, facial analysis, image moderation, and platform usage features. In the NPI, the *Vanity* subscale was assessed via questions asking if a respondent is preoccupied with his or her physical appearance (e.g. “I don’t particularly like to show off my body” versus “I like to show off my

body”). Although the current research has not formed an operational definition in terms of identifying “selfies” among the collected image data, *numberPhotosSingleFace* variable of facial analysis feature may provide some support for the past studies that explored the relationship between narcissism and selfies. Multiple studies have found the association between user’s selfie-posting behavior and narcissism, suggesting that narcissism has significant positive correlation with the frequency of posting photos of oneself (Bergman et al., 2011; Fox & Rooney, 2015; Halpern, Valenzuela, & Katz, 2011; Sorokowski et al., 2015). While NPI was most frequently used to assess participants’ levels of narcissism in these studies, only a few have attempted to break down the NPI into its seven subscales and identify which psychological aspect of such complex, multidimensional trait is actually related to the selfie-posting behavioral tendencies. Based on the findings of the present study, NPI’s *Vanity* facet showed highly significant positive correlation with *numberPhotosSingleFace* variable, suggesting that user’s motivation to show off his or her physical appearance may have an effect on posting selfies.

Regarding the multiple regression models constructed for each narcissistic measure, it is worth mentioning that NPI, PNI-

Grandiosity, and PNI-Vulnerability scores significantly predicted a number of platform usage variables such as number of hashtags, number of photos, number of following accounts, and posting frequency. These findings lend data-driven evidence to past research that found associations between the levels of narcissism and social media usage tendencies, including number of "friends," numbers of postings, and frequency of status updates (Buffardi & Campbell, 2008; Deters, Mehl, & Eid, 2014; Medizadeh, 2010; Ong et al., 2011; Ryan & Xenos, 2011). As posited by Morf and Rhodewalt (2001), narcissistic individuals engage in the "dynamic self-regulatory processing model," in which they not only constantly strive to form ideal concepts of themselves, but also require affirmation from an external source (p. 177). The findings of this study provide support to this model, as they indicate that narcissists are highly motivated to broaden their online audience and promote themselves through public postings more frequently than others. Through such online activities, narcissistic individuals may arouse attention as well as facilitate external feedback, in so doing possibly helping them confirm the grandiose yet vulnerable self-concepts of themselves (Ames, Rose, & Anderson, 2006).

Another interesting finding from multiple regression analyses was that *animal* category of object detection variables showed strong statistical significance across all the three models. Vonk, Patton, and Galvan (2016) conducted a psychological assessment among pet owners and found that those high in Grandiose Narcissism were more attached to their traditional pets, while those high in Vulnerable Narcissism showed more attachment only if their pets were exotic. Although the present study's object detection categorization did not separate traditional pets to exotic animals, the findings provide some statistical evidence to the relationship between narcissism and behavioral tendencies associated with posting photos of animals. Future research should seek to investigate how and why such strong associations exist.

The main contribution of this study relates to suggesting a novel methodological approach in social science research to directly quantify user's online behaviors and mapping them to multiple components of narcissistic traits. While the majority of past research in psychology focused on assessing user's behavioral tendencies using self-report questionnaires, the present study attempted to explore the role of narcissism in the context of social media utilizing quantified user data. The self-report approach

exposed itself to several limitations, including the inability to capture participants' honest and accurate reports upon their experience. Also, the survey methodology from past studies primarily focused on retrieving and analyzing user's social media activity reports rather than focusing on the user-created contents themselves.

By employing a state-of-the-art computer vision technique, the present study retrieved data embedded in uploaded photos and accumulated large-scale datasets. This attempt facilitated comprehensive analysis of multifaceted narcissistic traits, an analysis previously considered difficult because of the challenges that lay in collecting large-data sets from photos and in manually detecting divergent features of each photo. In fact, most existing studies on narcissism and social media have been limited to the assessment of users' text-based contents and its potential links with their narcissistic traits. However, as sharing personal photos on social media became increasingly popular, a large portion of user's photographic content also became readily available. Also, previous research on digital photo sharing has found that individual's motivations behind sharing photos tend to lie in fulfilling both their intrinsic and extrinsic needs, implying that photographic contents

are deemed to be essential in fulfilling one's self-disclosure desires (Lee, 2009; Nov, Naaman, & Ye, 2010). Therefore, it is worth noting that the present study presented a new perspective in exploring the role of narcissism in the context of social media, promoting a systematic and data-driven analysis beyond a simplistic assessment of user's activity logs and text-based self-presentations.

Despite these contributions, this study is subject to limitations in several ways. First, although the image recognition API used in the current study showed high levels of accuracy and precision, the API sometimes gave low confidence scores on the correctly detected object or produced obvious errors. Also, the extracted labels had huge variance, as some labels were impressively accurate while some labels with too much specificity were not as reliable. Similar errors were found in detecting variables of facial analysis. Such detection errors may have impacted the formation of the study's photo classification scheme and further have influenced the final results. Second, participants in this study were mainly young adults from South Korea. Future research may expand the current investigation to include other age group, race, or ethnicity as the study sample.

6. Conclusion

The present study explored how narcissistic personality traits are manifested in an image-based social media network. The research suggested a novel approach to analyze a broader set of pictures posted by each Instagram users via Instagram API and deep learning-based image recognition algorithm. Based on the collected quantified data on user's online behavioral tendencies and photographic contents, the research showed that different narcissistic traits are exhibited through observable behaviors on Instagram.

The results of this study presented not only quantitative evidence to the findings from past studies but also provided valuable insights into the narcissistic trait-related features that have not yet been discovered. The present findings confirmed that gender differences exist in narcissistic traits at the facet level; subscales of narcissism related to authority and self-sufficiency were shown among male users, while the vanity subscale was found among female users. Also, results showed that user's social media platform usage behaviors were mostly related to their narcissistic motivations associated with self-promotion desires. Regarding user's selfie-posting behavior, narcissistic trait associated with vanity showed

the highest correlation, suggesting that the motivation to show off his or her physical appearance may have an effect on posting photos of oneself. The multiple regression analyses found that narcissistic tendencies significantly predict user's social media platform usage, providing data-driven analysis to existing research that revealed the close relationships between the levels of narcissism and social media use.

