

Quantifying the Links Between Personality Sub-traits and the Basic Emotions

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Abstract. This article describes an exploratory study that aimed to analyse the relationship between personality traits and emotions. In particular, it investigates to what extent the sub-traits of the Five Factor Model has an empirically quantifiable correlation with the Basic Emotions (Anger, Anxiety, Disgust, Fear, Joy, Sadness, Surprise). If links between these personality traits and the basic emotions can be found, then this would enable an emotional-state-to-personality-trait mapping.

In this study, 38 participants answered a Big Five Aspects Scale (BFAS) questionnaire and then watched 12 emotionally provocative film clips along with answering 12 short emotional Likert-scales on their emotional experiences during each film clip. The results showed that (i) four of the seven Basic Emotions outright significantly correlated, while two emotions (Fear and Disgust) approached statistical significance, with at least one of the personality traits and (ii) significant correlations between personality traits and basic emotions could only be identified at the sub-trait level, demonstrating the value in adopting a higher-resolution personality model.

The results supports the long-term goal of this research, which is the enabling of state-to-trait inferences. A method for analysing and visualising such a mapping, that differentiates mappings based on the direction and magnitude of the effect size was also developed. The study contributes a blueprint towards utilising Affective Computing methodology to automatically map these phenomena.

Keywords: Personality · Emotion · Affective computing

1 Introduction

Personality and emotion are two important life components. Personality is the unique and typical way a person feels, perceives, desires, and behaves in the world [42]. Emotion is the brief but potent experience of states like joy, disgust, or sadness. Our personality accurately predicts our academic performances [41], our level of income and occupational success [47], the quantity and quality of

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our romantic relationships [32], our likelihood of developing mental illnesses [28], the likelihood of being persuaded by certain types of targeted messages, both commercial [23] and political [18,33], amongst many other [48]. Emotions provide important feedback on our goal-progress [14]; they prepare us either to take or avoid certain actions; and they are essential for everyday life decisions [8]. The functioning of both phenomena is necessary for healthy well-being.

A significant body of research exists on the study of personality and emotions as largely distinct phenomena [4,6,29]. In the last two handbook of emotions for psychology researchers, in-depth discussions of modern personality research are limited. In the 2016 version, the discussion of the relationship between emotions and personality largely focuses on the influence of social and individual differences factors, such as social display rules and differences in emotion regulation, rather than personality directly [4]. In the 2010 version, the discussion of personality and emotions focuses primarily on the individual differences in emotion regulation rather than experience [29]. Similarly, in the Cambridge handbook of personality psychology [6], while the relation between emotions and personality is discussed more directly, it is confined to one chapter.

The limited discussion of the relationship between personality and emotions overlooks the fact that they are interwoven with one another and the intersection between the two phenomena is a promising source of scientific inquiry. For example, people tend to describe the personality of another person in terms of that person's typical emotional experiences (e.g. he/she is a happy person, but can be prone to anger; he/she is an fearful person, and is often melancholic)[1,30]. Similarly, neuroscientific research conducted in the last 15 years has repeatedly found substantial correlations between neurological emotion systems and personality traits [9]. Such evidence supports the view that emotions are a springboard for people's personality; how much people feel certain emotions is an indicator of their personality.

Nevertheless, it is unclear what the exact relationship between personality and emotions is. Are people high in certain personality traits more likely to experience certain emotions? The limited evidence collected so far suggests yes. For example, according to a study that monitored the behaviour and emotions of people periodically in their daily lives, extraverted people experienced higher levels of positive emotion (e.g. joy) than introverted people. The study also showed that people high in Neuroticism (who tend to be emotionally unstable) tend to experience higher levels of negative emotion than people low in Neuroticism[1] [36]. However, the emotions that other personality traits are coupled with is yet to be sufficiently quantified.

The intersection of personality and emotions is fertile ground for cross-disciplinary research opportunities. Research in both the fields of personality and emotions have identified key components that are appropriate for rigorous scientific analysis.

[1] Positive and negative in this context refers to how pleasant an emotion feels to the person. This is typically referred to as the valence of an emotion.

