Abstract

Despite people spending nearly 10 per cent of each day on social media platforms, many also now appear to be anxious to limit the intrusion of social media into their everyday lives. Given the known link between mental anguish and trait neuroticism, understanding how personality relates to social media usage has become an important area of study in recent years. As a result, there is an abundance of articles exploring neuroticism and social media across a variety of contexts. This article synthesizes and reviews the existing work, based on a systematic search that identified 159 studies. Our findings highlight that this current research is highly contradictory, for example people with high trait neuroticism report excessive use despite appearing to use social media infrequently. We discuss the key trends across existing studies to date, and we consider the apparent difficulties experienced by people with high trait neuroticism in exploiting the full benefits of 'social' media, discussing the importance of considerations for both designers and users of social media platforms.

Keywords: Neuroticism, Personality, Big Five, Social Media

Understanding neuroticism and social media: A systematic review

1. Introduction

In March 2019, the UK parliament published a report recommending the publication of Government guidance to reduce 'excessive' social media use (Waterson, 2019). This follows related media reports of Londoners waking to check social media (Wolstenholme, 2018), influencers 'obsessed' with Instagram (Kucheran, 2019) and Facebook users struggling to start friendships offline (Knight, 2019). Such use of social media is sometimes referred to as an 'addiction' (NHS England, 2019) leading to proposals for a Social Media Addiction Reduction Technology (SMART) Act in the United States (The Economist, 2019). Despite the fanfare during the emergence of so-called Web 2.0, the tone of discussion today often therefore seems framed by a sense of foreboding about the dangers of social media for both individuals and society more widely. A reported 28 per cent of 16-24 year olds now track or limit their screen time (Kemp, 2019), suggesting a degree of self-diagnosed concern, yet social media users around the globe are believed to still spend an average of 2 hours 23 minutes per day on social media platforms (Kemp, 2019). This review contributes to debate about the academic justification for such concern (Orben, 2020).

Much of the discussion of potential deleterious effects of social media focuses on specific demographics, including young people (Royal Society for Public Health, 2017) and women (Parr, 2010). However, there is already evidence to suggest that the reported negative effects of excessive social media use, such as friendship difficulties, depression and anxiety, are related to specific personality traits across demographic segments (such as Atroszko, *et al*, 2018). This evidence sits within a large, and growing, body of research investigating the relationship between personality traits and various aspects of how people use social media. The goal of the present

review is to analyse this body of research in order to synthesise evidence relating social media usage to neuroticism. The review systematically reviews relevant literature and identifies prominent trends and recommendations for future research. Before we outline our search procedure, we define and introduce neuroticism as a trait within the five-factor model.

1.1. The identification and origin of trait neuroticism

A growing amount of research has indicated that social media use has a detrimental effect on wellbeing. Furthermore, previous lab studies of offline behaviour have specifically related trait neuroticism to similar problems, including friendship difficulties (Wilson, Harris, & Valzire, 2015) and depression (Saklofske, Kelly, & Janzen, 1995).

Although it is now common to discuss 'neuroticism' as one of the Big Five personality 'traits' (Costa and McCrae, 1992), the establishment of just five traits (or factors) is the end result of continual revisions throughout the twentieth century. Neuroticism (or its opposite – emotional stability) has been consistently recognised as an element of personality, ever since Cattell (1945) reduced the lexicon of 4,500 descriptors identified by Allport-Odport (1936) down to just 12 factors – one of which was 'neuroticism'. Later revisions altered 'neuroticism' to 'emotional stability' in the Sixteen Personality Factor Questionnaire [16PF] test (Cattell, 1957) and the Guilford-Zimmerman Temperament Survey (Guildford, 1959), before 'emotional stability' was identified as one of just five factors (Norman, 1963). Buss and Plomin (1975) then used factor analysis to again condense the 16PF to just four 'temperaments', including 'emotionality', although this evolved into a solution with three-factors (Costa and McCrae, 1976), of which one was 'neuroticism'. Neuroticism is now also a trait within their widely-accepted five-factor approach (Costa and McCrae, 1985). Although some have suggested condensing the five factors to just two (DeYoung, Quilty and Peterson, 2007) or four (Gerlach*, et*

al, 2018), this literature review presents research based on variants of the five-factor 'Big Five' or OCEAN model (Goldberg, 1981).

