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# How do personality traits influence the experience of positive emotions?

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## **Abstract**

Neuroticism is a personality trait known to be associated with negative emotions (Tellegan, 1985), but little is known about how it affects the experience of positive emotions, and more specifically, hope. Positive emotions can have long lasting effects on well-being, by broadening thought-action repertoires and undoing lingering negative emotions (Frederickson, 1998). Cognitive strategies strongly influence state positive emotions in individuals low in neuroticism, but have no effect on those with high neuroticism (Ng & Diener, 2009). We expected individuals high in neuroticism would experience a smaller increase in state hope following hope emotion induction. Participants completed an online survey involving a personality test and trait positive and negative emotion questionnaires. Prior to and following being randomly assigned to either the hope ( $n = 147$ ) or nurturant love ( $n = 142$ ) induction procedure, participants completed questionnaires on state positive and negative emotions. The results revealed the hope induction procedures of autobiographical recall and imagery were not effective at inducing state hope, but increased state positive emotions and decreased state negative emotions. Neuroticism was negatively correlated with trait hope and trait positive emotions and positively correlated with trait negative emotions. Exploratory analyses of control questions regarding how often participants thought of hopeful memories and whether they believe engaging in this daily to be beneficial were also performed. It was concluded that neuroticism is negatively associated with the experience of trait and state positive emotions, but not state hope. The limitations of the study design and future research are also discussed.

**Keywords:** Personality, neuroticism, positive emotions, hope, emotion induction

## **Introduction**

Everyone experiences emotions differently, but can our personality affect the way we experience positive emotions? Personality traits are consistent, descriptive labels used to describe individuals, are relatively stable across the lifespan and are moderated by external and internal stimuli (Bouchard & Loehlin, 2001). Patterns of thoughts, behaviours and feelings can be influenced by personality (McCrae & Costa, 1990), which can be determined by the environment and other heritable traits (Lucas, 2008). Personality can be measured by five distinguishable traits using The Big Five Personality Inventory (DeYoung, Quilty, & Peterson, 2007), the traits include openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. Each trait is further broken down into two facets measuring different aspects, for example, extraversion is measured using enthusiasm and assertiveness; traits are scored on a scale from high to low in that specific trait. Extraversion, openness, conscientiousness, and agreeableness are all independently positively correlated with one another, whereas neuroticism is negatively correlated with the other traits (DeYoung, Quilty, & Peterson, 2007). This negative correlation with the other four traits introduces neuroticism's representation of the negative affective component of personality (DeNeve & Cooper, 1998).

Neuroticism represents the tendency to experience intense negative emotions (McCrae & Costa, 2008) and is associated with being tense, anxious, depressed, shy, emotional, prone to guilt and low self-esteem (Eysenck & Eysenck, 1987). Neuroticism can be further broken down into two facets: withdrawal and volatility (DeYoung, Quilty, & Peterson, 2007). Withdrawal refers to susceptibility to negative affect, whereas volatility refers to a difficulty in controlling emotional impulses, irritability, and anger. An individual high in neuroticism would be prone to psychological distress and anxiety and be more reactive to negative affect (Larsen & Eid, 2008); whereas an individual low in neuroticism would be calm, well-adjusted, and emotionally hardy (Widiger, 2009). High neuroticism is predictive of low levels of psychological well-being and life satisfaction (Garcia, 2011) and has been found to be a common feature in depressive and anxiety disorders (Weinstock & Whisman, 2006) and associated with various health implications (Lahey, 2009; Smith & MacKenzie, 2006). Due to the negative nature of neuroticism, it is associated with experiencing negative emotions (Tellegan, 1985), unlike extraversion, which is associated with the experience of positive emotions (Smillie, DeYoung & Hall, 2015).

Positive emotions are pleasant or desirable situational responses, and include emotions such as contentment, interest, love, and joy (Cohn & Frederickson, 2006). Emotional experience is divided into two dimensions; state and trait (Spielberger & Barratt, 1972). State emotions are acute responses that reflect within-person variability from moment to moment and are dependent on context (Roseman & Smith, 2001), e.g., feeling happy but then receiving bad news and becoming sad. Trait emotions reflect between-person variability and denote the emotional pattern one person may feel across different contexts (Russell & Barrett, 1999), e.g., when receiving this bad news, one person may not feel as sad as another person might. State and trait emotions are somewhat linked, as emotional traits are likely to predict emotional states (Plattner et al., 2007).

Neuroticism is not associated with emotions such as love (Schmitt et al., 2009), happiness, relief, satisfaction, or pride (Ng, 2009). Individuals high in neuroticism

may be as capable of feeling positive emotions as those low in neuroticism (Ng, 2009), suggesting that neuroticism does not affect the experience of trait or state positive emotions. However, there is currently little research around the effects of neuroticism on these and other emotions, including hope.

The positive emotion of hope represents a striving towards desired outcomes (Cavanaugh, Cutright, Luce & Betteman, 2011), characterised by expectations of a positive future and believing one is able to meet situational demands (Ellsworth & Smith, 1988; Smith, Haynes, Lazarus, & Pope, 1993). Hope is thought to belong to the 'interest' family of positive emotions. This family is associated with intrinsic motivation, change or a sense of possibility and openness to ideas and experiences (Fredrickson, 1998). High trait hope has been correlated with a reduced frequency and severity of illness (Scioli et al., 1997), and indicated a higher quality of life (Rustøen & Wiklund, 2000) and mental health (Nunn, 1996). Whereas low trait hope predicted mortality (Everson et al., 1996) and is associated with depression (Abramson, Metalsky & Alloy, 1989).

Optimism is an emotion thought to form hope (Scioli et al., 1997), reflecting the ability to anticipate a positive future (Reker, 1997) and the expectation of positive over negative outcomes (Scheier & Carver, 1985). Optimism and hope are thought to be very similar, hope represents the personal attainment of specific goals, whilst optimism represents a broad expectation of the quality of future outcomes and goals in general (Bryant & Cvenegros, 2004). Optimism has been associated with high self-esteem and life satisfaction, as well as low depression and low negative emotions (Wrosch & Scheier, 2003). Furthermore, optimism is negatively associated with negative affect and positively associated with positive affect (Ben-Zur, 2003).

Optimism is thought to represent one side of the dimension, and pessimism the other (Kam & Meyer, 2012), whilst some argue they represent different dimensions (Kubzansky, Kubzansky & Maseiko, 2004). Pessimism represents a negative bias towards perceptions and expectations, whereas optimism represents a positive bias (Dember, Martin, Hummer, Howe & Melton, 1989), suggesting they represent two sides of the same coin.

Pessimism is positively associated with neuroticism (Marshall, Wortman, Kusulas, Hervig & Vickers Jr, 1992), whereas optimism is negatively associated with neuroticism (Kennedy & Hughes, 2004). Both pessimism and neuroticism have been linked to depressive symptoms and have been identified as risk factors for depression (Monteiro, da Silva, Pereira & Serra, 2011), whereas extraversion is associated with optimism (Marshall, Wortman, Kusulas, Hervig & Vickers Jr, 1992).

As previously mentioned, Ng (2009) suggested individuals high in neuroticism are as capable of feeling as much positive emotions as those low in neuroticism. However, as neuroticism has been associated with pessimism, and due the similarities between hope and optimism, we can hypothesise that neuroticism will not be associated with hope, and individuals high in neuroticism will experience less state and trait hope than those low in neuroticism, i.e., neuroticism should affect the experience of state and trait positive emotions, and more specifically, hope.

Experiencing any positive emotion can contribute to better overall well-being, including greater life satisfaction and success at work (Losada & Heaphy, 2004), improved health (Cohen, Doyle & Turner, 2003; Danner, Snowdon & Friesen, 2001), and a range of other positive life outcomes (Howell, Kern, & Lyubomirsky, 2007; Huppert, 2009; Lyubomirsky, King & Diener, 2005).

Frederickson's Broaden and Build Theory (1998) suggests that positive emotions have long lasting consequences on well-being. These positive emotions are vehicles for individual growth and social connection and lead to better lives in the future. The theory suggests positive emotions broaden individuals thought-action repertoires, for example, joy sparks the urge to play, ultimately promoting further positive emotions. It also suggests that positive emotions undo lingering negative emotions, fuel psychological resilience, and trigger upwards spirals towards enhanced emotional well-being.

As discussed, neuroticism is linked to poor well-being (Steel, Schmidt & Shultz, 2008), and those with high neuroticism are less likely to repair negative emotions, whereas those high in extraversion are more likely to savour positive emotions, enhancing well-being (Ng & Diener, 2009). This suggests that individuals who are high in neuroticism would benefit from experiencing more positive emotions, by utilising the 'broadening' aspect of Frederickson's (1998) theory by targeting the way people change while experiencing a positive emotion, and the 'build' aspect to make lasting changes that follow repeated positive emotional experiences over time.

In addition, Frederickson's (1998) theory suggests hope may be viewed as an emotion that enables the broadening of momentary thought-action repertoires, which can, in turn, assemble a variety of personal resources that can be retrieved later in life. When experiencing these positive emotions, their effect on subjective wellbeing is based more on the frequency rather than the intensity of these emotions (Diener, Colvin, Pavot & Allman, 1991), suggesting small bursts are more beneficial than deeper feelings of positive emotions. As positive emotions are linked to well-being, and neuroticism linked to poor well-being, those with high neuroticism may experience fewer positive emotions, or experience them differently, ultimately leading to their poor well-being.