To conclude, this study contributes to the field of social science research by suggesting a novel methodological approach in which user's online behaviors were directly quantified and mapped to various components of narcissism to produce important implications. Whereas the majority of existing research has focused on exploring user's behavioral tendencies via self-report questionnaires, the present study assessed the role of narcissism in the context of social media utilizing quantified user data. In doing so, the present study was able to accumulate large-scale datasets and facilitate in-depth analysis of multi-dimensional narcissistic traits.

7. References

Ackerman, R. A., Witt, E. A., Donnellan, M. B., Trzesniewski, K. H., Robins, R. W., & Kashy, D. A. (2011). What does the Narcissistic Personality Inventory really measure?. *Assessment*, *18*(1), 67-87.

Amazon Rekognition, Retrieved June 24, 2017, from https://aws.amazon.com/rekognition/.

Ames, M., & Naaman, M. (2007, April). Why we tag: motivations for annotation in mobile and online media. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 971-980). ACM.

Ames, D. R., Rose, P., & Anderson, C. P. (2006). The NPI-16 as a short measure of narcissism. *Journal of Research in Personality*, *40*(4), 440-450.

American Psychiatric Association. (2013). *Diagnostic and statisticalmanual of mental disorders* (5th ed.). Washington, DC: American Psychiatric Publishing Inc.

Back, M. D., Stopfer, J. M., Vazire, S., Gaddis, S., Schmukle, S. C.,

Egloff, B., & Gosling, S. D. (2010). Facebook profiles reflect actual personality, not self-idealization. *Psychological science, 21*(3), 372-374.

Barry, C. T., Doucette, H., Loflin, D. C., Rivera-Hudson, N., & Herrington, L. L. (2017). “Let me take a selfie”: associations between self-photography, narcissism, and self-esteem. *Psychology of popular media culture, 6*(1), 48.

Bergman, S., Fearrington, M. E., Davenport, S. W., & Bergman, J. Z. (2011), Millenials, narcissism, and social networking: What narcissists do on social networking sites and why. *Personality and Individual Differences, 50,* 706-711.

Buffardi, L. E., & Campbell, W. K. (2008). Narcissism and social networking web sites. *Personality and social psychology bulletin, 34*(10), 1303-1314.

Buss, D. M., & Chiodo, L. M. (1991). Narcissistic acts in everyday life. *Journal of personality, 59*(2), 179-215.

Campbell, W. K., Bonacci, A. M., Shelton, J., Exline, J. J., & Bushman, B. J. (2004). Psychological entitlement: Interpersonal consequences and validation of a self-report measure. *Journal of personality assessment, 83*(1), 29-45.

Campbell, W. K., Brunell, A. B., & Finkel, E. J. (2006). Narcissism, interpersonal self-regulation, and romantic relationships: An agency model approach. In E. J. Finkel & K. D. Vohs (Eds.), *Self and relationships: Connecting intrapersonal and interpersonal processes* (pp. 57-83). New York: Guilford.

Campbell, W. K., & Miller, J. D. (2011). *The handbook of narcissism and narcissistic personality disorder: Theoretical approaches, empirical findings, and treatments.* John Wiley & Sons.

Carpenter, C. J. (2012). Narcissism on Facebook: Self-promotional and anti-social behavior. *Personality and individual differences, 52*(4), 482-486.

Celli, F., Bruni, E., & Lepri, B. (2014, November). Automatic personality and interaction style recognition from Facebook profile pictures. In *Proceedings of the 22nd ACM international conference on Multimedia* (pp. 1101-1104). ACM.

Deters, F., Mehl, M. R., & Eid, M. (2014). Narcissistic power poster? On the relationship between narcissism and status updating activity on Facebook. *Journal of Research in Personality, 53*, 165-174.

DeWall, C. N., Buffardi, L. E., Bonser, I., & Campbell, W. K. (2011). Narcissism and implicit attention seeking: Evidence from linguistic analyses of social networking and online presentation. *Personality and Individual Differences, 51*(1), 57-62.

DuBrin, A. J. (2012). *Narcissism in the workplace: Research, opinion and practice*. Edward Elgar Publishing.

Eftekhar, A., Fullwood, C., & Morris, N. (2014). Capturing personality from Facebook photos and photo-related activities: How much exposure do you need?. *Computers in Human Behavior, 37*, 162-170.

Ellison, Heino, & Gibbs (2006). Managing impressions online: Self-presentation processes in the online dating environment. *Journal of Computer-Mediated Communication, 11*, 415-441.

Ellison, N., Steinfield, C., & Lampe C. (2007). The benefits of Facebook "friends": exploring the relationship between college students' use of online social networks and social capital. *Journal of Computer-Mediated Communication, 12*(3).

Evans, D. C., Gosling, S. D., & Carroll, A. (2008, March). What elements of an online social networking profile predict target-rater agreement in personality impressions?. In *ICWSM*.

Fox, J. & Rooney, M. C. (2015). The Dark Triad and trait self-objectification as predictors of men's use and self-presentation behaviors on social networking sites. *Personality and Individual Differences, 76,* 161-165.

Frohlich, D., Kuchinsky, A., Pering, C., Don, A., & Ariss, S. (2002, November). Requirements for photoware. In *Proceedings of the 2002 ACM conference on Computer supported cooperative work* (pp. 166-175). ACM.

Goh, D., Ang, R., Chua, A., & Lee, C. (2009). Why we share: A study of motivations for mobile media sharing. *Active media technology*, 195-206.

Gosling, S. D., Gaddis, S., & Vazire, S. (2007). Personality impressions based on Facebook profiles. *ICWSM, 7*, 1-4.

Grijalva, E., Newman, D. A., Tay, L., Donnellan, M. B., Harms, P.

D., Robins, R. W., & Yan, T. (2015). Gender differences in narcissism: A meta-analytic review. *Psychological bulletin*, *141*(2), 261.