Measuring neuroticism involves assessing an individual's ability to adjust to their environment (Ng, 2015). Individuals who are low in trait neuroticism typically demonstrate behaviour that might be described as 'calm' or 'stable' (Ng, 2015), whereas individuals who have high trait neuroticism tend to exhibit anxiety, anger, depression, self-consciousness, vulnerability, and impulsiveness (Costa and McCrae, 1992). Eysenck hypothesized that the neuroticism trait is caused by lower threshold activation in the autonomic nervous system (Eysenck, 1990); more recently, functional imaging studies have confirmed that neuroticism is associated with the brain's reaction to negative emotional stimuli (Canli*, et al*, 2001). Evidence suggests that these neurological differences are at least partly biologically determined (Pedersen*, et al*, 1988; Plomin and Caspi, 1999) and therefore heritable (Turkheimer, 2000; van den Berg*, et al*, 2014) akin to other personality traits. Around half of the variance in neuroticism is attributable to genetics (Lahey, 2009; Widiger, 2009) and it is also identifiable from an early age, with 'undercontrolled' or emotionally impulsive three-year-olds then showing high levels of negative emotionality when aged 26 (Caspi*, et al*, 2003), supporting the hypothesis that this trait is in-built rather than environmental. Other research has demonstrated that emotional stability increases with age (Roberts*, et al*, 2006; Scollon and Diener, 2006) and that women have overall higher scores for trait neuroticism than men (Weisberg*, et al*, 2011); yet, as neuroticism generally decreases with age, so does the disparity between genders (Weisberg*, et al*, 2011).

1.2. Behavioural characteristics of individuals with high trait neuroticism

Many studies have demonstrated that trait neuroticism is associated with feeling less happy than those who are emotionally stable (such as Headey, Muffels, and Wagner, 2010) as well as

experiencing and displaying negative emotions such as sadness, anxiety, and anger (such

as Diener and Lucas, 1999; Tackett and Lahey, 2017; Tellegen, 1985; Watson and Clark, 1984).

Those with high trait neuroticism appear to be particularly perceptive to negative experiences,

tend to appraise their environment negatively (Watson and Clark, 1984), and react negatively to

unpleasant stimuli (Gross, *et al*, 1998). Even objectively ambiguous stimuli are more likely to be

experienced negatively by those high in neuroticism (Rusting and Larsen, 1998).

Socially, those with high trait neuroticism generally report more negative interactions with

others (Lincoln, Taylor and Chatters, 2003; Russell, *et al*, 1997; Shurgot and Knight, 2005), and

therefore also report feeling less satisfied with their social support network than those who are

emotionally stable (Dehle and Landers, 2005; Suurmeijer, *et al*, 2005; Tong, *et al*, 2004; DeJong,

Van Sonderen and Emmelkamp, 1999). Supporting this apparent social unease, neuroticism has

been shown to relate to relationship problems (Bolger & Zuckerman, 1995), including marital

dissatisfaction (Gattis, Berns, Simpson, & Christensen, 2004) and marriage dissolution

(Donnellan, Conger, and Bryant, 2004; Karney & Bradbury, 1997; Kelly & Conley, 1987;

Rogge, *et al*, 2006; Roberts, *et al*, 2007; Tucker, *et al*, 1998). Mroczek and Almeida (2004) also

showed that people with high trait neuroticism are more likely to react to stress, with neuroticism

specifically related to feeling stressed or negative emotions when faced with stressful situations,

(Gleason, Powers, and Oltmanns, 2012; Gunthert, Cohen, and Armeli, 1999; Hankin, Fraley, &

Abela, 2005; Larsen & Ketelaar, 1991; Suls & Martin, 2005; Zautra, *et al*, 2005), including

occupational success specifically (Ozer & BenetMartínez, 2006; Roberts, *et al*, 2007), leading to

burnout and emotional exhaustion (Armon, Shirom, and Melamed, 2012). Coping strategies for

negative experiences include withdrawal, wishful thinking, and negative emotion-focused coping

(Connor-Smith and Flachsbart, 2007). Unsurprisingly, neuroticism is therefore linked to lower reported subjective well-being (Boyce, Wood, & Powdthavee, 2013; Steel*, et al*, 2008).

Whether a cause or effect of the negative experiences above, there are also clear relationships between neuroticism and mental disorders (Clark and Watson, 1991; Klein, Kotov and Bufferd, 2011; Tackett, 2006; Widiger and Smith, 2008), including both Axis I (psychiatric) disorders (Kotov*, et al*, 2010; Malouff*, et al*, 2005) and Axis II (personality) disorders (Saulsman and Page, 2004). For example, neuroticism appears to relate to various anxiety and mood disorders, such as depression and social anxiety (Barlow*, et al*, 2013), as well as many personality disorders, such as borderline and avoidant personality disorder (Saulsman & Page, 2004). Neuroticism is also linked to more physical health problems (Brickman, Yount, Blaney, Rothberg, & De-Nour, 1996; Drossman*, et al*, 2000; Smith & MacKenzie, 2006; Suls & Bunde, 2005) and those with high trait neuroticism use medical services more often (Goubert, Crombez and Van Damme, 2004). For detailed reviews of such phenomena, see the research conducted by Tackett and Lahey (2017) and Ng (2015).