Personality: The primary components are traits. Traits are typical patterns of emotion, behaviour, cognition, and motivation across situations [35].
Emotion: The primary components are the basic emotions, having been described as the "primary colours" underpinning all our emotional experiences [14].

The identification of such components represents an opportunity to enable a bi-directional emotion-state-to-personality-trait mapping (referred to hereafter as "state-to-trait mapping" or "trait-to-state mapping"). This mapping would correlate the relationship between personality traits and basic emotions, in order to enable inferences of one component based on the other.

Affective computing is in a prime position to enable such state-to-trait mappings. Affective computing researchers have been successful in categorising and automatically detecting the basic emotion states [39,40]. Therefore, if emotive states can be mapped to personality, the ability to automatically assess emotions could provide tools for personality categorisation and automatic detection. Similarly, there is interest in state-to-trait mappings in the area of automated personality synthesis, which is the process of creating technology that can mimic human personalities in their interactions with people [49]. Understanding the emotional make-up of personality configurations would enable artificial intelligence (AI) based systems to appear more human-like (e.g. an extraverted more bubbly personal assistant device, like Siri).

This paper presents an empirical study towards a correlated mapping that can be utilised by researchers for a variety of use cases. The focus of this study is mapping state-to-trait, future work is intended on mapping trait-to-state. An experimental study was conducted in order to assess the relationship between personality traits and the basic emotion. In particular, this study focused on the utility of incorporating a sub-trait level of personality in this assessment. A series of hypothesis will be investigated to quantify the value of sub-traits in assessing the relationship between personality traits and emotions. The results of these hypotheses are evaluated for statistical significance and the state-to-trait mapping is dynamically visualised, enabling analysis of the results.

The remainder of the paper is organised as follows: Sect. 2 discusses the concept of personality traits, their sub-traits, and the basic emotions. Related work on the interconnection between traits and emotions is also discussed. Section 3 details the design, participant pool, materials used, and the procedure for the experimental methodology to quantify the state-trait links. Section 4 presents the descriptive and inferential statistics resulting from the study. Section 5 presents an in-depth discussion of the results. Section 6 presents the overall conclusions with respect to the field at large and recommended future research directions are outlined.

2 Personality Traits and the Basic Emotions

Personality is a multi-levelled psychological phenomenon. The foundational level of personality consists of traits. Traits are defined here as typical patterns of

affect, behaviour, cognition, and motivation [11]. Traits represent a person's disposition towards the world [11]. Traits are bi-polar phenomena in that each trait will range from one pole to their opposite pole (e.g. Disagreeable is the opposite pole of Agreeableness). However, people vary on how much they have a trait on a spectrum relative to other people.

The predominant model for identifying and taxonomising important personality traits for analysis is The Five Factor Model (also known as *The Big Five*) [34]. The Five-Factor Model emerged through applying rigorous factor analysis through a large body of trait descriptions [26]. Results across multiple research groups repeatedly found a five-factor solution for taxonomising personality traits. The Five Factor therefore measures people's personality among five broad traits: Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism [37].

The FFM is a hierarchical model of personality traits [26]. The Five Factors are higher-level abstractions of specific aspects of traits, which are called facets. For example, Extraversion is made up of facets such like warmth, excitement-seeking, and gregariousness, all of which correlate significantly with one another. This enables researchers to generalise the influence and effects of these facets under the common factor Extraversion. However, while the FFM provides a reliable predictor for various important outcomes, the broadness of the Five Factors impedes precise predictions.

This impairment has prompted researchers to assess lower-levels of the Five Factor Model hierarchy in order to identify traits that can act as intermediate level between the generalisability offered by the Five-Factors and the precision offered from their facets. Cross-disciplinary research has demonstrated that such an intermediate level exists. Findings in both the areas of behavioural genetics and psychometrics demonstrate that each of The Big Five can be divided into two sub-traits [13]. These 10 sub-traits form an intermediate level in the hierarchy, below the Five Factors and above their facets. This study aims to assess whether the sub-traits can also provide insight to the relationship between emotions and personality. Therefore, the range of the traits considered in this study are listed in Table 1.