Guntuku, S. C., Qiu, L., Roy, S., Lin, W., & Jakhetiya, V. (2015, October). Do others perceive you as you want them to?: Modeling personality based on selfies. In *Proceedings of the 1st International Workshop on Affect & Sentiment in Multimedia* (pp. 21-26). ACM.

Halpern, D., Valenzuela, S., & Katz, J. E. (2016). "Selfie-ists" or "Narci-selfiers"?: A cross-lagged panel analysis of selfie taking and narcissism. *Personality and Individual Differences*, *97*, 98-101.

Han, S. J. (1999). *Overt and covert self-relevant cognition of narcissists*. (Unpublished master's thesis). Seoul National University, Seoul, Korea.

Hendin, H. M., & Cheek, J. M. (1997). Assessing hypersensitive narcissism: A reexamination of Murray's Narcism Scale. *Journal of Research in Personality*, *31*(4), 588-599.

Hu, Y., Manikonda, L., & Kambhampati, S. (2014, June). What We

Instagram: A First Analysis of Instagram Photo Content and User Types. In *ICWSM*.

Kapidzic, S. (2013). Narcissism as a predictor of motivations behind Facebook profile picture selection. *Cyberpsychology, Behavior, and Social Networking*, *16*(1), 14-19.

Kosinski, M., Stillwell, D., & Graepel, T. (2013). Private traits and attributes are predictable from digital records of human behavior. *Proceedings of the National Academy of Sciences*, *110*(15), 5802-5805.

Krämer, N. C., & Winter, S. (2008). Impression management 2.0: The relationship of self-esteem, extraversion, self-efficacy, and self-presentation within social networking sites. *Journal of media psychology*, *20*(3), 106-116.

Krizhevsky, A., Sutskever, I., & Hinton, G. E. (2012). Imagenet classification with deep convolutional neural networks. In *Advances in neural information processing systems* (pp. 1097-1105).

Lee, D. (2009) Mobile snapshots and private/public boundaries. *Knowledge and Policy*, 22 (3), 161-171.

Lee, E., Lee, J. A., Moon, J. H., & Sung, Y. (2015). Pictures speak

louder than words: Motivations for using Instagram. *Cyberpsychology, Behavior, and Social Networking*, *18*(9), 552-556.

Liao, W. H., Chang, T. Y., & Wu, Y. C. (2017, January). Identifying user profile using Facebook photos. In *Proceedings of the 11th International Conference on Ubiquitous Information Management and Communication* (p. 41). ACM.

Liu, L., Preotiuc-Pietro, D., Samani, Z. R., Moghaddam, M. E., & Ungar, L. H. (2016, May). Analyzing Personality through Social Media Profile Picture Choice. In *ICWSM* (pp. 211-220).

Lukowitsky, M. R., Roberts, N. R., Lehner, A. N., Pincus, A. L., & Conroy, D. E. (2007). Differentiating forms of narcissism by achievement-related motives and interpersonal problems. In *annual meeting of the Society for Interpersonal Theory and Research, Madison, WI.*

Malik, A., Dhir, A., & Nieminen, M. (2016). Uses and gratifications of digital photo sharing on Facebook. *Telematics and Informatics*, *33*(1), 129-138.

Malinen, S. (2011, January). Strategies for gaining visibility on Flickr. In *System Sciences (HICSS), 2011 44th Hawaii International Conference on* (pp. 1-9). IEEE.

Marcus, B., Machilek, F., & Schütz, A. (2006). Personality in cyberspace: Personal Web sites as media for personality expressions and impressions. *Journal of personality and social psychology, 90*(6), 1014.

Maxwell, K., Donnellan, M. B., Hopwood, C. J., & Ackerman, R. A. (2011). The two faces of Narcissus? An empirical comparison of the Narcissistic Personality Inventory and the Pathological Narcissism Inventory. *Personality and Individual Differences, 50*(5), 577-582.

Mehdizadeh, S. (2010). Self-presentation 2.0: Narcissism and self-esteem on Facebook. *Cyberpsychology, Behavior, and Social Networking, 13*(4), 357-364.

Morf, C. C., & Rhodewalt, F. (2001). Unraveling the paradoxes of narcissism: A dynamic self-regulatory processing model. *Psychological inquiry, 12*(4), 177-196.

Naaman, M., Boase, J., & Lai, C. H. (2010, February). Is it really

about me?: message content in social awareness streams. In *Proceedings of the 2010 ACM conference on Computer supported cooperative work* (pp. 189-192). ACM.

Nov, O., Naaman, M., & Ye, C. (2010). Analysis of participation in an online photo-sharing community: A multidimensional perspective. *Journal of the Association for Information Science and Technology*, *61*(3), 555-566.

Panek, Nardis, & Konrath. (2013). Mirror or megaphone?: How relationships between narcissism and social networking site use differ on Facebook and Twitter. *Computers in Human Behavior*, *29*(5), 2004-2012.

Paramboukis, O., Skues, J., & Wise, L. (2016). An Exploratory Study of the Relationships between Narcissism, Self-Esteem and Instagram Use. *Social Networking*, *5*(02), 82.

Pincus, A. L., Ansell, E. B., Pimentel, C. A., Cain, N. M., Wright, A. G. C., & Levy, K. N. (2009). Initial construction and validation of the Pathological Narcissism Inventory. *Psychological Assessment*, *21*, 365-379.

Pincus, A. L., Cain, N. M., & Wright, A. G. (2014). Narcissistic

grandiosity and narcissistic vulnerability in psychotherapy. *Personality Disorders: Theory, Research, and Treatment, 5*(4), 439-443.

Pincus, A. L. & Lutkowitsky, M.R. (2010). Pathological narcissism and narcissistic personality disorder. *Annual Review of Clinical Psychology, 6,* 421-446.

Preotiuc-Pietro, D., Carpenter, J., Giorgi, S., & Ungar, L. (2016, October). Studying the Dark Triad of Personality through Twitter Behavior. In *Proceedings of the 25th ACM International on Conference on Information and Knowledge Management* (pp. 761-770). ACM.

Raskin, R. & Hall, C. S. (1979). A narcissistic personality inventory. *Psychological Reports, 45,* 590.