Individuals can actively engage in intentional activities which can increase positive emotions (Lyubomirsky, Sheldon & Schkade, 2005), and therefore well-being. Most interventions focus on increasing well-being and decreasing levels of depression (Lyubomirsky, Sheldon & Schkade, 2005), for example, increasing positive affect by savouring positive experiences, and decreasing negative affect by reinterpreting negative events and experiences (Emmons & McCullough, 2003). Individuals high in neuroticism have been found to benefit more from improving their emotional well-being, rather than aiming to decrease negative mood, as they might gain useful benefits from experiencing these negative emotions (Tamir, 2005). Cognitive strategies such as savouring or practicing gratitude have assisted individuals high in neuroticism in maintaining or recovering their positive emotions (Ng, 2012). This suggests individuals can improve their momentary affect via maintaining or increasing their positive emotions, rather than aiming to reduce negative emotions the traditional way.

Siedlecka and Denson (2019) successfully induced positive emotions such as happiness using autobiographical recall of specific events where the emotion was strong and using imagery of a scenario to induce the emotion. Furthermore, autobiographical recall has also been found to aid mood regulation (Duckworth, Steen & Seligman, 2005) and underlying neural mechanisms have been found, further supporting its effectiveness (Speer, Bhanji & Delgado, 2014). In addition, questions regarding the memory and imagery scenario not only provides evidence that participants are completing the induction procedure effectively, but it has been shown that pondering over the details has been effective at improving well-being (Seligman, Steen, Park & Peterson, 2005). If positive emotions can be successfully induced, this could, in the future, help people build resilience, undo lingering negative emotions and improve well-being (Frederickson, 1998).

Joormann, Siemer and Gotlib (2007) found that after recalling positive memories, participants who had never been depressed experienced an increase in positive mood, whereas participants who had a history of depression were unchanged, and currently depressed participants displayed an increase in negative mood. This suggests state positive emotions can be induced with autobiographical recall in healthy participants, but participants with a history of depression seem to be unable to regulate negative mood with positive memory recall, and the effects continue to last after recovery. Additionally, cognitive strategies have been found to strongly influence those with low neuroticism but have no effects on individuals with high neuroticism (Ng & Diener, 2009). Due to the link between neuroticism and low mood and depression (Weinstock & Whisman, 2006), it could be suggested that those with high neuroticism would also experience a smaller change in state positive emotions including hope, and either an increase or no change in state negative emotions after autobiographical recall compared to those with low neuroticism.

In the present study, the effect neuroticism has on the experience of hope and positive and negative emotions will be examined. Participants will complete measures before and after either the hope or nurturant love emotion induction procedure using autobiographical recall, or imagery for those unable to recall a memory. Personality traits, with a focus on neuroticism, will be compared with positive emotions and more specifically hope to investigate whether neuroticism will be associated with the experience of these positive emotions.

The hypotheses were that (i) neuroticism is negatively correlated with trait hope, (ii) neuroticism is negatively correlated with trait general positive emotions, (iii) neuroticism is positively correlated with trait negative emotions, (iv) state hope will increase after the hope emotion induction task, and (v) the induction of state hope is negatively correlated with neuroticism. Further exploratory analyses will be conducted utilising control questions and traits.

## **Methodology**

### **Design**

A between-groups design was employed. There was one independent variable (emotion induction) with two levels (hope or nurturant love). The dependent variables were the personality (neuroticism) and emotion traits (hope, general positive and

general negative) and the state emotions reported before and after the emotion induction (hope, nurturant love, general positive and general negative).

### **Participants**

Participants who completed the survey included 330 over 18-year-olds who spoke English fluently (Male  $n = 53$ , Female  $n = 271$ , Other  $n = 4$ , Not specified  $n = 2$ ). Participants were recruited through convenience sampling using the University of Plymouth's Sona System (psychology undergraduates) in return for one participation point, as well as using social media, the survey was completed via a questionnaire link and advertised on the researcher's social media pages (e.g., Facebook, Instagram) with no reward.

Inclusion criteria consisted of all pre, post, state, and trait hope, nurturant love and positive and negative items and induction procedure items answered. Forty one participants were excluded due to non-completion of the questionnaire or failure to answer induction procedure questions. In total, 289 participants (Male  $n = 46$ , Female  $n = 240$ , Other  $n = 3$ ) were included (for neuroticism subscale  $n = 288$  due to 1 missing item). Of these, 147 participants (Male  $n = 25$ , Female  $n = 120$ , Other  $n = 2$ ) completed the hope induction procedure, and 142 participants (Male  $n = 21$ , Female  $n = 120$ , Other  $n = 1$ ) completed the nurturant love induction procedure.

### **Materials**

The online survey platform, Qualtrics (<https://www.qualtrics.com>), was used for the questionnaire, consisting of the below materials (see Appendix C for materials).

#### *Demographic questions:*

Demographic questions consisted of 4 items about age group, gender, student status and employment status (see Appendix C.1).

#### *The Big Five Aspect Scales (BFAS):*

The BFAS (DeYoung, Quilty & Peterson, 2007) was used to measure participants personality traits. The scale consists of 100 items that measure openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. In this study, only neuroticism, extraversion and openness to experience were measured, consisting of 60 items. Each item was rated using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) (see Appendix C.2).

#### *Scale of Positive and Negative Experience (SPANE):*

The SPANE (Diener et al., 2010) was used to measure trait and state general positive and negative emotions. The scale consists of 13 items, 6 measuring positive experience, and 7 measuring negative experience during the past 4 weeks and the moments after the emotion induction task. Trait items were rated using a 5-point Likert scale ranging from 1 (never) to 5 (always). State items were rated using a 5-point Likert scale ranging from 1 (not at all) to 5 (a great deal). Positive and negative items were scored separately (see Appendix C.3).

#### *State and trait positive emotion items:*

Items were taken from Weidman and Tracy (2020) and adapted to measure trait and pre and post state hope and nurturant love. The scale consists of 4 items to measure state hope, 4 items to measure state nurturant love, 5 items to measure trait hope and 4 items to measure trait nurturant love. An additional 4 items were added to both



state and trait items including more direct statements for hope ('I feel hope' and 'I feel optimistic') and nurturant love ('I feel love' and 'I feel fondness'). Both trait and state included 13 items for each scale. Trait items were rated based on feelings in the past 4 weeks using a 5-point Likert scale ranging from 1 (never) to 5 (always); state items were rated based on how participants were currently feeling using a 5-point Likert scale ranging from 1 (not at all) to 5 (a great deal) (see Appendix C.4).

#### *Control Questions:*

Control questions included 13 items, 6 items were asked pre-emotion induction and 7 were asked post-emotion induction. All items were rated using a 5-point Likert scale ranging from 1-5 with different responses depending on the item. Some items included multiple response selections or open-ended responses (see Appendix C.5 for items and response options).

#### *Induction Procedures (Hope and Nurturant Love):*

A pilot study found for both hope and nurturant love, the autobiographical recall and imagery scenario 2 procedures were the most effective at inducing the relevant emotion, both imagery scenario 1 procedures were excluded (see Appendix C.7-C.9 for procedures and Appendix D for results). The autobiographical recall was chosen as the main procedure, if participants could not recall a memory, they would complete the imagery scenario. During the autobiographical induction procedure 4 questions were asked about participants chosen memory. During the imagery scenario induction procedure 2/3 questions were asked about the scenario. Both the autobiographical recall and imagery procedures included open ended responses.

#### **Procedure**

Before testing, a pilot study was conducted using the researchers to assess the method of hope and nurturant love induction procedure. Cues for autobiographical memory recall and imagery scenarios for hope and nurturant love were created by the researchers to find the most effective task (see Appendix C.8 and C.9 for scenarios). Six raters scored the intensity of hope and nurturant love, how positive it made them feel, how long it took to do the task, the difficulty of the scenario on scales of 1-5 and any notes/ideas for improvement for each procedure (see Appendix D for results). From the results of the pilot study, autobiographical recall was the most effective procedure for inducing hope and nurturant love. For both hope and nurturant love, imagery scenario 2 was chosen for the alternative procedure for participants who were unable to recall a memory for the autobiographical procedure.

To begin the main study, participants clicked a link to an online survey. They were presented with an on screen consent form and brief (see Appendix A). After indicating informed consent by ticking a box, participants were then asked questions to determine their demographic. For all questionnaire's participants were instructed to select one statement that best applied to them for each question. Participants were then to answer the *BFAS* (DeYoung, Quilty & Peterson, 2007), the *trait hope and nurturant love items* (Weidman & Tracy, 2020) and the *trait SPANE items* (Diener et al., 2010). Participants then answered the pre induction *control questions*, pre induction *state hope and nurturant love items* (Weidman & Tracy, 2020) and the *state SPANE items* (Diener et al., 2010). Following these questions, participants were randomly assigned to either the hope or nurturant love induction procedure. Participants were instructed to complete the autobiographical recall procedure, if



they could not recall a memory for their allocated emotion, they completed the imagery scenario procedure in its place, both of which included answering questions. After the induction procedure, they then completed the post *state hope and nurturant love items* (Weidman & Tracy, 2020), the *state SPANE* (Diener et al., 2010) and the post induction *control questions*. Finally, the participants are presented on screen with the debrief (see Appendix B) and asked to close the window/tab. The survey took 30 minutes or less to complete.