Table 1. The Five Factor Model's five broad traits and the associated sub-traits as specified by [13]. The sub-traits are an intermediate level between the broad traits and their associated facets. Each sub-trait correlates highly with its partnered sub-trait ($r \geq .50$)

Personality trait	Sub-trait 1	Sub-trait 2
Openness to experience	Openness	Intellect
Conscientiousness	Industriousness	Orderliness
Extraversion	Enthusiasm	Assertiveness
Agreeableness	Compassion	Politeness
Neuroticism	Withdrawal	Volatility

2.1 The Basic Emotions

This study considers emotions under the basic emotions theory viewpoint. The basic emotions theory (BET) proposes that there exists a limited amount of emotions that are biologically, behaviourally, and psychologically distinct from one another [14,17]. These emotions have distinctive physiological, behavioural, and psychological signals; they are rooted in sub-cortical regions of the brain; they occur quickly and briefly; they motivate consistent forms of context appraisal and consequential actions; they have a distinctive subjective experience; they interact to form more culturally and cognitively mediated emotions, amongst other defining characteristics [14].

The authors do not argue that these emotions and their signals are exactly the same in every culture, but they do consider that there is sufficient similarity across several cultures to justify the inclusion of BET for this study. The authors also do not argue that there exists an exact 1-to-1 mapping between emotions and either their physiological, behavioural, or psychological signals. Research has shown that the origin of emotions emerge from the interaction of a range of physiological, behavioural, and psychological activity [3]. However, at the same time there is strong evidence indicating that there exists a consistent range of behaviour that can be identified and be used to accurately indicate the occurrence of a basic emotion [25]. The article also acknowledges that there are other aspects of emotions that are largely overlooked by this study, such as an emotion's valence and arousal level.

While there is some debate as to which emotions should be considered as "basic" [16], this paper considers the following seven emotions as basic: Anger, Anxiety, Disgust, Fear, Joy, Sadness, Surprise. The inclusion of Anxiety is a modification of the original BET model, which included Contempt instead of Anxiety. Contempt was excluded in this study to align with the consensus view of basic emotion researchers. In a survey that asked 250 emotion researchers which emotions have been empirically established as a basic emotion, the results showed that only 34% of those researchers considered Contempt as an established basic emotion [15]. The same survey did not ask researchers about the status of Anxiety as a basic emotion. Anxiety has been theoretically linked to the personality trait Withdrawal, which is a trait hypothesised to be motivated by a desire to reduce feelings of anxiety [10,11]. Therefore, the status of Anxiety as a basic emotion is investigated here (Table 2).

Table 2. The seven basic emotions considered as part of this work. These emotions are considered to have distinct physiological, behavioural, and psychological signals

Basic Emotions			
Anger	Anxiety	Disgust	Sadness
Fear	Joy	Surprise	

2.2 Links Between Personality Traits and the Basic Emotions

The relationship between Big Five traits and the basic emotions has been, in a limited sense, studied in the past. To date, the strongest correlation identified is in relation to the basic emotions and the personality traits Extraversion and Neuroticism. Extraversion has been found to positively correlate with Joy and Neuroticism has been found to positively correlate with Fear, Anxiety, and Sadness [10].

Extraverted people tend to experience more joy on a daily basis, measured by either self-reports, analysis of behaviour (e.g. how much participants laugh and smile in conversations), or through text [24,31,36]. The sub-traits associated with Extraversion (Assertiveness and Enthusiasm) provide information about the factors that causes Joy for extraverted people. Assertiveness has been positively correlated with the experience of joy with regards to the pursuit of a valued goal. Enthusiasm has been positively correlated with the experience of joy in relation to the attainment of valued goals [11,12].

People high in Neuroticism tend to experience more Fear, Anxiety, and Sadness. Neuroticism is unsurprisingly a key predictor of suffering from mental disorders such as Major Depression Disorder or Generalised Anxiety Disorder [46]. The sub-traits associated with Neuroticism (Withdrawal and Volatility) provide information about the factors that causes these emotions for people high in Neuroticism. Withdrawal has been positive correlated with Anxiety and Sadness in response to the perception of potential threat (e.g. the chance of being criticised). Volatility has been positively correlated with Fear and Sadness in response to a perceived current threat (e.g. the perception that one is being currently criticised).