Raskin, R. & Terry, H. (1988). A principal-components analysis of the Narcissistic Personality Inventory and further evidence of its construct validity. *Journal of Personality and Social Psychology, 54*(5), 890-902.

Ronningstam, E. (2005). *Identifying and understanding the narcissistic personality*. Oxford University Press.

Ryan, T., & Xenos, S. (2011). Who uses Facebook? An

investigation into the relationship between the Big Five, shyness, narcissism, loneliness, and Facebook usage. *Computers in Human Behavior*, *27*(5), 1658-1664.

Saneiro, M., Santos, O. C., Salmeron-Majadas, S., & Boticario, J. G. (2014). Towards emotion detection in educational scenarios from facial expressions and body movements through multimodal approaches. *The Scientific World Journal, 2014*.

Sheldon, P. (2015). In self-monitoring and narcissism as predictors of sharing Facebook photographs. *Presented at the southern states communication association conference, Tampa, FL.*

Slinker, B. K., & Glantz, S. A. (2008). Multiple linear regression. *Circulation*, *117*(13), 1732-1737.

Socialbakers. (2013). Photos make up 93% of the most engaging posts on Facebook. Retrieved from http://www.socialbakers.com/blog/1749-photos-make-up-93-of-the-most-engaging-posts-on-facebook

Sorokowski, P., Sorokowska, A., Oleszkiewicz, A., Frackowiak, T., Huk, A., & Pisanski, K. (2015). Selfie posting behaviors are associated with narcissism among men. *Personality and Individual Differences, 85*, 123-127.

Souza, F., de Las Casas, D., Flores, V., Youn, S., Cha, M., Quercia, D., & Almeida, V. (2015, November). Dawn of the selfie era: The whos, wheres, and hows of selfies on Instagram. In *Proceedings of the 2015 ACM on conference on online social networks* (pp. 221-231). ACM.

Twenge, J. M., & Campbell, W. K. (2009). *The narcissism epidemic: Living in the age of entitlement*. Simon and Schuster.

Twenge, J. M., Konrath, S., Foster, J. D., Keith Campbell, W., & Bushman, B. J. (2008). Egos inflating over time: A cross-temporal meta-analysis of the Narcissistic Personality Inventory. *Journal of personality*, *76*(4), 875-902.

Van House, N., Davis, M., Ames, M., Finn, M., & Viswanathan, V. (2005, April). The uses of personal networked digital imaging: an empirical study of cameraphone photos and sharing. In *CHI'05 extended abstracts on Human factors in computing systems* (pp. 1853-1856). ACM.

Vazire, S., & Gosling, S. D. (2004). e-Perceptions: personality impressions based on personal websites. *Journal of personality and social psychology*, *87*(1), 123.

Vonk, J., Patton, C., & Galvan, M. (2016). Not So Cold-blooded:

Narcissistic and Borderline Personality Traits Predict Attachment to Traditional and Non-traditional Pets. Anthrozoös, 29(4), 627-637.

Wallace, H. M., & Baumeister, R. F. (2002). The performance of narcissists rises and falls with perceived opportunity for glory. *Journal of Personality and Social Psychology*, *82*, 819-834.

Wang, S. S., & Stefanone, M. A. (2013). Showing off? Human mobility and the interplay of traits, self-disclosure, and Facebook check-ins. *Social Science Computer Review, 31,* 436-457.

Watson, P. J., Little, T., Sawrie, S. M., & Biderman, M. D. (1992). Measures of the narcissistic personality: Complexity of relationships with self-esteem and empathy. *Journal of Personality Disorders, 6*(4), 434-449.

Weiser, E. B. (2015). # Me: Narcissism and its facets as predictors of selfie-posting frequency. *Personality and Individual Differences, 86*, 477-481.

Winter, S., Neubaum, G., Eimler, S. C., Gordon, V., Theil, J., Herrmann, J., Meinert, J., & Kramer, N. C. (2014). Another brick in the Facebook wall – How personality traits relate to

the content of status updates. *Computers in Human Behavior, 34*, 194-202.

Yang, J. & Kwon, S. (2012). *Emotional characteristics of narcissists with grandiosity and vulnerability.* (Unpublished master's thesis). Seoul National University, Seoul, Korea.

8. Appendix

<Appendix 1-1> Narcissistic Personality Inventory (NPI)

다음에는 사람들이 자신에 대해 갖는 일반적인 태도를 나타내는 문장이 쌍으로 제시되어 있습니다. 두 가지의 선택지 가운데 귀하가 좀더 동의하는 문장을 골라 선택해 주세요. 두 개의 선택지 중 선택지가 애매한 경우에는 그래도 더 가깝다고 생각되는 쪽에 체크해 주시면 됩니다.

