How situation affects personality expression in word use : trait relevance and situation strength

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**HOW SITUATION AFFECTS PERSONALITY EXPRESSION IN
WORD USE: TRAIT RELEVANCE AND SITUATION STRENGTH**

**CHEN JIAYU
SCHOOL OF SOCIAL SCIENCES
2021**

**HOW SITUATION AFFECTS PERSONALITY EXPRESSION IN
WORD USE: TRAIT RELEVANCE AND SITUATION STRENGTH**

CHEN JIAYU

SCHOOL OF SOCIAL SCIENCES

A thesis submitted to the Nanyang Technological University in partial
fulfilment of requirement for the degree of Doctor of Philosophy

2021

Statement of Originality

I certify that all work submitted for this thesis is my original work. I declare that no other person's work has been used without due acknowledgement. Except where it is clearly stated that I have used some of this material elsewhere, this work has not been presented by me for assessment in any other institution or University. I certify that the data collected for this project are authentic and the investigations were conducted in accordance with the ethics policies and integrity standards of Nanyang Technological University and that the research data are presented honestly and without prejudice.

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Authorship Attribution Statement

This thesis contains material from one paper(s) published in the following peer-reviewed journal(s) / from papers accepted at conferences in which I am listed as an author.

Chapter 1 is published as Chen, J., Qiu, L., & Ho, M. H. R. (2020). A Meta-analysis of Linguistic Markers of Extraversion: Positive Emotion and Social Process Words. *Journal of Research in Personality*, 89, 104035.

The contributions of the co-authors are as follows:

- I proposed the initial project direction, and Prof. Qiu Lin provided suggestions and helped narrow down the scope.
- I prepared the manuscript drafts. Prof. Qiu Lin and I revised the manuscript several rounds. Prof. Ringo Ho edited the final version of manuscript draft.
- I co-designed the study with Prof. Qiu Lin and performed all the data collection with a research assistant.
- I conducted data analysis, and some statistical questions were solved with the help of Prof. Ringo Ho.

Dec 27, 2020

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Chen Jiayu

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Abstract

Existing studies have shown the associations between personality traits and word use. However, these associations often vary substantially across contexts. We proposed that situation trait relevance (i.e., opportunity for trait expression) and situation strength are two important factors affecting personality expression in word use. In particular, we hypothesized that the associations between personality and word use are stronger in more trait-relevant and weaker situations respectively. Four studies were conducted to investigate our hypotheses. We focused on extraversion, a well-studied personality trait with ample evidence showing its connection to the use of positive emotion and social process words.

In Study 1, we conducted a meta-analysis ($k = 37$, $N = 82,132$) of the relationship between extraversion and its two linguistic markers. Results revealed a small correlation between extraversion and social process words ($r = .06$, 95% $CI = [.02, .10]$), and a small correlation between extraversion and positive emotion words ($r = .07$, 95% $CI = [.04, .10]$). More importantly, we found that the correlation between extraversion and positive emotion words was stronger in public than private contexts, and stronger in real-life than lab settings. Given that public contexts are likely to be more relevant to extraversion than private contexts, and real-life settings tend to be weaker than lab settings, the above results provided preliminary evidence supporting our hypotheses regarding the moderation effect of trait relevance and situation strength.

In Study 2, we examined the influence of situation trait relevance using naturalistic language data from Facebook. By analyzing a sample of 27,235 users' Facebook status updates and their social network density, we found that social network density strengthened the relationship between extraversion and social process /positive emotion words. Given that denser social networks tend to have more close friends and social interactions, they are more relevant to extraversion. Therefore, social network density can be considered an index of situation trait relevance for extraversion, and the above results supported the moderation effect of situation trait relevance.

In Study 3, we conducted a within-subject lab experiment to test the effect of situation strength by using three different speaking tasks: self-introduction, hobby-telling, and storytelling. Results showed that extraverts displayed more extraverted behaviors (i.e., a composite factor reflecting sociable and positive state) in their language than introverts across the three language tasks, confirming the connection between extraversion and language use. Meanwhile, participants' language use was more extraverted in the hobby-telling task than the self-introduction task. However, situation strength did not interact with extraversion to predict word use as well as extraverted behaviors, which could be due to the low trait-relevance of the three language tasks.

To increase situation trait relevance, in Study 4, we asked participants to talk to a confederate in the three language tasks used in Study 3 so that these tasks could have more situation sociality. As expected, results showed that the association between extraversion and extraverted linguistic behaviors was stronger

in self-introduction and hobby-telling than in storytelling. However, situation strength did not interact with extraversion to predict word use.