There are limited empirical findings in the literature detailing the correlation between basic emotions and the traits Openness to Experience, Conscientiousness, and Agreeableness along with their sub-traits. This is a motivating factor for pursuing the current study, to quantitatively assess the relationship between these Big Five Factors and basic emotions.

The following links should be considered as tentative and in the need for further empirical investigation. Openness to Experience has correlated with experiencing all basic emotions more intensely, rather than being underlined by any particular emotion [11]. Conscientiousness has positively correlated with experiencing disgust. A theoretical suggestion for this link has been that disgust motivates conscientiousness people to act [5,11]. Agreeableness has positively with neurological systems that both mimic the emotions of others, or inhibit emotions that might cause conflict [9,10,21]. It is also not clear how the sub-traits of these traits correlate with the basic emotions.

2.3 Experiment Hypotheses

Following from the previous section, the hypotheses used to guide the research were as follows:

1. Each Emotion will correlate significantly and with a substantial effect size with at least one of the Big Five or their sub-traits.
2. Extraversion will positively correlate with the emotion Joy.
3. Neuroticism will positively correlate with at least one of the following emotions, Fear, Anxiety or Sadness.
4. Agreeableness will be negatively correlate with Anger.
5. Conscientiousness will positively correlate with Disgust.
6. Openness to Experience will correlate with a substantial effect size with every emotion, across its two sub-traits.

3 Methodology

The aim of this study is to analyse the relationship between personality and emotions. This necessitates the identification of quantifiable correlations between personality traits, their sub-traits, and the basic emotions. This will provide an empirical basis for a high resolution mapping of state-to-trait analysis.

3.1 Participants

The majority of participants were recruited from Cork Institute of Technology (CIT). These participants were recruited through the main researcher speaking with students about the study, posting informative and recruitment flyers around the campus, and campaigning for participants via the institutes student webpages. The majority of the participants were female (N = 38, Females = 25, Males = 13). Most of the participants were in their twenties or thirties (M = 33.77, SD = 13.93, Range = 19–63).

3.2 Materials

- *Personality Questionnaire*. The Big Five Aspects Scale was used. This is a standardized measure of the FFM traits. The scale is composed of 100 units (e.g. I seldom feel blue). Participants were asked to rate on a Likert-scale how well each statement described themselves. For each of the Big Five traits, there were 10 accompanied statements, which are further split into 5 statements per sub-trait. The Likert-scale ranged from 1 to 5, with 1 representing "strongly disagree" and 5 representing "strongly agree", on how well each statement describes them. The Cronbach Alpha of the sub-scales were: Openness to Experience (.81), Conscientiousness (.85), Extraversion (.85), Agreeableness (.74), Neuroticism (0.85).
- *Emotions Scale*. A short scale was created for the purposes of this study. Whilst there exists several standardised Basic Emotions scales, each of those scales either accounted for other hypothesised basic emotions or did not consider each basic emotion accounted for here (e.g. Anxiety). The question that accompanied each emotion scale was: "While watching the previous film clip, to what extent did you experience these emotions?". Participants answered

each Likert-scale on a range from 1–5, with 1 representing "no degree of such emotion", 3 representing "a moderate degree of such emotion", and 5 representing "a great degree of such emotion". The experiment software required participants to give a response for each of the basic emotions. The overall scale consisted of 84 questions (.95), with Anger (.80), Disgust (83), Fear (.85), Anxiety (.80), Sadness (.76), Joy (.66), and Surprised (.88) all having 12 questions each.

– *Emotional Stimuli.* Film clips were used in order to elicit emotional reactions. Film clips have been shown to reliably elicit emotional expressions by multiple independent research groups. For this study, twelve film clips were selected, the lengths of the film clips varied between 1 to 5 min. Nine of the film clips used in this experiment were selected based on past research indicating they elicited emotional reactions [19,22]. Three new film clips (*Annabelle*, *Who-Dunnit?*, and *Peep Show*), which have not been used in independent research, were chosen after conducting a pilot study with 8 participants who watched and rated a variety of film clips and self-reported their emotions.