1. A. 나는 주위 사람들에게 영향을 미치는 데에 타고난 능력이 있다.
   B. 나는 주위 사람들에게 영향을 주는 식의 행동은 잘 못한다.

2. A. 겸손은 내게 어울리지 않는다.
   B. 나는 기본적으로 겸손한 사람이다.

3. A. 나는 거의 모든 일을 과감하게 하는 편이다.
   B. 나는 상당히 조심스러운 사람인 편이다.

4. A. 사람들에게 칭찬을 받으면 나는 때때로 당황하게 된다.
   B. 다른 사람들이 계속 그렇게 말해주기 때문에 나는 내가 괜찮은 사람이라고 생각한다.

5. A. 내가 세상을 지배한다는 것은 생각만 해도 너무 겁나는 일이다.
   B. 내가 세상을 지배할 수 있다면 세상은 훨씬 더 살기 좋은 곳이 될 것이다.

6. A. 나는 무슨 일이든지 다른 사람을 설득하여 내가 원하는 방식대로 할 수 있다.
   B. 나는 내가 한 행동의 결과를 받아들이려고 노력한다.

7. A. 나는 여러 사람 속에 섞여 있는 것이 더 좋다.
   B. 나는 주목받는 것을 좋아한다.

8. A. 나는 성공한 사람이 될 것이다.
   B. 나는 성공같은 것에는 별로 관심이 없다.

9. A. 나는 대부분의 사람들보다 잘나지도 못나지도 않았다.

B. 나는 특별한 사람이라고 생각한다.

10. A. 나는 훌륭한 리더가 될 자신이 없다.
B. 나는 좋은 리더가 될 자신이 있다.

11. A. 나는 자기주장을 분명하게 하는 편이다.
B. 나는 내가 좀더 자기주장을 잘하면 좋겠다.

12. A. 나는 다른 사람들에게 권위를 갖는 것을 좋아한다.
B. 나는 별로 개의치 않고 다른 사람의 지시에 따른다.

13. A. 사람들을 내 마음대로 조종하는 것이 그렇게 어려운 일은 아니다.
B. 사람들을 조종하는게 나는 별로 내키지 않는다.

14. A. 나는 내가 받아 마땅한 대접을 해줄 것을 요구한다.
B. 나는 대개 내가 받을만한 대접을 받는다.

15. A. 나는 내 몸매(또는 체격)를 뽐내기를 별로 좋아하지 않는다.
B. 나는 내 몸매(또는 체격)를 뽐내기를 좋아한다.

16. A. 나는 다른 사람들의 마음을 훤히 읽을 수 있다.
B. 사람들은 때때로 이해하기 어렵다.

17. A. 내가 잘 할 수 있는 부분에 대해서는 기꺼이 의사결정의 책임을 진다.
B. 나는 내 책임하에 어떤 결정을 내리는 것을 좋아한다.

18. A. 나는 그저 적당히 행복하기를 원한다.
B. 나는 세상 사람들의 눈으로 봤을 때 무언가를 이룬 사람이 되고 싶다.

19. A. 나의 신체는 별 볼일 없다.
B. 나는 내 몸을 바라보는 것을 좋아한다.

20. A. 나는 나 자신을 자랑하지 않으려고 노력한다.
B. 나는 기회가 되면 나의 자랑거리를 드러내는 경향이 있다.

21. A. 나는 항상 내가 무엇을 하고 있는지 잘 알고 있다.
B. 내가 지금 무엇을 하고 있는지 확신하지 못할 때가 있다.

22. A. 나는 어떤 일을 하기 위해 때때로 다른 사람에게 의지한다.
B. 나는 어떤 일을 하기 위해서 다른 이에게 의존하는 일이 거의 없다.

23. A. 나도 어쩔 때는 재미있는 이야기를 한다.
B. 누구나 내가 하는 이야기를 듣는 것을 좋아한다.

24. A. 나는 다른 사람들에게 기대하는 것이 많다.
B. 나는 다른 사람을 위해 무언가 하는 것을 좋아한다.

25. A. 나는 내가 당연히 얻어야 하는 것을 모두 얻을 때까지 결코 만족하지 않을 것이다
B. 나는 그럴 만한 일이 생기면 그것에 대해 만족한다.

26. A. 칭찬을 들으면 좀 난처하다.
B. 나는 칭찬받는 것을 좋아한다.

27. A. 나는 권력에 대한 의지가 강하다.
B. 나는 권력 그 자체에는 별 관심이 없다.

28. A. 나는 새로운 유행과 스타일에 대해 별로 신경쓰지 않는다.
B. 나는 새로운 유행과 스타일을 주도하기를 좋아한다.

29. A. 나는 거울을 보는 것을 좋아한다.
B. 나는 거울을 들여다보는데 별 관심이 없다.

30. A. 나는 사람들의 관심의 대상이 되는 것을 좋아한다.
B. 나는 사람들의 관심의 대상이 되는 것이 불편하다.

31. A. 나는 내가 원하는 대로 내 삶을 살 수 있다.
B. 항상 자신이 원하는 방식대로 삶을 살 수 있는 것은 아니다.

32. A. 권위를 갖는 것이 나에게는 큰 의미가 없다.
B. 사람들은 항상 내 권위를 인정해 주는 것 같다.

33. A. 선택할 수 있다면 리더가 되는게 좋다.
B. 내가 리더이든 아니든 나에겐 별 상관이 없다.

34. A. 나는 위대한 사람이 될 것이다.
B. 나는 내가 성공할 수 있기를 바란다.

35. A. 사람들은 때때로 내가 하는 말을 믿는다.
B. 나는 누구에게나 내가 원하는 대로 뭔가를 믿게 할 수 있다.

36. A. 나는 타고난 리더이다.
B. 리더십은 오랜 시간에 걸쳐 개발되는 것이다.

37. A. 나는 훗날 누군가가 내 자서전을 써 주었으면 좋겠다.
B. 나는 어떤 이유로든 사람들이 내 삶을 들추어내는 것이 싫다.

38. A. 나는 밖에 나갔을 때 사람들이 내 모습에 주목해주지 않으면 속상하다.
B. 나는 밖에 나갔을 때 군중 속에 묻혀 눈에 띄지 않아도 상관없다.

39. A. 나는 다른 사람보다 더 유능하다.
B. 다른 사람에게도 아주 많은 것을 배울 수 있다.

40. A. 나는 다른 여느 사람들과 비슷한 사람이다.
B. 나는 특별한 사람이다.

<Appendix 1-2> Narcissistic Personality Inventory (NPI)

This inventory consists of a number of pairs of statements with which you may or may not identify.
Choose one of the two statements which seems closer to yourself.

1. A. I have a natural talent for influencing people.
   B. I am not good at influencing people.

2. A. Modesty doesn't become me.
   B. I am essentially a modest person.

3. A. I would do almost anything on a dare.
   B. I tend to be a fairly cautious person.

4. A. When people compliment me I sometimes get embarrassed.
   B. I know that I am good because everybody keeps telling me so.

5. A. The thought of ruling the world frightens the hell out of me.
   B. If I ruled the world it would be a better place.

6. A. I can usually talk my way out of anything.
   B. I try to accept the consequences of my behavior.

7. A. I prefer to blend in with the crowd.
   B. I like to be the center of attention.

8. A. I will be a success.
   B. I am not too concerned about success.

9. A. I am no better or worse than most people.
   B. I think I am a special person.

10. A. I am not sure if I would make a good leader.
    B. I see myself as a good leader.

11. A. I am assertive.

B. I wish I were more assertive.

12. A. I like to have authority over other people.
    B. I don't mind following orders.

13. A. I find it easy to manipulate people.
    B. I don't like it when I find myself manipulating people.

14. A. I insist upon getting the respect that is due me.
    B. I usually get the respect that I deserve.

15. A. I don't particularly like to show off my body.
    B. I like to show off my body.

16. A. I can read people like a book.
    B. People are sometimes hard to understand.

17. A. If I feel competent I am willing to take responsibility for making decisions.
    B. I like to take responsibility for making decisions.