1.3. Neuroticism and social media

Although the 20th Century saw many studies of offline behaviour by personality psychologists, the recent growth in popularity of social media platforms in the past ten years mean that many human interactions now occur online. Online environments therefore provide an important and growing area of research for five-factor personality psychologists. Importantly, behaviour on social media is often visible to a greater number of peers (and sometimes beyond) than equivalent offline behaviour. In addition, this technology offers functionality that equivalent offline social interactions do not, such as the ability to easily create and share content with potentially larger numbers of contacts. Given the recent increased public awareness and

suspicion of how personal data can be used and collected through social media (The Guardian, 2020), it is sometimes difficult to differentiate fact from fiction. A number of reviews have therefore examined the extent to which various aspects of individuals' identities can be predicted from social media usage patterns, including demographic attributes (Hinds & Joinson, 2018) and personality traits (such as Azucar*, et al*, 2018; Hinds & Joinson, 2019; Tskhay & Rule, 2014). However, the present review synthesises research from across the social sciences, with a focus on only trait neuroticism.

This review employs a systematic search to identify relevant papers before discussing key trends regarding social media behaviour. This is an important and topical area of study, shedding particular light on the published research findings beyond the headlines which suggest general harmful effects of social media. For example, whilst social media users may present or report symptoms of poor mental health (Royal Society for Public Health, 2017), this may be particularly pronounced for those demonstrating trait neuroticism given the disorders described above.

Furthermore, this review provides further insight into trends between neuroticism and social media use. By identifying the literature to date systematically we seek to corroborate and synthesize early findings, such as evidence that neuroticism negatively relates to usage (Correa, Hinsley, & Zúñiga, 2011), correlates with use of negative phrases (Schwartz, *et al,* 2013) as well as longer posts (Bai, Gao and Zhu, 2012), yet motivates usage for social interaction (Hughes*, et al*, 2012).

2. Method

The present review has taken a traits-based approach to the identification of neuroticism, presenting research that is based on self-reported personality as identified through one of several commonly used questionnaire-based tests. The methods are presented in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher, *et al*, 2009). [1]

2.1. Eligibility criteria

To be included in this literature review, studies were required to: a) quantitatively examine the relationship between social media use and neuroticism as defined through the five-factor model; b) measure neuroticism using a published scale associated with the five-factor model (see measures below); c) be published on or before 5 July 2019; d) be published in a peer-reviewed journal or in peer-reviewed conference proceedings. Studies were required to include a quantifiable measure of social media use, although the scale and measurement tool varied depending on the type of social media use.

Papers which reported the Big Five traits as mediating variables were not included. Further, papers that identified correlations between traits and behaviour in order to contribute ground truth for a machine-learning algorithm were also removed.

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[1] Note, the method used here was initially applied to a systematic search of all of the Big Five Traits. Because the search produced a substantial number of articles that met our criteria, we have focused our discussion on one trait (neuroticism) in order to discuss the findings in a detailed and meaningful way. Consequently, the method reported herein essentially "replicates" the method reported in a related review on extraversion and social media (see Bowden-Green, Hinds & Joinson [2020]). That is, both reviews followed the same method, and analytical procedures in reviewing personality and social media (yet are reported separately in order to preserve brevity).

2.2. Search strategy and information sources

The following databases were searched up to and including 5 July 2019: Scopus, Web of Science, ACM digital library, PsychInfo and Pubmed. The search strategy involved identifying papers that combine *personality* as defined through the five-factor model, and *social media use*. Therefore, a search string relating to personality or each personality trait, was combined with a search string relating to social media or a social media platform. These strings were searched for within both titles and abstracts. The Boolean search performed in each database was: ["social media" OR "social network*" OR instagram OR facebook OR twitter OR youtube AND personality OR extraver* OR neurotic* OR agreeable OR conscientious* OR open* OR ocean OR "big five"].

2.3. Study selection

The search was firstly performed within the Scopus database, with all 16,502 citations downloaded into a single Mendeley library. The results of additional databases were then added, with automated removal of duplicates. This resulted in 25,209 papers to be reviewed.

The abstracts and titles were then screened by a researcher (first author), who examined the titles and abstracts of the papers and removed those that were not specifically researching five-factor personality and social media behaviour. For example, as our Boolean search was broad enough to capture abstracts featuring the words 'openness' and 'social media' without actually exploring five-factor personality, these were manually removed. This left 494 papers to be reviewed. Figure 1 displays the PRISMA flowchart with full detail of this process.

The remaining papers were then reviewed by two researchers (first and second authors) independently to select those where personality predicts behaviour (rather than identifying personality *from* behaviour). In order to be eligible for this literature review, participants must have undertaken a self-report personality test and then provided evidence of their social media behaviour either through answering a questionnaire (n=133), some form of observation (n=45), an experiment (n=3), or an interview (n=1). In some cases (see Bachrach*, et al*, 2012; Tadesse*, et al*, 2018) the work presented reported *both* personality predicting social media use *and* how patterns of use could predict personality. In these cases, the papers were included in the review, but only the results from the former analyses integrated rather than the latter. Finally, Cohen's Kappa was used to assess interrater agreement, and demonstrated high levels of consensus, *k* =0.82.

The remaining 190 papers included findings for any of the five personality traits; however, for this literature review only the 159 papers including results for neuroticism were taken through to the analysis stage.