3.3 Procedure

Potential participants were provided with an information sheet explaining the study. Those who were interested in taking part, were invited to fill out a demographic information form, which gathered information about their age, gender, nationality, and previous experience with psychometric tests. Participants who completed this section were invited to take part in the laboratory stage of the experiment. There was two parts to the laboratory stage of the study:

1. Participants completed the Big Five Aspects scale questionnaire in order to attain a baseline reading of their personality. This questionnaire took on average 15 min to complete.
2. Upon completion, a researcher set up film clip recording software on the computer used for the experiment. Given that participants varied in height, there had to be a manual check to ensure that each participant's face occupied the centre of camera's frame[2]. Once this was ensured, the researcher left the room, and the participants watched 12 film clips, always in the same order. After each film clip, participants answered the emotions scale designed for the experiment (see Sect. 3.2) to assess what emotional reactions the participants had whilst watching the film. This stage took on average 45 min to complete. Afterwards participants were debriefed on the study.

4 Results

This section presents the key descriptive and inferential statistics from the study in relation to the hypotheses.

[2] The automated analysis of participants video footage captured is not considered here or incorporated into results. It is intended be the subject of a future publication.

4.1 Descriptive Statistics

Emotion Scores: Participants did not experience a dominant emotion throughout the study. The mean and standard deviations of the emotions scores are presented in Table 3.

Table 3. Descriptive statistics for self-reported emotions (M = Mean; SD = Standard Deviation)

Emotion	M	SD	Emotion	M	SD
Fear	2.02	0.66	Anxiety	2.46	0.62
Anger	1.92	0.57	Sadness	2.22	0.49
Joy	1.56	0.37	Surprise	2.83	0.84
Disgust	2.49	0.57			

Personality Scores: Personality scores were around the midway point of 3 and frequency scores were normally distributed. The only exceptions to this were for the traits Agreeableness and Compassion (Table 4).

Table 4. Descriptive statistics for big five aspect scale scores (M = Mean; SD = Standard Deviation)

Trait	M	SD	Trait	M	SD
Openness to Experience	3.55	0.39	Agreeableness	4.02	0.30
>Openness	2.90	0.48	>Compassion	4.22	0.42
>Intellect	3.49	0.51	>Politeness	3.82	0.34
Conscientiousness	3.47	0.57	Neuroticism	2.94	0.45
>Industriousness	3.39	0.59	>Volatility	2.91	0.72
>Orderliness	3.55	0.67	>Withdrawal	2.96	0.42
Extraversion	3.50	0.46			
>Enthusiasm	3.72	0.48			
>Assertiveness	3.27	0.62			

4.2 Inferential Statistics

Inferential statistics in this analysis were interpreted using traditional protocol. Namely, a correlation was considered statistically significant if $p \leq .05$. However, this analysis also gives values to correlations that approach statistical significance, $p \geq 0.05$ and $p \leq 0.15$. This value is given due to the lack of power

of the study, making it apriori likely to make false negatives (see Sect. 5.1), but also to align with the "New Statistics" approach emerging in Psychology [7]. This approach aims to avoid the pitfalls that occur when researchers obsess on whether a p-value is $\leq .05$ and has been recommended by multiple independent research groups [2,20]. This obsession has been deemed as one of the primary causes of the replication crisis in psychology [38].