18. A. I just want to be reasonably happy.
    B. I want to amount to something in the eyes of the world.

19. A. My body is nothing special.
    B. I like to look at my body.

20. A. I try not to be a show off.
    B. I will usually show off if I get the chance.

21. A. I always know what I am doing.
    B. Sometimes I am not sure of what I am doing.

22. A. I sometimes depend on people to get things done.
    B. I rarely depend on anyone else to get things done.

23. A. Sometimes I tell good stories.

B. Everybody likes to hear my stories.

24. A. I expect a great deal from other people.
    B. I like to do things for other people.

25. A. I will never be satisfied until I get all that I deserve.
    B. I take my satisfactions as they come.

26. A. Compliments embarrass me.
    B. I like to be complimented.

27. A. I have a strong will to power.
    B. Power for its own sake doesn't interest me.

28. A. I don't care about new fads and fashions.
    B. I like to start new fads and fashions.

29. A. I like to look at myself in the mirror.
    B. I am not particularly interested in looking at myself in the mirror.

30. A. I really like to be the center of attention.
    B. It makes me uncomfortable to be the center of attention.

31. A. I can live my life in any way I want to.
    B. People can't always live their lives in term of what they want.

32. A. Being an authority doesn't mean that much to me.
    B. People always seem to recognize my authority.

33. A. I would prefer to be a leader.
    B. It makes little difference to me whether I am a leader or not.

34. A. I am going to be a great person.
    B. I hope I am going to be successful.

35. A. People sometimes believe what I tell them.

B. I can make anybody believe anything I want them to.

36. A. I am a born leader.
    B. Leadership is a quality that takes a long time to develop.

37. A. I wish somebody would someday write my biography.
    B. I don't like people to pry into my life for any reason.

38. A. I get upset when people don't notice how I look when I go out in public.
    B. I don't mind blending into the crowd when I go out in public.

39. A. I am more capable than other people.
    B. There is a lot that I can learn from other people.

40. A. I am much like everybody else.
    B. I am an extraordinary person.

<Appendix 2-1> Pathological Narcissism Inventory (PNI)

각 문장을 읽고 자신을 얼마나 잘 설명하는지를 표시해 주시기 바랍니다. 여기에 정답은 없습니다.

각 문장이 자신을 얼마나 잘 설명하는지를 0 에서 5 점 사이의 적절한 숫자에 체크해 주세요.

	전혀 나같지 않다	별로 나같지 않다	약간 나같지 않다	약간 나같다	꽤 나같다	매우 나같다
1. 나는 사람들에게 칭찬받고 존경받는 것에 대한 상상을 자주 한다.	0	1	2	3	4	5
2. 나의 자존감은 변동이 심하다.	0	1	2	3	4	5
3. 다른 사람들이 나를 실망시킬 때, 그들에 대한 나의 (잘못된) 기대에 대해서 종종 자책을 한다.	0	1	2	3	4	5
4. 나는 어떤 상황에서든 말을 잘해서 모면할 수 있다.	0	1	2	3	4	5
5. 나는 혼자 있을 때 나 자신에 대해 좋은 감정을 느끼기가 어렵다.	0	1	2	3	4	5
6. 다른 사람들을 돌보아주어야 나는 기분이 좋아진다.	0	1	2	3	4	5
7. 나는 (다른 사람에게) 도움 청하기를 싫어한다.	0	1	2	3	4	5
8. 다른 사람들이 나를 신경 쓰지 않으면 나는 기분이 안 좋아지기 시작한다.	0	1	2	3	4	5
9. 다른 사람들이 나를 무언가 결핍된 의존적인 사람으로 여길까봐 두려워서 종종 나의 욕구를 숨기곤 한다.	0	1	2	3	4	5
10. 나는 누구에게든지 내가 원하는 것을 믿게 할 수 있다.	0	1	2	3	4	5
11. 내가 다른 사람들을 위해서 해준 것을 그들이 알아주지 않으면 화가 난다.	0	1	2	3	4	5
12. 내가 말하거나 행동하는 것에 다른 사람들이 관심을 갖지 않으면 속이 상한다.	0	1	2	3	4	5
13. 내가 존경하지 않는 사람에게는 나의 개인적인 생각과 느낌들을 전부 드러내지 않는다.	0	1	2	3	4	5
14. 나는 내 주변의 세상에 커다란 영향을 미치는 상상을 자주 한다.	0	1	2	3	4	5
15. 나에게는 다른 사람을 조종하는 일이 쉽다.	0	1	2	3	4	5
16. 다른 사람들이 나를 신경 쓰지 않으면, 나는 나 자신이 쓸모없다고 느껴진다.	0	1	2	3	4	5
17. 사람들이 나를 실망시킬 수 있다는 걱정 때문에, 나는 종종 사람들을 피하곤 한다.	0	1	2	3	4	5
18. 다른 사람들로부터 내가 원하는 것을 얻을 수 없을 때면, 나는 늘 화가 많이 난다.	0	1	2	3	4	5
19. 가끔씩 내가 인생에서 중요하게 여기는 사람들이 나에게 '내가 가치 있는 사람이라는 것'을 확인시켜주는 것이 필요하다.	0	1	2	3	4	5
20. 내가 다른 사람들을 위해 무언가를 했을 때, 나는 그들이 나를 위해서도 무언가 해주기를 기대한다.	0	1	2	3	4	5