## **Analysis**

Statistical analyses were carried out using R Studio (version 1.3.959.1; RStudio Team, 2020), the *psy* (v1.1; Falissard, 2012), *tidyverse* (Wickham et al., 2019), *BayesFactor* (v0.9; Morey & Rouder, 2018), *apaTables* (v2.0.5; Stanley, 2018), and *effsize* (v0.8.0; Torchiano, 2016) packages. The full reproducible code and raw data are available in the additional R Script document and Excel spreadsheet.

Descriptive statistics and Cronbach's Alpha were conducted to determine internal consistency of each scale. Multiple Pearson's Correlations were conducted to determine relationships between personality traits, trait and state general positive and negative emotions, and trait and state hope. Further correlations were conducted for the exploratory analyses using control questions. Paired samples *t*-tests were conducted to determine whether the induction procedure was effective at inducing hope in individuals who completed the hope emotion induction procedure.

The interpretation of effect size was based on Gignac and Szodorai (2016), where 0.10, 0.20, and 0.30 represent small, medium/typical, and large correlations, respectively. The interpretation of Bayes Factor and *p*-value was based on Wetzels et al. (2011). A Bayes Factor of > 3.0 indicates the evidence is in favour of the experimental hypothesis, 0.33-3.0 indicates inconclusive evidence, not for or against the experimental hypothesis, and <0.33 indicates the evidence is against the experimental hypothesis or in favour of the null hypothesis. A *p*-value of <0.05 indicates significant results, whereas >0.05 indicates insignificant results. Interpretations of scale reliability (Cronbach's Alpha) were based on Cronbach (1951), where values between 0.7-0.8 indicate an acceptable level of reliability.

## **Results**

### **Descriptive Statistics**

Descriptive statistics and reliability of scales are summarised in Table 1. All responses were approximately normally distributed. Table 1 shows all scales met acceptable internal consistency (Cronbach's Alpha). Participants mean score was highest for openness to experience, then extraversion and the lowest for neuroticism. Mean scores for trait hope were slightly higher than mean scores of trait love. Participants scored higher for trait positive emotions than trait negative emotions. Participants mean scores of hope increase slightly and mean nurturant love decreases slightly following hope emotion induction. State positive emotion mean scores increased following emotion induction procedure and state negative emotions decreased.

**Table 1:** Means and standard deviations for hope induction procedure and reliability of scales.

Variable	<i>M</i>	<i>SD</i>	<i>Reliability</i>
Neuroticism	61.8	14.9	0.92
Extraversion	67.9	10.0	0.82
Openness	71.1	8.48	0.73
Trait Hope	23.9	4.39	0.70
Trait Love	23.0	3.63	0.70
Trait Positive Emotions	19.9	4.53	0.89
Trait Negative Emotions	16.3	4.40	0.86
Pre-State Hope	23.3	4.80	0.75
Pre-State Love	19.6	4.65	0.75
Pre-State Positive Emotions	19.5	5.41	0.92
Pre-State Negative Emotions	13.8	5.54	0.89
Post-State Hope	23.7	5.30	0.81
Post-State Love	19.1	5.29	0.81
Post-State Positive Emotions	20.2	5.24	0.93
Post-State Negative Emotions	13.3	5.33	0.91

Note. *M* and *SD* are used to represent mean and standard deviation for participants who completed the hope induction procedure ( $n = 147$ ), and *Reliability* is used to represent Cronbach's Alpha including all participants ( $N = 289$ ), respectively. For neuroticism subscale  $n = 288$  due to missing items.

The relationships between personality and emotion traits for all participants are summarised in Table 2.

**Table 2:** Correlations with confidence intervals and bayes factor for traits of all participants (N = 289)

Variable	1	2	3	4	5	6
1. Neuroticism						
2. Extraversion	-.48** [-.56, -.39] (1.33)					
3. Openness	-.23** [-.33, -.11] (>100)	.39** [.29, .49] (>100)				
4. Trait Hope	-.46** [-.54, -.36] (2.10)	.52** [.43, .60] (4.35)	.34** [.23, .43] (>100)			
5. Trait Love	-.25** [-.36, -.14] (>100)	.46** [.37, .55] (7.30)	.38** [.28, .48] (>100)	.58** [.50, .66] (4.11)		
6. Trait SPANE Positive	-.58** [-.65, -.49] (3.92)	.53** [.44, .61] (1.01)	.16** [.04, .27] (4.25)	.62** [.54, .68] (1.96)	.37** [.27, .47] (>100)	
7. Trait SPANE Negative	.64** [.57, .71] (2.64)	-.43** [-.52, -.33] (>100)	-.11 [-.22, .01] (.77)	-.40** [-.49, -.30] (>100)	-.22** [-.33, -.11] (>100)	-.70** [-.76, -.64] (5.53)

Note. Values in square brackets indicate the 95% confidence interval. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). Values in brackets indicate the Bayes Factor for each correlation. \* indicates  $p < .05$ . \*\* indicates  $p < .01$ . For neuroticism subscale  $N = 288$  due to missing items.

Table 2 supports the literature, e.g., neuroticism is negatively correlated with extraversion, openness, trait hope, and positive emotions, but positively correlated with negative emotions. Table 2 shows correlations which test the hypotheses (i) neuroticism is negatively correlated with trait hope, (ii) neuroticism is negatively correlated with trait general positive emotions, and (iii) neuroticism is positively correlated with trait negative emotions for both hope and nurturant love emotion induction conditions.

The relationships between personality and emotion traits, emotion state differences and control questions for participants who completed the hope emotion induction procedure are summarised in Table 3.

Table 3 supports the literature, e.g., neuroticism is positively correlated with trait negative emotions. Table 3 shows correlations which test the hypotheses (i) neuroticism is negatively correlated with trait hope, (ii) neuroticism is negatively correlated with trait general positive emotions, (iii) neuroticism is positively correlated with trait negative emotions, (iv) state hope will increase after the hope emotion induction task, and (v) the induction of state hope is negatively correlated with neuroticism, plus exploratory analyses of control questions.

**Table 3:** Means, standard deviations, and correlations with confidence intervals, and bayes factor for traits, differences in pre and post state emotions, and control questions for hope induction participants (n = 147).

Variable	M	SD	1	2	3	4	5	6	7	8	9	10
1. Neuroticism	61.83	14.93										
2. Extraversion	67.87	10.02	-.45** [-.57, -.32] (>100)									
3. Openness	71.06	8.48	-.12 [-.28, .04] (.54)	.31** [.16, .45] (>100)								
4. Trait Hope	23.94	4.39	-.40** [-.53, -.25] (>100)	.43** [.29, .55] (>100)	.20* [.04, .35] (3.44)							

(Table 3 continues on next page)

**Table 3 (continued)**

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10
5. Trait SPANE Positive	19.90	4.53	-.55** [-.66, -.43] (>100)	.50** [.36, .61] (>100)	.08 [-.08, .24] (.31)	.65** [.55, .73] (7.72)						
6. Trait SPANE Negative	16.32	4.40	.57** [.45, .67] (1.46)	-.39** [-.52, -.25] (>100)	-.05 [-.21, .11] (.23)	-.41** [-.54, -.27] (>100)	-.75** [-.81, -.67] (1.33)					
7. State Hope Difference	0.38	3.15	.06 [-.10, .22] (.24)	.00 [-.16, .17] (.19)	.04 [-.13, .20] (.21)	.05 [-.11, .21] (.23)	-.01 [-.17, .16] (.19)	-.02 [-.18, .14] (.20)				
8. State Positive SPANE Difference	0.73	2.71	.23** [.07, .38] (8.69)	-.12 [-.28, .04] (.52)	-.05 [-.21, .11] (.23)	-.17* [-.32, -.00] (1.34)	-.20* [-.35, -.04] (3.22)	.20* [.04, .35] (3.46)	.29** [.13, .43] (69.93)			
9. State Negative SPANE Difference	-0.50	2.72	-.30** [-.44, -.15] (>100)	.20* [.04, .35] (2.99)	-.02 [-.18, .15] (.19)	.22** [.06, .37] (5.54)	.33** [.18, .47] (>100)	-.30** [-.44, -.14] (>100)	-.13 [-.28, .04] (.57)	-.37** [-.50, -.22] (>100)		
10. Control Question (often think of hope)	2.92	1.08	-.26** [-.41, -.11] (29.21)	.36** [.21, .49] (>100)	.07 [-.09, .23] (.27)	.55** [.43, .65] (>100)	.44** [.29, .56] (>100)	-.25** [-.39, -.09] (15.64)	.01 [-.15, .17] (.19)	-.03 [-.19, .13] (.20)	.12 [-.04, .28] (.52)	
11. Control Question (benefit of thinking of hope daily)	3.84	1.00	.17* [.00, .32] (1.31)	.11 [-.05, .27] (.44)	.02 [-.14, .18] (.20)	.30** [.14, .44] (>100)	.10 [-.07, .25] (.36)	-.02 [-.18, .14] (.20)	.20* [.04, .35] (2.91)	.26** [.10, .40] (21.03)	-.12 [-.27, .05] (.50)	.37** [.22, .50] (>100)