Table 5. Bi-Directional Mappings of Personality Traits and the Basic Emotions

Personality Traits	Fear	Anger	Joy	Anxiety	Sad	Surprise	Disgust
Openness to Experience	0.01	0.06	0.18	0.05	0.15	0.09	0.08
Openness	0.01	0.13	0.18	0.16	0.17	**0.31***	0.24
Intellect	0.00	-0.02	0.11	-0.06	0.07	-0.15	-0.11
Conscientiousness	-0.09	-0.02	-0.16	0.05	-0.03	**-0.30***	-0.19
Industriousness	-0.18	-0.07	-0.24	0.09	-0.11	**-0.36****	**-0.28***
Orderliness	0.01	0.04	-0.05	0.00	0.04	-0.20	-0.08
Extraversion	**-0.28***	-0.13	0.00	-0.19	-0.11	-0.10	-0.15
Assertiveness	-0.22	-0.08	-0.01	-0.10	-0.01	-0.10	-0.17
Enthusiasm	-0.26	-0.14	0.02	-0.22	-0.20	-0.06	-0.07
Agreeableness	-0.18	-0.18	**-0.38****	0.00	-0.04	-0.04	-0.06
Compassion	-0.26	-0.18	**-0.34***	-0.14	-0.07	0.02	-0.08
Politeness	0.01	-0.09	-0.24	0.17	0.01	-0.09	0.00
Neuroticism	0.17	0.27	**0.29***	0.06	**0.35***	0.26	0.26
Withdrawal	0.15	-0.08	**0.33***	0.01	0.01	0.21	0.04
Volatility	0.13	**0.38****	0.17	0.07	**0.43****	0.21	**0.31***

** *Indicates a p-value* $\leq .05$.
* *Indicates a p-value* ≥ 0.05 *and* $p \leq 0.15$
*** ***Colour of correlation indicates both the strength and direction of the correlation***

Relationship Between Personality Traits and Emotions in Relation to Hypotheses: A Pearson's R correlation was conducted on each personality trait variable with each distinct emotion self-report rating. Given the fact that these phenomena are diverse in nature, personality being a stable trait and emotions being fleeting states, the data needed to be prepared for correlation analysis. For each participant the mean score per emotion was calculated and correlated with the mean score per trait. Table 5 denotes a correlation mapping between each emotion and personality variable. The results are visualised in a manner that indicates their significance in terms of whether they are statistically significant, the magnitude of their effect size, and the direction of the correlation. The results associated with the studies proposed hypothesis, as detailed in Sect. 2.2 are as follows:

1. **Each Emotion will correlate significantly and substantially with at least one of the Big Five or their sub-traits:** Fear and Anxiety were the only emotions not to have a p value less than 0.05. Fear negatively correlated with Extraversion that fit this study's guidelines for approaching significance $r(36) = -0.28$, $p = .13$. While Anxiety also negatively correlated with Extraversion $r(36) = -0.19$, $p = .33$, and a negative correlation with Enthusiasm $r(36) = -0.22$, $p = .24$, neither p-value was statistically significant.

Every other emotion significantly correlated with at least one personality trait.

2. **Extraversion will positively correlate with the emotion Joy:** Extraversion had no linear relationship with reported Joy, $r(36) = .00$, $p = 0.98$. The two sub-traits, Assertiveness ($r(36) = -0.01$, $p = .96$) and Enthusiasm ($r(36) = 0.02$, $p = .91$), insubstantially correlated with Joy.
3. **Neuroticism will positively correlate with at least one of the following emotions, Fear, Anxiety or Sadness:** Neuroticism correlated positively with both Fear ($r(36) = 0.17$, $p = .37$) and Anxiety ($r(36) = 0.06$, $p = .74$), but neither reached statistical significance. Neuroticism did positively correlate with Sadness with a medium effect size, which approached the threshold of statistical significance, ($r(36) = 0.35$, $p = .06$). The sub-trait Volatility had a medium-to-strong positive correlation with Sadness and did reach statistical significance, ($r(36) = 0.43$, $p = .02$). This was the strongest relationship found between personality traits and emotions in the data-set. Volatility also had a medium-to-large positive relationship with Anger, $r(36) = 0.38$, $p = .04$.
4. **Agreeableness will negatively correlate with Anger:** Agreeableness was negatively correlated with Anger with a small effect size ($r(36) = -0.18$, $p = .34$).
5. **Conscientiousness will positively correlate with Disgust:** Conscientiousness was negatively correlated with Disgust, ($r(36) = -0.19$, $p = .96$). This was both true for Orderliness ($r(36) = -0.01$, $p = .69$) and Industriousness ($r(36) = -0.28$, $p = .14$), although Industriousness had a stronger negative relationship with Disgust.
6. **Openness to Experience will correlate with a substantial effect size with every emotion, across its two sub-traits:** Openness to Experience had a substantial effect size with Joy ($r(36) = 0.18$, $p = .33$) and Sadness ($r(36) = 0.15$, $p = .43$). The sub-trait Openness had a substantial relationship with Anger ($r(36) = 0.13$, $p = .49$), Joy ($r(36) = 0.18$, $p = .35$), Anxiety ($r(36) = 0.16$, $p = .41$), Sadness ($r(36) = 0.17$, $p = .38$), Surprise ($r(36) = 0.31$, $p = .10$), and Disgust ($r(36) = 0.24$, $p = .24$). Intellect negatively correlated with a substantial effect size with surprise, but this result was not close to statistical significance.
7. **Relationship Between Personality Traits and Emotions in relation to non-Hypothesised Results:** Agreeableness had a medium-to-strong negative correlation with Joy, $r(36) = -0.38$, $p = .04$. This relationship seemed to be underlined mostly by the sub-trait Compassion, $r(36) = -0.34$, $p = .07$. The sub-trait Industriousness negatively correlated with Surprise, $r(36) = -0.30$, $p = .05$. Disgust positively correlated with disgust with a medium-effect size, $r(36) = 0.31$, $p = .10$.