INSERT FIGURE 1 ABOUT HERE

2.4. Analysis

The analysis consisted of five stages during which data was extracted from each of the articles that met our inclusion criteria. First, a researcher (first author) independently read through the transcripts and developed a comprehensive codebook to record key features from each study. This included reference information (title, authors, publication year), sample sizes, platform (such as Facebook or Twitter), measures used (such as Costa & McCrae [1992] or John*, et al* [1991]), and outcome behaviour (such as frequency of use, addiction, or commenting). Second, the outcome behaviours extracted were refined into a series of distinct codes. After, the

behaviours (i.e. dependent variables) were recorded, two researchers (first author – a PhD student interested in personality and systematic reviews, and second author – a postdoctoral researcher experienced in performing systematic reviews) read through the behaviours and identified variables that were conceptually similar or equivalent. Such behaviours were merged into a series of independent categories, for example "follower quantity" and "network size" were grouped into an overall "network size" code.

Third, 25 per cent of randomly selected studies were second coded (by the second author) to assess reliability. In other words, after developing the set of categories for each outcome behaviour, a subset of articles was independently read and the behavioural outcome was coded in line with these pre-defined categories. Cohen's k was used to assess interrater agreement, and demonstrated moderate levels of consensus, $k = 0.58$. All discrepancies that occurred in data extraction were resolved through discussion[2]. Fourth, the outcome behavioural codes were reviewed again in order to assess similarities/differences and were grouped into a series of themes according to commonalities between the dependent outcomes studied, following Braun & Clarke's (2006) guidelines for thematic analysis. The themes were then agreed and named collaboratively through discussion. For example, "posting images", "posting videos", and "posting specific words" were grouped into a "content creation" theme. An outline of each of these themes can be found in Section 3.2. Further, an overview of the themes is provided in Table 2, and all studies included in the analysis are provided in the Supplementary Materials.

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[2] The discussion revealed that differences in coding resulted when the researchers interpreted behavioural outcomes in slightly different ways (such as coding a behaviour reported as 'mild use' in one paper as 'frequency of use' by one researcher, and 'time spent' by another), or when studies that reported many behaviours (which caused the researchers to code a different number of behaviours) . Thus, such differences were mostly due to subtle differences in assigning behaviours to categories, rather than actual 'disagreements'

3. Results

3.1. Study characteristics

The studies reviewed focused on a variety of dependent variables (see Table 1), with numerical outcomes the most common, such as network size (n=27), followed by time spent on social media (n=17), update frequency (n=14), and more general frequency of use (n=12). Facebook is the social media platform with the most research (n=92) with the other main platforms studied being Twitter (n=11), and Instagram (n=7). The full range of platforms studied is outlined in Table 2. Questionnaires are the most common method used to collect information about participants' social media use (n=118). Where reported, the majority of the samples in the research we reviewed included students (n=79) and/or participants recruited though Facebook (n=31).

There are a variety of scales used to measure neuroticism as part of the five-factor model. Where reported, the most popular was Goldberg, *et al* (2006) (n=16), followed by John and Srivastava (1999) (n=15) and Gosling, Rentfrow and Swann (2003) (n=12). The full range of measures and their frequency of use is shown in Figure 2.

<center>INSERT TABLE 1 ABOUT HERE</center>

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3.2. Major findings

We identified six main themes within the papers reviewed.[3] These themes encapsulated the main trends and commonalities amongst the behavioural outcomes identified, and are outlined as follows:

1. *Aggression, trolling and excessive use.* The studies within this theme investigate anti-social or 'dark' (Baccarella *, et al*, 2018) uses of social media as previously attributed to demographics (Thacker and Griffiths, 2012; Kirik, *et al*, 2015).

2. *Patterns of use.* These are studies revealing patterns of behaviour on social media that are created unconsciously and likely to be driven by trait neuroticism. Gosling*, et al* (2002) explain that people unintentionally leave such observable 'residue', relating to their personality traits, through their day-to-day behaviour. This is particularly pertinent on social media where such unintentional behavioural clues can be interpreted by those with whom the person interacts. In simple terms, a person with high trait neuroticism often signals the fact to their followers or friends.

3. *Content creation.* These are studies which find that people with high trait neuroticism consciously create content in order to manage the image presented to others through social media. Goffman (1978) first observed that people 'manage' their actions in interactional situations in order to create a specific impression on others. This was later applied to social media by Kaplan and Haenlein (2010). This theme is related to the first theme above, in that a person's use of content is visible to their followers or

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[3] Please note that these themes were identified through our analysis of all of the Big Five Traits. These themes therefore essentially "replicate" those reported in a related review on extraversion and social media (see Bowden-Green, Hinds & Joinson [2020]). This manuscript however discusses only the findings for neuroticism within each theme.

friends; however, this theme explores clues to a person's personality that have been intentionally created. This is a particularly interesting area to explore for people with high trait neuroticism, who are known to display negative emotions (Watson and Clark, 1984).

4. *Content reaction*. This theme presents research showing how extraverts manage their image through visibly reacting to social media content produced by others. Again, as above, displaying a reaction is likely to be a conscious decision (Goffman, 1978; Kaplan & Haenlein, 2010).