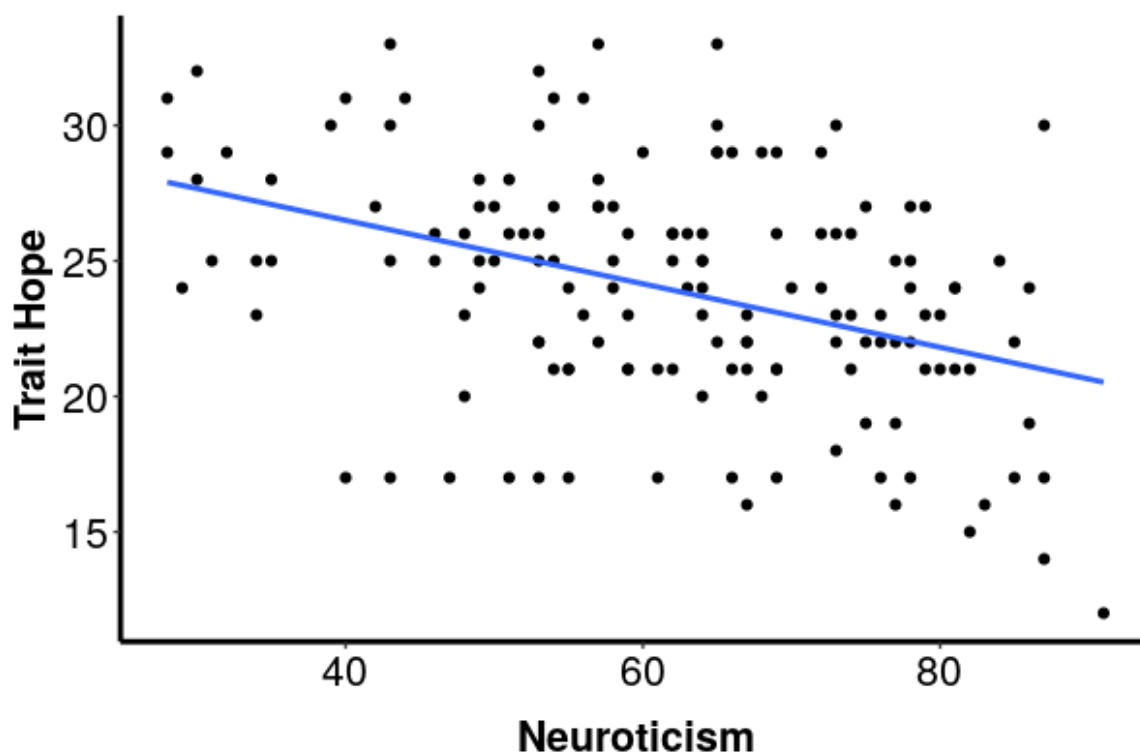
Note. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). Values in brackets indicate Bayes Factor for each correlation. \* indicates  $p < .05$ . \*\* indicates  $p < .01$ .

### Hypotheses

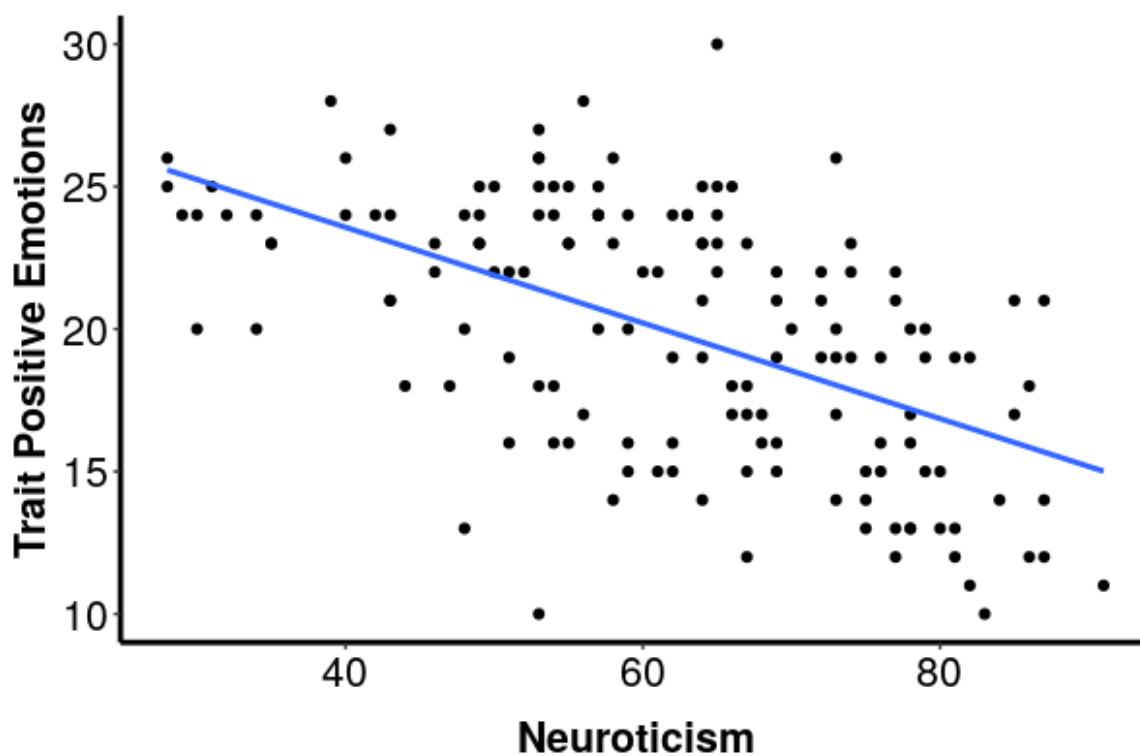
A Pearson correlation was used to test the hypothesis that (i) neuroticism is negatively correlated with trait hope and is illustrated in Figure 1.

The data in Figure 1 shows a linear negative relationship. The results of the Pearson correlation indicated that there was a significant large negative correlation between neuroticism and trait hope, and there is decisive evidence for the experimental hypothesis,  $r(145) = -.40, p < .001, BF = 32,009.57$ . This negative relationship supports the hypothesis that those with high neuroticism have lower trait hope.

A Pearson correlation was used to test the hypothesis that (ii) neuroticism is negatively correlated with trait general positive emotions and is illustrated in Figure 2.



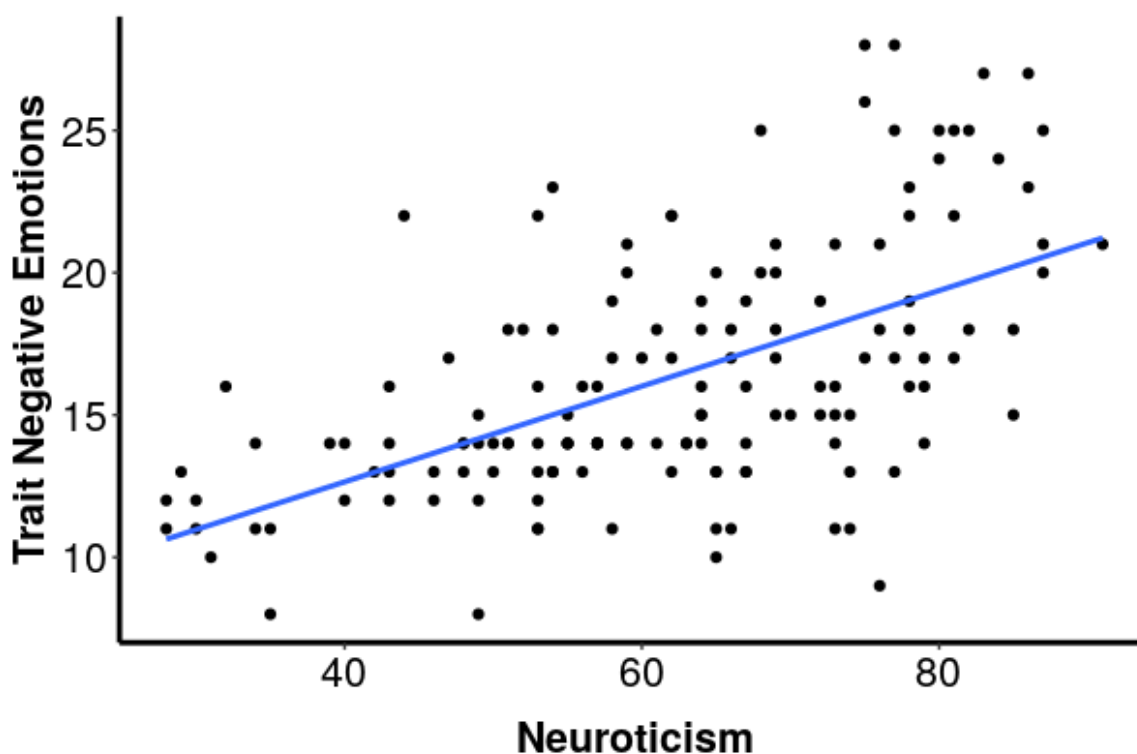
**Figure 1:** Scatterplot with regression line showing the relationship between neuroticism and trait hope for participants who completed the hope induction procedure ( $n = 147$ ).