5 Discussion

In this study, participants answered a personality questionnaire before reporting their emotional experiences with a series of film clips. The immediate goal of

this study was to generate a quantitative mapping between the FFM traits and their sub-traits with the basic emotions. The distal goal was to make progress towards automated state-to-trait mappings that can be utilised across academic and industry domains. The results of the study in relation to hypotheses are discussed here.

Hypothesis 1 - Each Emotion will significantly correlate with at least one of the Big Five or their sub-traits. This hypothesis was partially supported. Six of the basic emotions correlated significantly or approached significance with one of the personality traits. Fear correlated with Extraversion; Anger correlated with Volatility: Joy correlated with Agreeableness, Compassion, Neuroticism, and Withdrawal; Sadness correlated with Neuroticism and Volatility; Surprise correlated with Openness, Conscientiousness, and Industriousness; Disgust correlated with Industriousness and Volatility. Only Anxiety failed to significantly correlate or approach statistical significance with a personality trait.

Overall, this result justifies the immediate goal of a state-to-trait quantitative mapping. The fact that the personality traits (and their sub-traits), Openness to Experience (via Openness), Conscientiousness, and Agreeableness, correlated substantially with one of the basic emotions is a significant research contribution. The link between these personality traits and the basic emotions has previously been overlooked, such that their relation to emotions have mostly been inferred rather than empirically quantified. The finding that some of these correlations (e.g. Openness and Surprise) only emerged at the sub-trait level justifies including this level of the trait hierarchy.

Hypothesis 2 - Extraversion will significantly positively correlate with Joy. This hypothesis was not supported. There was no significant correlation found between Extraversion, and its sub-traits Enthusiasm and Assertiveness, with Joy. This result is surprising as Extraversion has consistently positively correlated with positive emotion. Extroverted people on average smile more, laugh more, use more positive emotion language, and report feeling happier than those who score low on Extraversion [50].

The most likely reason for this result is the emotional stimuli used. Joy was the lowest emotion participants experienced while watching the film clips. For one of the targeted Joy-clips, *Peep Show*, half of the participants (n = 18) reported a 1 on the Likert-scale for Joy while watching this film clip, indicating they experienced no degree of Joy. This statistic indicates that our emotional stimuli possibly created a ceiling effect, in that the potential for Joy to be experienced was too low in order to detect the hypothesised relationship.

Hypothesis 3 - Neuroticism will significantly positively correlate with Fear, Anger, Anxiety, and Sadness. This hypothesis was partially supported. Neuroticism positively and close to significance correlated with Sadness and Anger, but surprisingly not with Anxiety or Fear. This partially supports past research that has shown consistent links between Neuroticism and negative emotion states. The sub-trait Volatility significantly and positively

correlated with Anger, Sadness, and Disgust. The relationship between Volatility and Sadness was the largest correlation in the data-set. This finding supports the postulation that Volatility represents an emotional unstable and active defence response to negative emotion.