5. *User profile characteristics*. These are studies that relate neuroticism to the factual information revealed within a user's profile information, such as network size. This is relevant to neuroticism as those with high trait neuroticism tend to report negative interactions with others (such as Russell*, et al*, 1997), and experience relationship problems (Bolger & Zuckerman, 1995).

6. *Perceptions of social media*. These are studies which investigate the motivations and attitudes towards the value of social media, as previously related to demographics (Joinson, 2008).

3.2.1. Neuroticism and aggression, trolling and excessive use

3.2.1.1. Excessive use

Many studies show that people with high trait neuroticism are more likely to report that they use social media excessively (Malo-Cerrato, Martín-Perpiñá, Viñas-Poch, 2018) or 'compulsively' (Hsiao, Lee, Chiang, Wang, 2016). Although Wilson, Fornasier and White (2010) found no significant relationship between neuroticism and an addictive tendencies scale,

in many cases this 'excessive' usage is presented as 'addiction' (such as Biolcati, *et al*, 2018),

'problematic use' (Marino, *et al*, 2016) or Facebook 'intrusion' (Błachnio, *et al*, 2016), using

measures including the self-report Bergen Facebook Addiction Scale (such as Lee, 2019) and

Social Media Addiction Questionnaire (Hawi and Samaha, 2019). Studies of specific platforms

find similar results for: compulsive YouTube use (Klobas, *et al*, 2018); excessive use of Weibo

(Hou, *et al*, 2018), and either 'problematic' use (Balta, *et al*, 2018) or apparent 'addiction' to

Instagram (Kircaburun and Griffiths, 2018). Yet, there are somewhat mixed results for reported

Facebook addiction, with Andreassen (2013) finding no significant relationship and Tang, *et al*

(2016) finding a negative relationship. Alternatively, Blackwell, *et al*. (2017) link neuroticism

indirectly to reported addiction through the "pervasive apprehension that others might be having

rewarding experiences from which one is absent" known as FoMO ('Fear of Missing Out';

Przybylski, *et al*, 2013).

These findings highlight ways that social media may be considered to be problematic,

including measures of 'excessive use', 'compulsion', and 'addiction'. Yet the studies are limited

in that they are all dependent on self-report measures. Thus, such claims are restricted to

individuals' *perceived* usage rather than their *actual* usage, which raises questions about the

validity of what such studies claim to measure. This issue has been raised by numerous

researchers (such as Coyne, *et al*, 2020; Ellis, 2019; Ellis, Davidson, Shaw, & Geyer, 2019) who

argue that, in comparison to objective measurement, self-report instruments may not be sensitive

enough to correctly record technology use. As such, the extent to which individuals use social

media excessively and compulsively – versus *feeling* that their use is excessive or compulsive –

is currently not well understood. There is also a wider question about whether 'addiction' is an

appropriate term for behaviours such as high technology use (Davidson & Ellis, 2019), given its

origin as a term for describing 'physical' dependency on psychoactive drugs (Jarvis & Okami, 2020).

3.2.1.2. Neuroticism and trolling or aggression

Even if neurotics do experience aggression emotions, restraint appears to prevent corresponding behaviour online. Although those with high trait neuroticism admit to feeling envy on Facebook (Wallace, James and Warkentin, 2017), and experiencing aggressive fantasies (McCreery and Krach, 2016), reflecting the 'anger' facet (Costa and McCrae, 1992), there is no link to trolling (Howard, *et al*, 2019), bullying (Kokkinos, Baltzidis and Xynogala, 2016), or posting uncivil comments (Koban, *et al*, 2018). People with high trait neuroticism may feel anger, but self-consciousness (Costa & McCrae, 1992) is likely to prevent these feelings being acted upon. Nor is a relationship found to posting about *faux pas* topics (such as Karl, Peluchette and Schlaegel, 2010) including drugs or alcohol (Stoughton, Thompson and Meade, 2013). Given that a link between neuroticism and drug use has previously been found (Prisciandaro, *et al*, 2011), the lack of posts revealing this again suggests restraint through self-consciousness (Costa & McCrae, 1992).

3.2.2. Neuroticism and patterns of use

3.2.2.1. Neuroticism and frequency or duration of use

Our findings display mixed results linking neuroticism to social media membership, with studies relating neuroticism to membership of Tumblr (Brailovskaia and Margraf, 2018) and social media platforms in general (Stronge, *et al*, 2015), whilst others find a negative relationship (such as Bogg, 2017). Reflecting the evidence for excessive use discussed above, some studies suggest a link between neuroticism and social media use (Correa, Hinsley, and de Zúñiga, 2010)

or frequency of sessions (Caci, *et al*, 2014), Facebook checking (Seidman, 2019) and general Facebook use (such as Błachnio and Przepiorka, 2016). Yet, most of the studies in our set found no relationship to frequency of use whatsoever (such as Annisette and Lafreniere, 2017). These null results were consistent across different platforms including XING (Buettner, 2016), Instagram (Pornsakulvanich, 2017) and Twitter (Katrimpouza, Tselios and Kasimati, 2017). Similarly, while some studies demonstrate a relationship between neuroticism and time spent on social media per day (such as Moore and McElroy, 2012), most show either no significant relationship (such as Skues, Williams and Wise, 2017) or a negative relationship (such as Jain, Gera and Ilavarasan, 2016).