21. 다른 사람들이 나의 기대를 충족시켜주지 않으면, 나는 내가 기대했던 바에 대해 종종 창피함을 느낀다.	0	1	2	3	4	5
22. 다른 사람들이 나를 실망시키면, 나는 종종 나 자신에게 화가 나곤 한다.	0	1	2	3	4	5
23. 나는 다른 사람들의 생각과 기분을 잘 파악할 수 있다.	0	1	2	3	4	5
24. 다른 사람들이 나를 실망시키면, 나는 종종 나 자신에게 화가 나곤 한다.	0	1	2	3	4	5
25. 다른 사람들을 위해 내가 희생했을 때, 내가 그들보다 더 나은 사람이 된 것처럼 느껴진다.	0	1	2	3	4	5
26. 나는 내 능력 이상의 것을 성취하는 상상을 자주 한다.	0	1	2	3	4	5
27. 다른 사람들이 내가 원하는 대로 무언가를 하지 않을 것이라는 걱정에, 나는 종종 사람들을 피하곤 한다.	0	1	2	3	4	5
28. 나의 내면적인 약점을 다른 사람들에게 보여주기가 어렵다.	0	1	2	3	4	5
29. 나는 남에게 비판을 받을 때 화가 난다.	0	1	2	3	4	5
30. 다른 사람들이 나를 대단하게 여긴다고 생각되지 않으면, 나 자신에 대해 좋은 감정을 느끼기가 어렵다.	0	1	2	3	4	5
31. 나는 내가 들인 노력에 대한 보상을 받는 상상을 자주 한다.	0	1	2	3	4	5
32. 나는 대부분의 사람들이 나에게 관심이 없다는 생각과 걱정에 사로잡혀 있다.	0	1	2	3	4	5
33. 나에게 의지하는 친구들을 두는 것을 좋아하는데, 왜냐하면 그렇게 함으로써 내가 중요한 존재라는 생각이 들기 때문이다.	0	1	2	3	4	5
34. 내가 사람들을 위해 한 것을 그들이 인정하지 않을 수도 있다는 걱정 때문에, 나는 종종 사람들을 피하곤 한다.	0	1	2	3	4	5
35. 모든 사람들은 내 이야기를 듣는 것을 좋아한다.	0	1	2	3	4	5
36. 다른 사람들이 나를 좋아한다고 생각되지 않으면, 나 자신에 대해 좋은 감정을 느끼기가 어렵다.	0	1	2	3	4	5
37. 내가 얼마나 좋은 사람인지 사람들이 알아주지 않으면, 나는 짜증이 난다.	0	1	2	3	4	5
38. 내가 누릴 자격이 있는 모든 것들을 얻을 때까지 나는 결코 만족할 수 없을 것이다.	0	1	2	3	4	5
39. 나는 내가 희생함으로써 나 자신이 얼마나 좋은 사람인지 보여주려고 노력한다.	0	1	2	3	4	5
40. 사람들이 나에게 관심을 갖지 않으면 나는 실망하게 된다.	0	1	2	3	4	5
41. 다른 사람들의 성취를 질투하는 나 자신을 종종 발견하곤 한다.	0	1	2	3	4	5
42. 나는 영웅적인 행동을 하는 상상을 자주 한다.	0	1	2	3	4	5
43. 나는 내가 좋은 사람이라는 것을 입증하기 위해서 다른 사람들을 돕는다.	0	1	2	3	4	5
44. 내심 자신이 없더라도, 나 스스로 할 수 있다는 것을 사람들에게 보여주는 것이 중요하다.	0	1	2	3	4	5
45. 나는 나의 성취에 대해서 인정받는 상상을 자주 한다.	0	1	2	3	4	5
46. 나는 다른 사람들에게 의존하는 것을 참을 수 없는데, 왜냐하면 내가 나약하다고 느껴지기 때문이다.	0	1	2	3	4	5

47. 내가 원하는 대로 다른 사람들이 반응해주지 않으면, 나 자신이 괜찮은 사람이라는 느낌을 유지하기가 어렵다.	0	1	2	3	4	5
48. 나에게는 나를 인정해주는 사람들이 필요하다.	0	1	2	3	4	5
49. 나는 세계의 이목을 끄는 인물이 되기를 원한다.	0	1	2	3	4	5
50. 다른 사람들이 나의 부족함을 알아채면, 나는 불안하고 수치스럽다.	0	1	2	3	4	5
51. 내가 원하는 모든 것을 다른 사람들로부터 얻지 못할 바에는 차라리 혼자 있는 것이 더 편하다.	0	1	2	3	4	5
52. 다른 사람들이 나의 의견에 동의하지 않으면 나는 매우 화가 난다.	0	1	2	3	4	5

제외된 문항: 2, 3, 6, 7, 9, 13, 18, 22, 23, 28, 32, 38, 41, 44, 46, 50, 51

<Appendix 2-2> Pathological Narcissism Inventory (PNI)

Read each statement carefully and indicate to what degree you think it presently describes you. Then select one of the five answers that best describes your agreement or disagreement with the statement.

	전혀 나같지 않다	별로 나같지 않다	약간 나같지 않다	약간 나같다	꽤 나같다	매우 나같다
1. I often fantasize about being admired and respected.	0	1	2	3	4	5
2. My self-esteem fluctuates a lot.	0	1	2	3	4	5
3. I sometimes feel ashamed about my expectations of others when they disappoint me.	0	1	2	3	4	5
4. I can usually talk my way out of anything.	0	1	2	3	4	5
5. It's hard to feel good about myself when I'm alone.	0	1	2	3	4	5
6. I can make myself feel good by caring for others.	0	1	2	3	4	5
7. I hate asking for help.	0	1	2	3	4	5
8. When people don't notice me, I start to feel bad about myself.	0	1	2	3	4	5
9. I often hide my needs for fear that others will see me as needy and dependent.	0	1	2	3	4	5
10. I can make anyone believe anything I want them to.	0	1	2	3	4	5
11. I get mad when people don't notice all that I do for them.	0	1	2	3	4	5
12. I get annoyed by people who are not interested in what I say or do.	0	1	2	3	4	5
13. I wouldn't disclose all my intimate thoughts and feelings to someone I didn't admire.	0	1	2	3	4	5
14. I often fantasize about having a huge impact on the world around me.	0	1	2	3	4	5
15. I find it easy to manipulate people.	0	1	2	3	4	5
16. When others don't notice me, I start to feel worthless.	0	1	2	3	4	5
17. Sometimes I avoid people because I'm concerned that they'll disappoint me.	0	1	2	3	4	5
18. I typically get very angry when I'm unable to get what I want from others.	0	1	2	3	4	5
19. I sometimes need important others in my life to reassure me of my self-worth.	0	1	2	3	4	5
20. When I do things for other people, I expect them to do things for me.	0	1	2	3	4	5
21. When others don't meet my expectations, I often feel ashamed about what I wanted.	0	1	2	3	4	5