**Figure 2:** Scatterplot with regression line showing the relationship between Neuroticism and Trait Positive Emotions for participants who completed the hope induction procedure ( $n = 147$ ).

The data in Figure 2 shows a linear negative relationship. The Pearson correlation indicated that there was a significant large negative correlation between neuroticism and trait positive emotions, and there is decisive evidence for the experimental hypothesis,  $r(145) = -.55$ ,  $p < .001$ ,  $BF = 20,394,205,788.00$ . This negative relationship supports the hypothesis that those with high neuroticism have lower trait general positive emotions.

A Pearson correlation was used to test the hypothesis that (iii) neuroticism is positively correlated with trait general negative emotions and is illustrated in Figure 3.



**Figure 3:** Scatterplot with regression line showing the relationship between Neuroticism and Trait Negative Emotions for participants who completed the hope induction procedure ( $n = 147$ ).

The data in Figure 3 shows a linear positive relationship. The Pearson correlation indicates a significant large positive correlation between neuroticism and trait negative emotions, and anecdotal evidence for the experimental hypothesis,  $r(145) = .57$ ,  $p < .001$ ,  $BF = 1.46$ . There is anecdotal evidence for the hypothesis that those with high neuroticism have high trait general negative emotions.

Multiple two tailed paired-samples  $t$ -tests were conducted to investigate the hypothesis that (iv) state hope will increase following hope emotion induction.

A paired-samples  $t$ -test was conducted to compare state hope before and after hope emotion induction. There was no significant difference in pre induction state hope ( $M = 23.3$ ,  $SD = 4.80$ ) and post induction state hope ( $M = 23.7$ ,  $SD = 5.30$ ). This



increase, 0.38, 95% CI [0.13, 0.90], was not statistically significant and there is no evidence for the experimental hypothesis,  $t(146) = 1.47$ ,  $p = .14$ ,  $d = .07$ ,  $BF = .26$ .

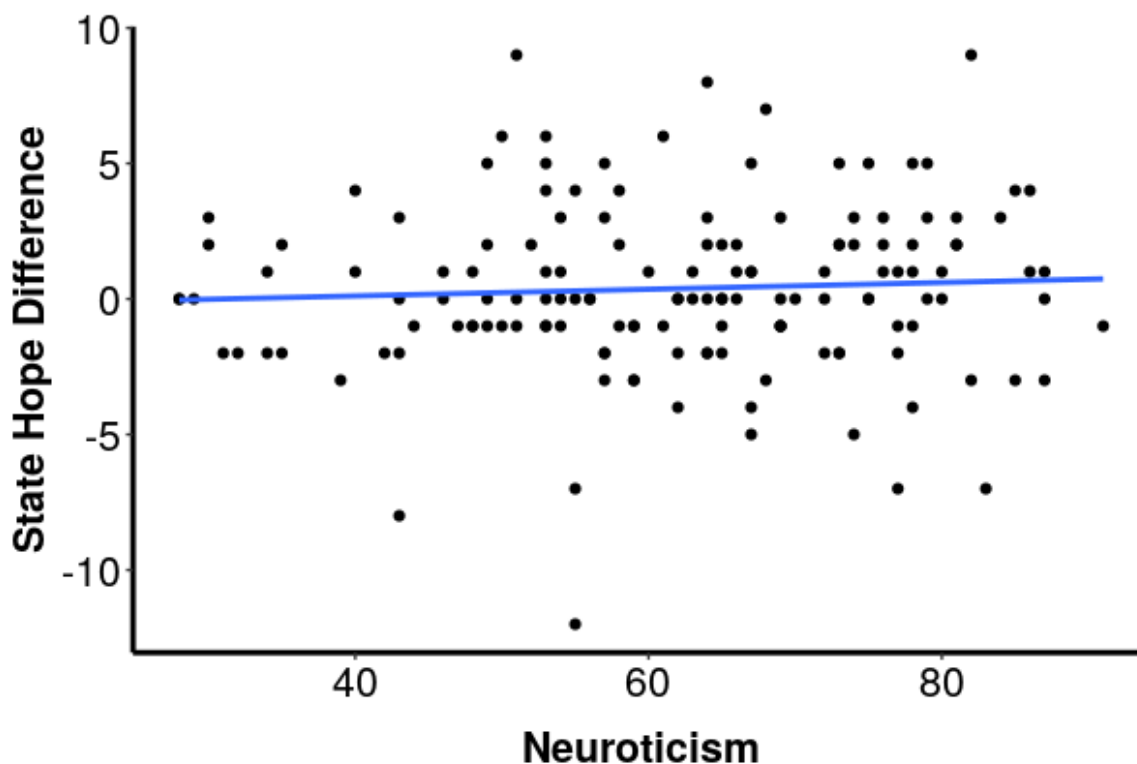
A paired-samples  $t$ -test was conducted to compare state nurturant love before and after hope emotion induction. There was a significant difference in pre induction state nurturant love ( $M = 19.6$ ,  $SD = 4.65$ ) and post induction state nurturant love ( $M = 19.1$ ,  $SD = 5.29$ ). This decrease, -0.58, 95% CI [0.14, 1.02], was statistically significant, and there is only anecdotal evidence for the experimental hypothesis,  $t(146) = -2.61$ ,  $p = .01$ ,  $d = -.11$ ,  $BF = 2.42$ .

A paired-samples  $t$ -test was conducted to compare state general positive emotions before and after hope emotion induction. There was a significant difference in pre induction state general positive emotions ( $M = 19.5$ ,  $SD = 5.41$ ) and post induction state general positive emotions ( $M = 20.2$ ,  $SD = 5.24$ ). This increase, 0.73, 95% CI [0.29, 1.18], was statistically significant, and there is strong evidence for the experimental hypothesis,  $t(146) = 3.29$ ,  $p = .001$ ,  $d = .14$ ,  $BF = 15.29$ .

A paired-samples  $t$ -test was conducted to compare state general negative emotions before and after hope emotion induction. There was a significant difference in pre induction state general negative emotions ( $M = 13.8$ ,  $SD = 5.54$ ) and post induction state general negative emotions ( $M = 13.3$ ,  $SD = 5.33$ ). This decrease, -0.50, 95% CI [0.05, 0.94], was statistically significant, however there is no evidence for the experimental hypothesis,  $t(146) = -2.22$ ,  $p = .03$ ,  $d = -.09$ ,  $BF = .98$ .

The paired-samples  $t$ -tests show the hope emotion induction procedure was not effective at increasing state hope, but increased state positive emotions. The induction procedure also decreased state love and state negative emotions.

A Pearson correlation was used to test the hypothesis that (v) the induction of state hope is negatively correlated with neuroticism and is illustrated in Figure 4.



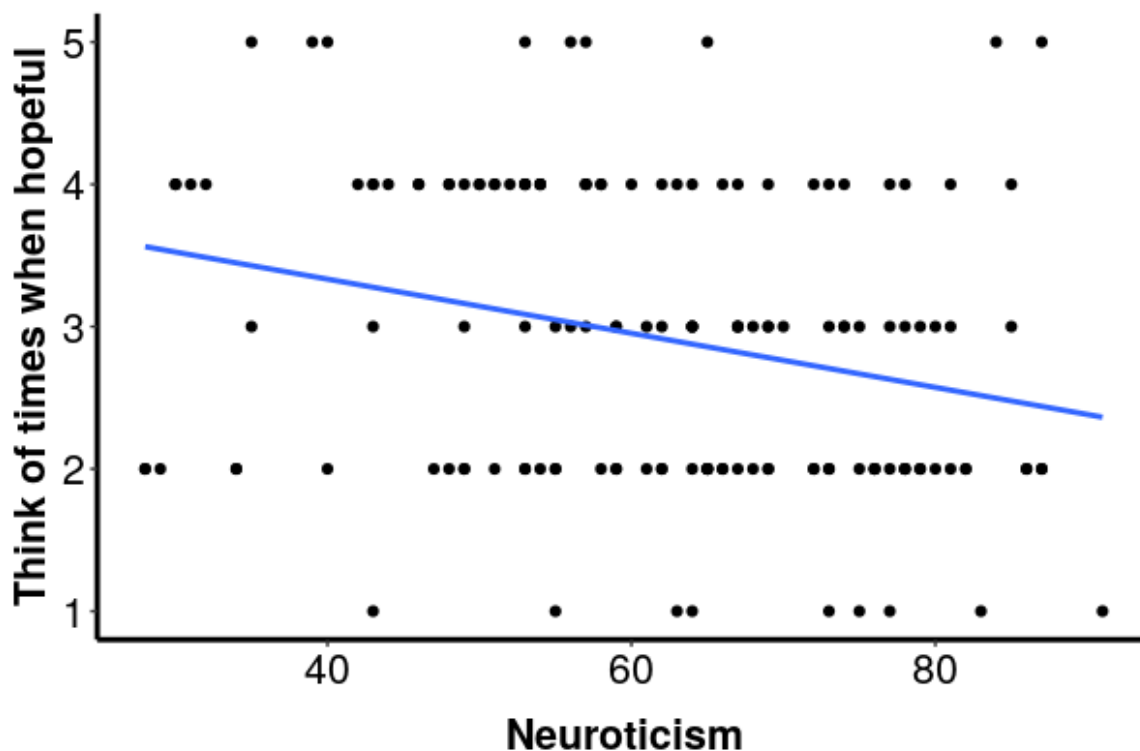
**Figure 4:** Scatterplot with regression line showing the relationship between Neuroticism and the difference in state hope after hope emotion induction ( $n = 147$ ).