These findings highlight much confusion and contradiction in terms of understanding social media usage patterns; some research suggests that individuals with high trait neuroticism use social media excessively, compulsively or even addictively, yet other work indicates that people with high trait neuroticism spend little time on social media. However, it is important to recognise that despite moderate correlation between frequency of use data and excessive, compulsive, or addictive use data, each is collected using different measures and may not indicate the same behaviour. For example, those who self-perceive excessive use despite not actually using any platform frequently may be demonstrating an anxious preoccupation with social media that is typical of the anxiety and stress associated with neuroticism (Gunthert, Cohen, and Armeli, 1999; Suls & Martin, 2005).

3.2.3. Neuroticism and user profile characteristics

3.2.3.1.   Neuroticism and network size

Our findings show that people with high trait neuroticism do not appear motivated to grow their online networks, reflecting similar findings for offline 'support networks' (Tong, *et al*, 2004). We find that they do not have a significantly high number of friends or followers on social media platforms (such as Lönnqvist and Große Deters, 2016), yet neither do they have a significantly low number (such as Bachrach, *et al*, 2012). Only one study identified a negative relationship to friend quantity online specifically (Pornsakulvanich, 2017).

3.2.4. Neuroticism and perceptions of social media

3.2.4.1.   Neuroticism and motivation to use

Although people with high trait neuroticism tend to have small social networks, social interaction is a motivation for individuals to use social media (such as Hughes, *et al*, 2012). Similarly, motivation is found for interacting with work peers (Bhattacharya, Sinha and Sheorey, 2014). Just one study finds no significant relationship to social use (Horzum, 2016).

3.2.4.2.   Neuroticism and self-disclosure

Counterintuitively, considering the tendency for people with high trait neuroticism to worry, our findings suggest that there is no significant relationship to privacy settings or alternative privacy protection (such as Gerber, Gerber and Hernando, 2017). In fact, some studies suggest that those with high trait neuroticism are indiscreet in their posts (such as Hollenbaugh and Ferris, 2014), although contradictory research suggesting a lack of self-disclosure means that the findings are inconclusive (such as Chen, Pan and Guo, 2016).

3.2.5. Neuroticism and content creation

3.2.5.1. *Neuroticism, self-presentation and status updates*

Trait neuroticism includes a self-consciousness facet (Costa and McCrae, 1992) which suggests that people with high trait neuroticism are concerned about how they appear to others (Costa and McCrae, 1992). Supporting this, our findings specifically show that those with high trait neuroticism seem keen to present an ideal or false self, rather than the 'real' self (such as Michikyan, Subrahmanyam and Dennis, 2014), and there is a positive relationship with use of social networks for self-promotion (Roulin, 2014). As such, individuals with high trait neuroticism have been found to comment on news as a form of 'exhibitionism' (Wu and Atkin, 2017), but are concerned about others' comments about them (Shi, Yue and He, 2013). Further, they are particularly worried about receiving feedback on selfies, suggesting sensitivity to rejection and a need for peer acceptance (Choi, *et al*, 2017). This apparent desire not to displease again reflects the vulnerability facet of trait neuroticism (Costa and McCrae, 1992). People with high trait neuroticism also report using Facebook for validation and conformity (such as Marshall, Lefringhausen and Ferenczi, 2015), and Tinder to enhance their self-esteem enhancement (rather than sex; Orosz, *et al*, 2018).

While these findings generally suggest that those with high trait neuroticism are anxious about the image they portray on social media (Tackett and Lahey, 2017), some research has identified a negative relationship between neuroticism and 'broadcasting' behaviour (Kabadayi and Price, 2014). Aside from one study (Wang, *et al*, 2012), most have not identified a significant relationship with status update quantity (such as Casado-Riera and Carbonell, 2018), supporting what others have identified to be 'passive' behaviour (such as Rozgonjuk, *et al*., 2019).

When people with high trait neuroticism do post updates though, they tend to be longer (such as Bai, Gao and Zhu, 2012) and convey overwhelmingly negative emotions (such as Kern, *et al*, 2014), although Cho (2017) finds that this relationship is not significant. Likewise, there is a negative relationship to displays of positive emotion (such as Farnadi, *et al*, 2014). This is an unsurprising finding, given that trait neuroticism is generally associated with both experiencing and displaying negative emotions (Diener and Lucas, 1999; Tellegen, 1985; Watson and Clark, 1984). It also lends support to the hypothesis that such negativity hinders participation in large social networks [as discussed above] and relationship problems (Bolger and Zuckerman, 1995).