22. I feel important when others rely on me.	0	1	2	3	4	5
23. I can read people like a book.	0	1	2	3	4	5
24. When others disappoint me, I often get angry at myself.	0	1	2	3	4	5
25. Sacrificing for others makes me the better person.	0	1	2	3	4	5
26. I often fantasize about accomplishing things that are probably beyond my means.	0	1	2	3	4	5
27. Sometimes I avoid people because I'm afraid they won't do what I want them to.	0	1	2	3	4	5
28. It's hard to show others the weaknesses I fell inside.	0	1	2	3	4	5
29. I get angry when criticized.	0	1	2	3	4	5
30. It's hard to feel good about myself unless I know other people admire me.	0	1	2	3	4	5
31. I often fantasize about being rewarded for my efforts.	0	1	2	3	4	5
32. I am preoccupied with thoughts and concerns that most people are not interested in me.	0	1	2	3	4	5
33. I like to have friends who rely on me because it makes me feel important.	0	1	2	3	4	5
34. Sometimes I avoid people because I'm concerned they won't acknowledge what I do for them.	0	1	2	3	4	5
35. Everybody likes to hear my stories.	0	1	2	3	4	5
36. It's hard for me to feel good about myself unless I know other people like me.	0	1	2	3	4	5
37. It irritates me when people don't notice how good a person I am.	0	1	2	3	4	5
38. I will never be satisfied until I get all that I deserve.	0	1	2	3	4	5
39. I try to show what a good person I am through my sacrifices.	0	1	2	3	4	5
40. I am disappointed when people don't notice me.	0	1	2	3	4	5
41. I often find myself envying others' accomplishments.	0	1	2	3	4	5
42. I often fantasize about performing heroic deeds.	0	1	2	3	4	5
43. I help others in order to prove I'm a good person.	0	1	2	3	4	5
44. It's important to show people I can do it on my own, even if I have some doubts inside.	0	1	2	3	4	5
45. I often fantasize about being recognized for my accomplishments.	0	1	2	3	4	5
46. I can't stand relying on other people because it makes me feel weak.	0	1	2	3	4	5
47. When others don't respond to me the way that I would like them to, it is hard for me to still feel ok with myself.	0	1	2	3	4	5
48. I need others to acknowledge me.	0	1	2	3	4	5
49. I want to amount to something in the eyes of the world.	0	1	2	3	4	5

50. When others get a glimpse of my needs, I feel anxious and ashamed.	0	1	2	3	4	5
51. Sometimes it's easier to be alone than to face not getting everything I want from other people.	0	1	2	3	4	5
52. I can get pretty angry when others disagree with me.	0	1	2	3	4	5

Omitted Items: 2, 3, 6, 7, 9, 13, 18, 22, 23, 28, 32, 38, 41, 44, 46, 50, 51

국문초록

이미지 기반 소셜 네트워킹 사이트 사용행태를 통한 나르시시즘 성향 파악 연구

이준영
서울대학교 대학원
인지과학 협동과정

인터넷과 스마트폰 보급의 확산에 따라 이미지 기반 소셜 네트워킹 플랫폼은 사용자가 사진을 통한 자기표현을 할 수 있는 가장 중요한 가상 포럼이 되었다. 이에 따라, 최근에는 소셜 미디어 행동과 나르시시즘 사이의 연관성을 찾는데 학술적 관심이 급증하고 있다. 나르시시스트는 자신의 내적 개선을 위해 대인 관계 속 상호작용을 이용하기 때문에, 소셜 미디어야 말로 나르시시스트가 자신의 이상적인 자아를 강화시킬 수 있는 최고의 환경이 될 수 있다. 특히 인스타그램의 경우, 사람들이 사진 공유 활동을 통해 자기표현과 같은 사회적 상호작용 욕구를 충족시키기 때문에, 사용자의 나르시시스트적 특성을 확인하는데 적합한 소셜 플랫폼이라고 할 수 있다.

기존 연구에서 나르시시즘과 소셜 미디어 사용 간 정적 관계에 대한 충분한 증거를 제공하였지만, 양적 분석을 통한 실증적 연구는 아직 부족한 실정이다. 다수의 기존 심리학 연구들이 실험 참여자의 자기보고식 설문을 통해 수행되었으나, 이 같은 실험 방법은 참여자가 솔직하게 설문에 응답하지 않거나 참여자 본인의 과거 행동을 제대로 기억해내지 못하여 정확한 정보 수집이 어렵다는 한계점을 갖고 있다. 따라서 본 연구에서는 사용자의 소셜 미디어 행동에 대한 객관적인 데이터 수집을 위해, 인스타그램 API와 이미지 분석을 위한 머신러닝 알고리즘을 사용하였다.

이 연구는 이미지 기반 소셜 네트워킹 사이트 사용행태를 수집 및 분석하고 이를 사용자의 나르시시즘 성향과 연관 지어 살펴보고자 하는 탐색적 연구로, 인스타그램에서 사용자의 나르시시스트적 성향이 어떻게 나타나는지를 파악하고자 하는 목적을 가진다. 정량화된 데이터를 기반으로 나르시시즘의 세부적 특성이 소셜 미디어 사용행동과 어떤 연관성을 갖는지 파악하고 그 결과를 기록하였다. 이 연구는 나르시시즘과 소셜 미디어 간의 관계를 파악하기 위해, 각 사용자가 업로드한 다수의 사진을 바탕으로 탐색적 분석을 시도한 첫 연구라고 할 수 있다.

주요어: 나르시시즘, 자기애, 자기애적 웅대성, 자기애적 취약성,

소셜 미디어, 인스타그램, 이미지 분석

학번: 2015-20108