The data in Figure 4 shows a linear positive relationship. The Pearson correlation indicated there was no significant weak positive correlation between the difference in state hope and neuroticism and no evidence for the experimental hypothesis,  $r(145) = .06$ ,  $p = 0.48$ ,  $BF = 0.24$ . The results support the null hypothesis that there will be no difference between those high or low in neuroticism in state hope after emotion induction.

### Exploratory Analyses

#### Control Question 1: 'Do you often think of times when you were hopeful?'

A Pearson correlation was used to demonstrate the relationship between neuroticism and whether participants often think of times when they were hopeful and is illustrated in Figure 5.

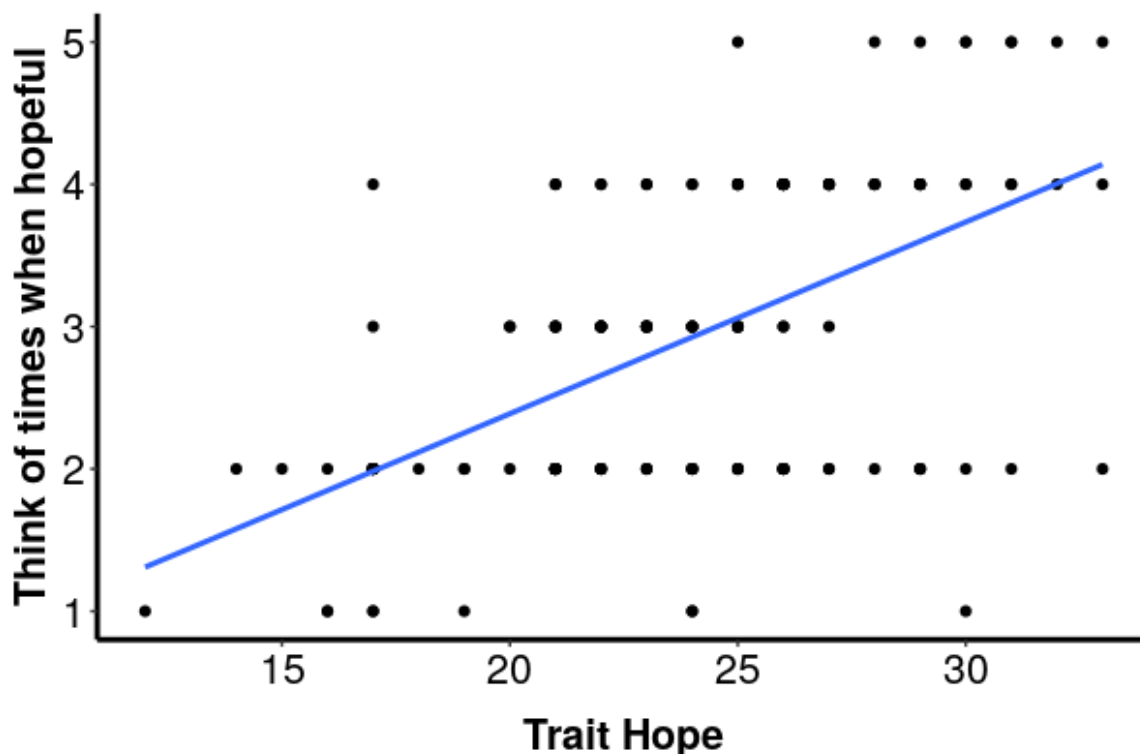


Note. Control question response 1 indicates 'never' and 5 indicates 'always'.

**Figure 5:** Scatterplot with regression line showing the relationship between Neuroticism and thinking of times when hopeful ( $n = 147$ ).

The data in Figure 5 show a linear negative relationship. The Pearson correlation indicated that there was a significant medium negative correlation between neuroticism and participants often thinking of times when they were hopeful, and strong evidence for the experimental hypothesis,  $r(145) = -.26$ ,  $p = .001$ ,  $BF = 29.21$ . Participants who are low in neuroticism don't often think of times when they were hopeful and those who are high in neuroticism often think of times when they were hopeful.

A Pearson correlation was used to demonstrate the relationship between trait hope and whether participants often think of times when they were hopeful and is illustrated in Figure 6.

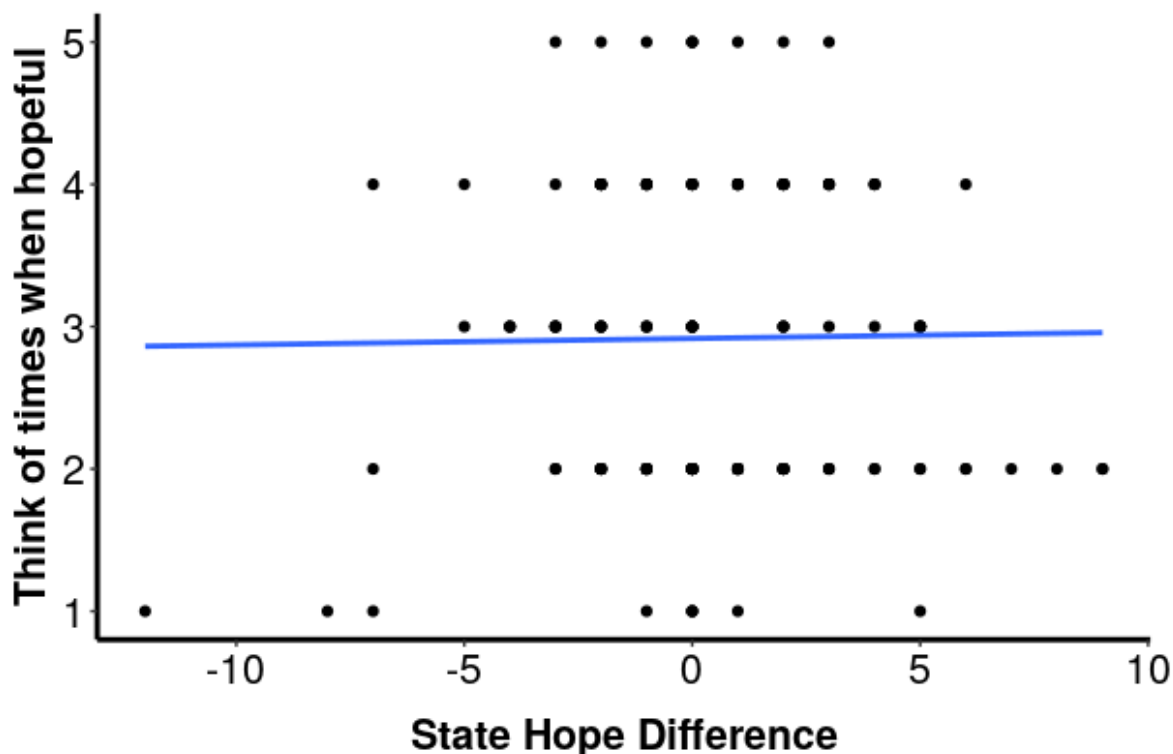


Note. Control question response 1 indicates 'never' and 5 indicates 'always'.

**Figure 6:** Scatterplot with regression line showing the relationship between trait hope and thinking of times when hopeful ( $n = 147$ ).

The data in Figure 6 show a linear positive relationship. The results from the Pearson correlation indicated that there was a significant strong positive correlation between neuroticism and participants often thinking of times when they were hopeful, and decisive evidence for the experimental hypothesis,  $r(145) = .55$ ,  $p < .001$ ,  $BF = 14,815,526,870.00$ . Participants who are low in trait hope don't often think of times when they were hopeful and those who are high in trait hope often think of times when they were hopeful.

A Pearson correlation was used to demonstrate the relationship between the difference in state hope before and after hope emotion induction and whether participants often think of times when they were hopeful and is illustrated in Figure 7.