3.2.5.2.   Neuroticism and images

Several studies find a positive association with posting photos (such as Eftekhar, Fullwood and Morris, 2014) and sharing photos (Hwang, 2017), including photos of travelling with family, traveling alone, or self-portraits (Yang, 2019), and buildings, dark, or abstract photos (Kim and Kim, 2018). Qiu, *et al* (2015) find a relationship between neuroticism and the use of the 'duckface' pose in selfies, but Kim and Chock (2017) find no significant relationship to taking selfies at all.

The research on profile photos is mixed though, suggesting a positive relationship to posting a profile photo (Amichai-Hamburger and Vinitzky, 2010), yet not to changing profile image (Whitty, *et al*, 2016) nor the choice of profile photo (Wu, Chang and Yuan, 2015), and a negative relationship with the level of detail (Segalin, *et al*, 2017).

3.2.6. Neuroticism and reaction to content

Supporting the previous evidence of people with high trait neuroticism using social media 'passively', our findings suggest that the relationship to 'liking' or 'commenting' on others' posts

is either negative (such as Lee, Ahn and Kim, 2014) or non-significant (such as Gosling, *et al*, 2011). Again, given the purpose of social media to 'socialise' (i.e. create, share and respond to content), there could be a causal link between this unwillingness to engage and smaller social network size for those with high trait neuroticism as demonstrated above.

Similarly, although self-reports suggest a general willingness to engage with brands (Islam, Rahman and Hollebeek, 2017), reactions to marketing content appear to be 'passive', with a negative relationship to clicking on a link in an advert (Chen*, et al*, 2015), a reluctance to comment on ads and sponsored stories (Clark and Çalli, 2014), and no significant relationship with Facebook commerce (Leong, Jaafar and Sulaiman, 2017). This appears to be the case even when the content being 'marketed' is health information (Boontarig, 2017) rather than commercial products.

4. Discussion

4.1. Major findings and implications

Our review highlights a number of key trends across the vast amount of research attempting to understand how neuroticism relates to social media. First, there is no significant evidence that people with high trait neuroticism access social media particularly frequently or for long periods of time. Likewise, research has failed to find a relationship between status update frequency and neuroticism. There is also no consistently reported link between reacting to the content of others through commenting or liking and neuroticism. These findings contrast with the perceptions of their own usage.

Our findings also highlight numerous contradictions within the current research. For instance, although there appears to be a clear link between neuroticism and excessive usage of

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social media, often identified through self-report measures (such as Hawi and Samaha, 2019), this isn't necessarily reflected in duration or frequency of use findings. Some researchers have raised concerns about self-report measures as a valid and reliable means of determining technology addiction (Coyne, *et al*, 2020; Ellis, 2019). Ellis (2019) also hypothesised a potentially causal correlation between 'anxiety' and self-reported addiction. A logical conclusion to be therefore drawn from these apparently conflicting findings (excessive yet infrequent use) is that people with high trait neuroticism worry about their usage more than their actual usage warrants, reflecting the anxiety facet associated with trait neuroticism (Tackett and Lahay, 2017). In turn, their anxiety to reduce perceived 'excessive' use could lead to lower usage in terms of time (e.g Kuo and Tang, 2014) and/or more 'passive' use. Ironically though, even passive use has previously been found to reduce well-being (Verduyn, *et al*, 2015). The concern among people with high trait neuroticism about their social media use, may actually lead to a behaviour that is further contributing to their anxiety.

In respect of the initial goal to understand how personality traits relate to the apparent harmful effects of social media (Waterson, 2019), we find a wealth of evidence to support a link between self-report measures of excessive use and neuroticism as discussed above. Therefore, given the indication that levels of concern about problematic use differ between personality traits, the evidence suggests that specific traits may respond more effectively to reduction efforts. Modern 'microtargeting' methods (Barbu, 2014) for example, especially in this social media environment, provide the potential to tailor specific intervention messages to specific personality traits (Matz, *et al*, 2017).

Another prominent trend is the apparent motivation of those with high trait neuroticism to use social media to socially interact (such as Eşkisu, Hoşoğlu and Rasmussen, 2017). Again, the

research we identify indicates that people with high trait neuroticism have a comparatively small online social network (such as Noë, Whitaker and Allen, 2018), appearing at odds with this socialising motivation. Yet, one explanation requiring further research may be a difference in perception regarding the number of friends/contacts required to 'socialise'. Are those with high trait neuroticism content with a smaller network? Given that trait neuroticism is generally associated with feelings of dissatisfaction towards a social group (such as Dehle and Landers, 2005), people with high trait neuroticism do not seem to particularly value networks or strive to achieve a large online social network. Another explanation could be their usage of social media in terms of content creation and reaction. The design of social media platforms/algorithms requires users to be 'social' and to interact through creating and sharing content. Our findings suggest that those with high trait neuroticism generally do not provide significantly high quantities of status updates (such as Cheevasuntorn, *et al*, 2018) or react to others' content through 'likes' or 'comments' (such as Lee, Ahn and Kim, 2014). Therefore, it is unsurprising that this 'passive' use (Ryan and Xenos, 2011) does not attract a large following or friendship base. Furthermore, the valence of the content that is shared by people with high trait neuroticism may well play a part in their experience of social media (and vice-versa – through the virtuous circle discussed below). Previous research indicates that positive content is more attractive to online audiences (Berger and Milkman, 2012), yet the overwhelming evidence is that people with high trait neuroticism share negative valence content (such as Shen, Brdiczka and Liu, 2015). Infrequent posting of 'positive' content that might otherwise attract peers is therefore a third potential causal explanation of the small network size.