Hypothesis 4 - Agreeableness will significantly negatively correlate with Anger. This hypothesis was not supported. Agreeableness had a negative but non-significant correlation with Anger. Agreeableness and Compassion instead had a significant negative correlation with Joy. Prior research has shown that people high in Compassion are more likely to empathise with the emotion and situation of other people [21]. This result is consistent with that hypothesis. In this study, several film clips targeted negative emotions (e.g. Anger, Sadness, Fear) where the protagonist often experienced something terrible (e.g. The Lion King – the protagonist mourns the death of his father). People high in Agreeableness and in particular Compassion may have strongly empathised with these protagonists. A direction for future research is the use of more balanced film clips to assess whether Agreeableness and Compassion would positive correlate with Joy during positive emotion film clips. If so, this would suggest that Agreeableness is highly sensitive to context in regards to emotional experience.

Hypothesis 5 - Conscientiousness will significantly positively correlate with disgust. This hypothesis was not supported. Conscientiousness, and in particular Industriousness, was negatively associated with Disgust. This result is unlikely to be due to the film clips, as the majority of participants rated both disgust film clips as highly disgusting. This contradicts prior arguments that Conscientiousness people have general disgust sensitivity [44]. Instead in this study people high in Conscientiousness were more likely to be comfortable dealing with disgusting material than people low in Conscientiousness. If one analyses the Disgust emotion, this is not surprising. Disgust is associated with avoidance behaviour (e.g. closing ones mouth and turning ones face away from contaminated food; [45]). Industriousness is a trait characterised by taking action. From this perspective, it is intuitive that Conscientiousness and Industriousness would negatively correlate with Disgust.

Hypothesis 6 - Openness to Experience will substantially correlate with each of the basic emotions, across its two sub-traits. This hypothesis was weakly supported. Openness to Experience positively correlated with Joy and Sadness with an effect size greater than .10, its sub-trait Openness positively correlated with Anger, Anxiety, and Surprise, and Disgust all with $r \geq .10$ and Intellect positively correlated with Joy and negatively correlated with Surprise and Disgust. However, out of these correlations, the only correlation that approached significance was between Openness and Surprise. Also, there was no relationship found between Openness to Experience and Fear and other personality traits had similar patterns of relationships with emotions (e.g. Neuroticism).

5.1 Limitations

The primary limitation of this study was the sample size of 38 participants. Whilst some have argued that 30 participants is the "magic" number for data collection, this is unsupported by hard evidence [27]. An important factor in determining the appropriate number of participants in a study is the usual effect size of the phenomenon being studied. The effect size of relationships between personality traits and other phenomenon tend to be between r = .20 and r = .30, so based on Cohen's principles, they are small-to-moderate [43]. In order to be statistically confident of reliably finding an effect size between this range, the sample size of a study would need to be between 50 and 83 participants. In order to meet the long-term goal of this research, a larger-scale study with more participants is being planned in order to achieve a robust level of statistical power.

6 Conclusions

Research in the fields of personality and emotion have identified key components suitable for rigorous scientific inquiry. These key components are personality traits and the basic emotions. It has been repeatedly shown that both components are essential for a healthy, successful, and enjoyable life. Given this, it is surprising that these components have been largely treated as distinct. This is despite the fact that there exists a tight interconnection between the two phenomena. There is a need for quantitative research conducted on the correlation of personality traits and the basic emotions. This study aimed to address this need by carrying out a quantitative assessment of the links between personality traits and the basic emotions. Participants in this study answered a personality questionnaire before watching a series of film clips chosen on their ability to elicit emotions. The intermediate goal of this study was to generate a quantitative mapping between the Big Five personality traits and their sub-traits with the basic emotions.

The results of this preliminary study offers a marker for further exploration of this mapping. The statistical analysis found several moderate, by research standards, effect sizes between personality traits and emotions. In particular, the negative relationships found between the sub-trait Compassion with Joy, Industriousness and Disgust, and the powerful positive relationship between Volatility and Sadness demonstrate how the use of a higher-resolution model of personality can identify relationships that lower resolution personality models have been unable to. A future study with a larger population sample should establish a clearer and more fine-grained analysis of the relationship between personality traits and their sub-traits with the basic emotions such that it can form a foundation for Affective computing state-to-trait applications.

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