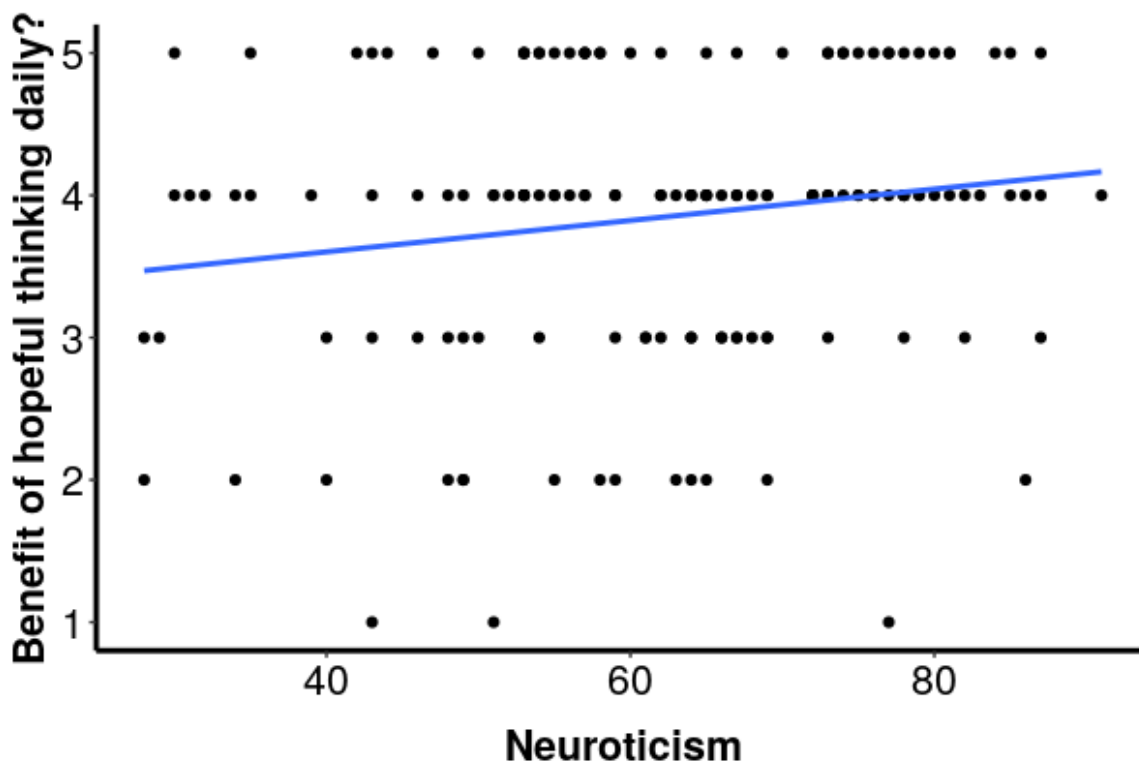
Note. Control question response 1 indicates 'never' and 5 indicates 'always'.

**Figure 7:** Scatterplot with regression line showing the relationship between the difference in state hope before and after hope emotion induction and thinking of times when hopeful ( $n = 147$ ).

The data from Figure 7 show a linear positive relationship. The results from the Pearson correlation indicated that there was a non-significant weak positive correlation between the difference in state hope before and after hope emotion induction and participants often thinking of times when they were hopeful, and no evidence for the experimental hypothesis,  $r(145) = .01$ ,  $p = 0.87$ ,  $BF = 0.19$ . Participants often thinking of times when they were hopeful has no significant relationship with the difference in state hope participants experienced after hope emotion induction.

Control Question 2: 'Do you think it would benefit you to think of a time when you were hopeful daily?'

A Pearson correlation was used to demonstrate the relationship between neuroticism and whether participants think there is a benefit of hopeful thinking daily and is illustrated in Figure 8.

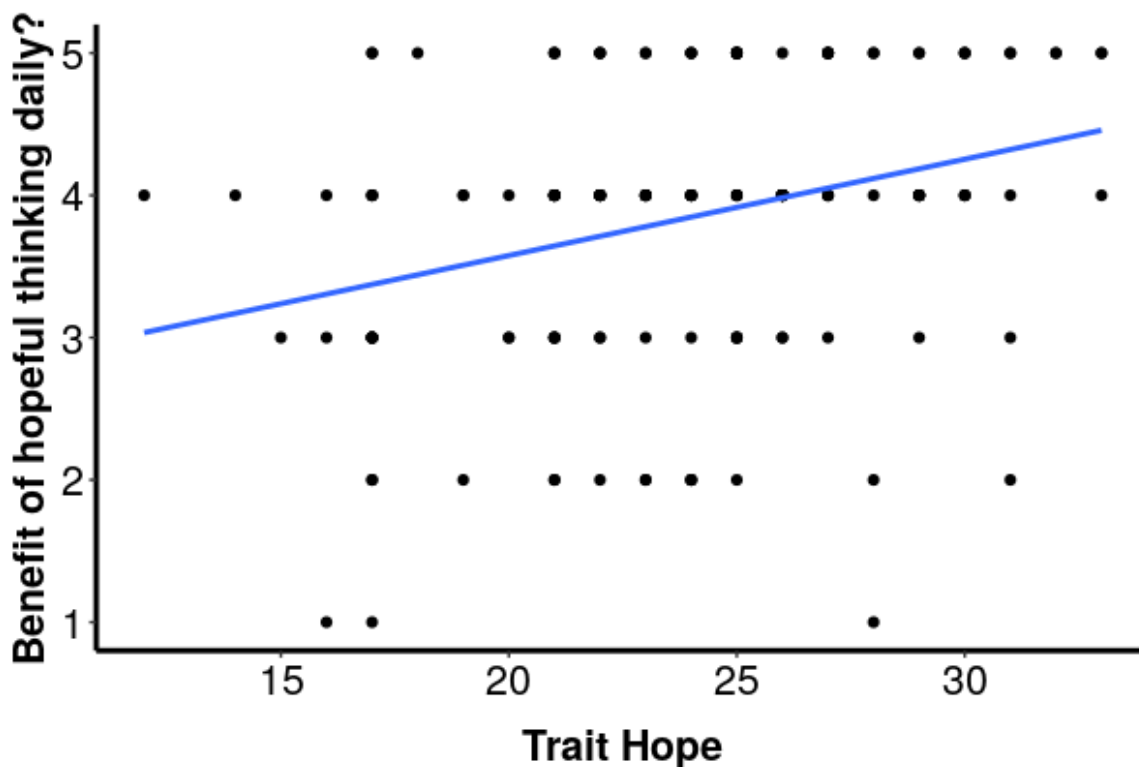


Note. Control question response 1 indicates 'definitely not' and 5 indicates 'definitely yes'.

**Figure 8:** Scatterplot with regression line showing the relationship between neuroticism and the benefit of hopeful thinking daily ( $n = 147$ ).

The data from Figure 8 show a linear positive relationship. The results from the Pearson correlation indicated mixed results, there was a significant small positive correlation between neuroticism and the benefit of hopeful thinking daily, but no evidence for the experimental hypothesis,  $r(145) = .17$ ,  $p = 0.05$ ,  $BF = 1.31$ . There is some evidence that participants low in neuroticism think hopeful thinking daily would be not beneficial, whereas those high in neuroticism think it would be beneficial.

A Pearson correlation was used to demonstrate the relationship between trait hope and whether participants think there is a benefit of hopeful thinking daily and is illustrated in Figure 9.



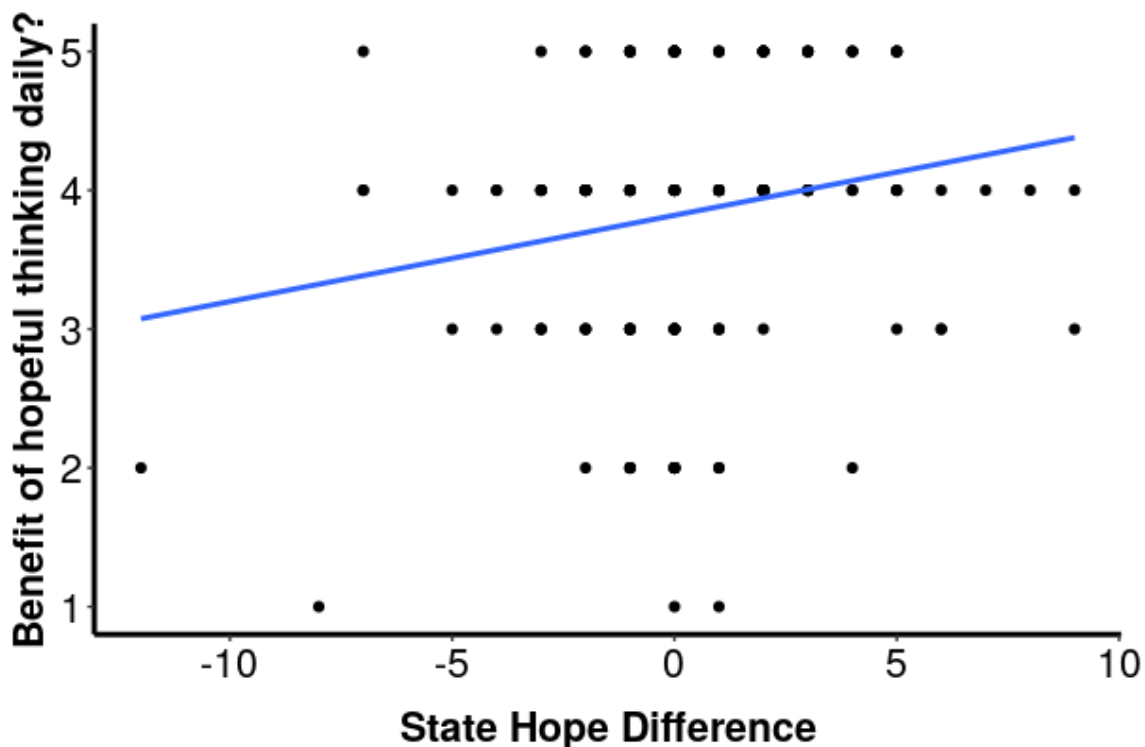
Note. Control question response 1 indicates 'definitely not' and 5 indicates 'definitely yes'.