In some ways, there appears to be an injurious circle or self-fulfilling prophecy, with potential dissatisfaction in a network (such as Dehle and Landers, 2005) leading to a negative

experience which is reflected in negative sentiment and emotion (such as Shen, Brdiczka and Liu, 2015), again limiting the extent to which those with high trait neuroticism socialise on social media. A similar pattern may be occurring with the concern for self-presentation leading to extreme caution or anxiety about the posts created and therefore a smaller quantity of posts. It seems likely that this low level of interaction may lead to a smaller network size, which may intensify the concern for self-presentation.

Ultimately, if individuals with high trait neuroticism struggle to present themselves or interact with others properly on social media, they can be left craving social interaction (such as Eşkisu, Hoşoğlu and Rasmussen, 2017) and seeking favourable self-presentation (such as Seidman, 2013), yet limited in their success with either due to facets within their personality. People with high trait neuroticism may be unable to consistently present a positive online persona that would otherwise enable them to socialise successfully. As research on self-disclosure shows, there is perhaps no 'filter' (or not enough of a filter) on revealing facts about themselves (such as Peluchette*, et al*, 2015) or presenting their true (i.e. negative) feelings. Therefore, as also demonstrated offline (Lincoln, Taylor and Chatters, 2003; Russell*, et al*, 1997; Shurgot and Knight, 2005), those with high trait neuroticism do not enjoy interactions with others and are left unsatisfied with their social support network (De Jong, Van Sonderen and Emmelkamp, 1999; Dehle and Landers, 2005; Suurmeijer*, et al*, 2005; Tong*, et al*, 2004).

In sum, these findings cast considerable doubt on the ability of users with high trait neuroticism to exploit the full benefits of 'social' media. This is important given the increasing reliance (or assumed reliance) on social media to disseminate information and gather viewpoints. Thus, developers of social media platforms, businesses and organisations using social media

should consider these aspects when designing social media spaces that are inclusive to all types of people.

4.2. Limitations and future directions

This research is not intended to offer quantifiable means of assessing the strength of effect sizes, and instead explores key trends and nuances across these studies. There is therefore an opportunity for future research to present meta-analyses of these trends. This would also explore in greater depth, for example, the differences in outcome when different data collection techniques are employed. Greater statistical analysis might also explore the effect size when traits combine.

In addition, further studies could shed further light on the apparent inconsistency between measures of compulsive, excessive or even addictive use, yet relatively low frequency of use. For example, a single sample could be invited to complete measures of both frequency and some measure of self-reported problematic use to further underline this difference between perception and reality. Furthermore, a related area for further research is then why neurotics self-report 'problematic' social media use. For instance, Davidson and Ellis (2019) have previously hypothesized a causal link to anxiety, a facet of the neuroticism trait.

Another important topic is the finding that people with high trait neuroticism appear to have fewer friends/contacts than their counterparts. This appears to contradict motivations for using social media and suggests that they may have a different perception of what it is to be 'sociable' online. This is an important topic for research because the nature of 'social' media requires users to establish and maintain networks. For example, although all recipients may believe they are participating as required, a social media campaign inviting users to share content

is likely to be less effective when targeting people with high trait neuroticism recipients rather than those who are emotionally stable. An important question therefore is whether they realise this difference.

A final, and fundamental, topic for investigation is the relationship between content creation and network size. Our findings demonstrate that people with high trait neuroticism are, on average, less frequent in their posting of status updates i.e. they are 'passive' users of social media. In addition, they tend to post content that is negative in valence. Either, or both, variables could offer a causal explanation of the smaller-than-average network size.

4.3. Conclusions

To our knowledge, this is the first literature review to systematically identify published literature linking trait neuroticism to social media behaviour. Whilst it has identified some parallels to the offline behaviour of people with high trait neuroticism, such as a tendency to express negativity and friendship difficulties, there are also several contradictions requiring further investigation. For example, these include the contrast between self-reported addiction and studies of usage, and the contrast between a desire to socialise and both actual network size and the frequency/tone of content updates. This work therefore casts doubt on the role of social media as 'a leveller' (Holt*, et al,* 2013), connecting citizens within a democratic society; it instead suggests differences in usage and engagement according to personality traits. In fact, rather than dispelling myths created by media headlines about the problems with social media, such as addictive behavior, our findings suggest that some of these concerns are particularly pertinent for those with high trait neuroticism . Respecting the need to design and use social media in a way that appeals to all personality traits is therefore an important point for

consideration by organisations intending to engage an audience online as well as the platform

designers themselves.

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