**Figure 9:** Scatterplot with regression line showing the relationship between trait hope and the benefit of hopeful thinking daily ( $n = 147$ ).

The data from Figure 9 show a linear positive relationship. The results from the Pearson correlation indicated that there was a significant large positive correlation between trait hope and the benefit of hopeful thinking daily, and decisive evidence for the experimental hypothesis,  $r(145) = .30$ ,  $p = <.001$ ,  $BF = 123.82$ . Participants low in trait hope think hopeful thinking daily would be not beneficial, whereas those high in trait hope think it would be beneficial.

A correlation was used to demonstrate the relationship between the difference in state hope before and after hope emotion induction and whether participants think there is a benefit of hopeful thinking daily and is illustrated in Figure 10.





Note. Control question response 1 indicates 'definitely not' and 5 indicates 'definitely yes'.

**Figure 10:** Scatterplot with regression line showing the relationship between the difference in state hope before and after hope emotion induction and the benefit of hopeful thinking daily ( $n = 147$ ).

The data in Figure 10 show a linear positive relationship. The results from the Pearson correlation indicated a significant medium positive correlation between the difference in state hope before and after hope emotion induction and the benefit of hopeful thinking daily, but only anecdotal evidence for the experimental hypothesis,  $r(145) = .20$ ,  $p = 0.02$ ,  $BF = 2.91$ . There is anecdotal evidence that participants who experienced a smaller difference in state hope think hopeful thinking daily would be not beneficial, whereas those who experienced a bigger difference in state hope think it would be beneficial.

## Discussion

This study aimed to identify a relationship between neuroticism and positive emotions, more specifically, hope. Neuroticism was found to be negatively associated with trait hope; individuals high in neuroticism had lower trait hope than those low in neuroticism, which is consistent with our hypothesis. The results support our assumptions about trait hope, which are based on previous findings that neuroticism is positively correlated with pessimism (Marshall, Wortman, Kusulas, Hervig & Vickers Jr, 1992), and negatively correlated with optimism (Kennedy & Hughes, 2004).

However, although the results support a negative relationship between neuroticism and trait hope, there was no significant relationship between neuroticism and the difference in state hope, contradicting our hypothesis. Further correlations revealed

that trait hope was associated with state hope, supporting Plattner et al. (2007), who suggested that emotional traits are likely to predict emotional states. While we found no significant relationship, our results support those of Ng (2009), who suggested individuals high in neuroticism are as capable of experiencing as much positive emotion as those low in neuroticism. Furthermore, the results also contradict our assumptions from the literature on pessimism and optimism (Marshall, Wortman, Kusulas, Hervig & Vickers Jr, 1992; Kennedy & Hughes, 2004), as we did not find a difference in the experience of state hope dependent on neuroticism scores. There was no significant difference in state hope between those high or low in neuroticism, which supports the findings of Ng (2012), and Ng and Diener (2008) who found cognitive strategies either maintained or had no effect on state positive emotions in those with high neuroticism. However, Ng and Diener (2008) also found individuals with low neuroticism were strongly influenced by these cognitive strategies and experienced an increase in state positive emotions, contradicting our findings. Overall, there is a negative association between neuroticism and trait hope, but no relationship with state hope following hope emotion induction.

There was no significant increase in state hope following the induction procedures of autobiographical recall and imagery, contradicting our hypothesis. This could explain the lack of relationship between neuroticism and state hope, as the procedures were not effective. However, autobiographical recall resulted in reduced state nurturant love, and increased state general positive emotions, as previously reported by Lybomrsky et al. (2005) and Joorman et al. (2007). However, whereas Siedlecka and Denson (2019) suggested individual state positive emotions could be induced, our findings did not support the assumptions that state hope would increase. In addition to increasing state positive emotions, the induction procedures reduced state general negative emotions, supporting Frederickson's (1998) theory, as the hope emotion induction procedure reverses lingering state negative emotions, whilst furthering state positive emotions, unlike most other interventions (Lyubomirsky, Sheldon & Schkade, 2005).

The results are consistent with both the hypotheses that neuroticism will be negatively correlated with trait positive emotions and positively correlated with trait negative emotions, and are consistent with the association of neuroticism with emotions (Schmitt et al., 2009; Ng, 2009; Tellegan, 1985; McCrae & Costa, 2008). The results also concur with Frederickson's Broaden and Build Theory (1998) of positive emotions being linked to well-being; this could explain why individuals high in neuroticism have lower well-being, as they experience low trait positive emotions but high trait negative emotions.

The exploratory analyses revealed that individuals who often think of times when they were hopeful were low in neuroticism or high in trait hope, and there was no relationship with the difference in state hope following emotion induction. This suggests that engaging in hopeful thoughts often does not influence the experience of state hope, but is associated with high trait hope and low neuroticism. Additionally, individuals who believe it would be beneficial to think of times when they were hopeful daily were individuals high in neuroticism or high trait hope. Although individuals high in neuroticism believe hopeful thinking would be beneficial, they do not do it often, even if it will increase their well-being. There was some evidence for the relationship between the belief that it would be beneficial to think of hopeful times

daily and the difference in state hope. Individuals who believe hopeful thinking is beneficial experienced a larger increase in state hope following hope emotion induction; suggesting that believing in the benefits of an intervention might affect its success. However, due to the link of neuroticism with depression and low self-esteem (Eysenck & Eysenck, 1985), these individuals may not feel motivated to regularly engage in this intervention, even if they believe it to be beneficial. Furthermore, some individuals may believe that emotions are not controllable, and therefore hopeful thinking is not beneficial, which may influence their motivation to engage in this self-regulation (Bandura, 1986; Seligman, 1975) and result in a smaller increase in state hope.

There are practical implications with this study. Although we failed to induce state hope, state positive emotions were induced, and state negative emotions were reduced by autobiographical recall and imagery scenarios of hope. Negative emotions can be reduced with the aim of increasing positive emotions and improving well-being. The results found individuals high in neuroticism are just as capable of experiencing positive emotions as those low in neuroticism as reported by Ng (2009), suggesting wherever an individual falls on the neuroticism scale, they will experience positive emotions the same way. However, it would be more beneficial for individuals high in neuroticism to increase their positive affect and thus reduce negative affect.

This study has some limitations. The researchers created the induction procedures and engaged in the pilot study to determine which emotion induction procedure to use. During the evaluation, they may have been implicitly biased and rated the emotions more intensely than experienced, resulting in state hope not being induced as intended. Future research should consider replicating with more effective procedures such as Virtual Reality (VR). VR has been successful at inducing positive emotions such as joy, as it engages both mental and bodily components of the individual (Meuleman & Rudrauf, 2018). More effective induction procedures could then be used to clarify the relationship between neuroticism and state hope.

Another limitation is the repetitive nature of the survey. Participants completed trait and state variations of the hope, nurturant love and SPANE items three times, which were all presented very similarly. Participants may not have noticed differences in measure instructions and item wording between the trait and state questions resulting in different patterns of responses. This could also explain why state hope did not increase, as the instructions were too similar.

Finally, as this study is correlational, the association between neuroticism and its effect on positive emotions is not casual, other mediating factors could play into the effect of neuroticism on positive emotions, or vice versa. For example, neuroticism is associated with low self-esteem (Eysenck & Eysenck, 1987), and has been linked to the dampening of positive emotions (Goodall, 2015), suggesting self-esteem could also affect the experience of state positive emotions.

To further study the impact of neuroticism and state positive emotions on well-being, this study could be repeated using a more effective procedure to induce state hope in individuals with high neuroticism, and measure the effect of an increase in state hope on well-being, using for example, well-being scales. Furthermore, as the 'build'

aspect of Frederickson's theory (1998) suggests experiencing positive emotions repeatedly will make lasting changes, further studies could investigate the effects of repeated hope emotion induction, and its long term effects on neuroticism and trait hope.

The inclusion of modern methods of significance such as Bayes Factor (BF) alongside  $p$  values should also be considered. Most of this study's results were significant, and the BF provided more detail on the evidence for the experimental hypotheses. However, where the  $p$  value and BF were incongruent, more information on the relationships and the BF was needed, in order to prevent overestimation of the evidence in favour of an effect based solely on the  $p$  value (Wetzels et al., 2011).

## **Conclusions**

In conclusion, the results support the predictions that neuroticism is negatively associated with the experience of trait and state positive emotions, but not state hope. Although the induction procedures were unsuccessful at inducing state hope, they induced state positive emotions and reduced state negative emotions, suggesting the intervention is still beneficial. The results show that individuals who often think of hopeful memories have low neuroticism and high trait hope, and those who believed this to be beneficial experienced a larger increase in state hope following emotion induction. The relationship between neuroticism and state hope with effective induction procedures, and the effects of state hope on well-being and its link to neuroticism, needs to be explored further.

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