The four studies above used three different methods to demonstrate how situation trait relevance and situation strength affect the relationship between personality and word use. It expands the Person x Situation interactionism theory by specifying how trait relevance and situation strength interact with personality to influence word use and unveils why the relationship between personality and word use varies across situations. It also advances the theory of personality expression in language use by integrating situation characteristics into the model. Our work makes important theoretical contributions to personality science and has important practical implications in improving personality prediction based on linguistic data.

Keywords: Personality; Linguistic style; Situation; Situation trait relevance; Situation strength; Extraversion

Chapter I Introduction

Word use has been considered as reflections of social and psychological processes (Pennebaker, Mehl, & Niederhoffer, 2003). Substantial evidence regarding the associations between personality traits and linguistic styles has been provided in studies on the psychology of language (Pennebaker & King, 1999; Pennebaker et al., 2003). However, the associations vary substantially across language samples. For example, the correlation between extraversion and positive emotion words is .28 in a sample of tweets (Qiu, Lin, Ramsay, & Yang, 2012) but only .05 in a sample of daily language use (Mehl, Gosling, & Pennebaker, 2006). The correlation between agreeableness and negative emotion words is -.25 in text messages (Holtgraves, 2011) but -.07 in personal essays (Pennebaker & King, 1999). While scholars have proposed that communication contexts (e.g., private vs. public) may cause the inconsistency in personality expression across different linguistic samples (Mehl, Robbins, & Holleran, 2012), little is known about why, how, and which situational factors affect personality expression in word use. Therefore, in this thesis, we aim to fill in the research gap by investigating how situation characteristics influence the relationship between personality and word use. Specifically, we focus on extraversion, a well-studied and robust trait consistently found across various personality models. Situation trait relevance and situation strength are two important situational factors influencing personality expression (Judge & Zapata, 2015), and they are included in this research to help identify the boundary conditions of traits-word use relationships. This work is important because a core objective of personality psychology is to identify

observable behavioral manifestations of personality traits (Funder, 2001), and adding situational factors may increase the accuracy of predicting personality by using word use. In addition, it will advance the theory of personality expression by integrating situation characteristics into the model of personality and word use. It will explain the varied relationships between personality and language style and reveal the situations suitable for observing a particular trait expression in word use.

The Characteristics of Extraversion

Extraversion has been found to be a fundamental and robust dimension of personality in both the Big Five model (Goldberg, 1990, 1992; McCrae & Costa, 1987) and the six-factor HEXACO model (Lee & Ashton, 2008). It is defined as the tendency to be sociable, assertive, and energetic based on factor analysis of trait descriptive adjectives (Goldberg, 1990; Lee & Ashton, 2008). Meanwhile, according to the two-factor motivational model of personality, extraversion, positive emotionality (i.e., a tendency to experience positive emotion and positively engage in life), and behavioral activation system (i.e., a motivation to facilitate behavior and produce positive affect) form the approach temperament factor of personality, while neuroticism (i.e., a trait refers to the tendency to experience negative feelings and anxiety), negative emotionality (i.e., a tendency to experience negative emotion and negatively engage in life), and behavioral inhibition system (i.e., a motivation to inhibit behavior and produce negative affect) form the avoidance temperament factor (Elliot & Thrash, 2002). This model suggests that extraversion reflects vigilance and sensitivity to positive and desirable stimuli (Elliot & Thrash, 2002; Larsen & Ketelaar, 1991; Lucas & Baird,

2004). Extraversion has also been considered as the tendency to engage in pleasurable activities and experience positive emotion (Tellegen, 1985; Tellegen et al., 1988; Watson & Clark, 1997), because it tends to be related with trait positive affectivity across different measurements (Watson & Clark, 1997).

Despite the different accounts of extraversion, empirical evidence has shown reliable associations between extraversion and positive emotions experiences (Argyle & Lu, 1990; Aziz, Mustaffa, Samah, & Yusof, 2014; Costa, McCrae, & Norris, 1981). The relationship has been found to hold across cultures (Lucas, Diener, Grob, Suh, & Shao, 2000). Studies showed that extraversion is positively related to individuals' general happiness (Tan & Lee, 2017), positive affect (C.-C. Lin, 2014) and happiness after controlling for the other four Big Five traits, which are agreeableness, conscientiousness, neuroticism, and openness (Warner & Vroman, 2011). Agreeableness describes people's tendency to be warm, friendly, and tactful, while conscientiousness refers to the tendency to be responsible, organized, and hard-working. Openness suggests to what extent people are imaginative, curious, and open-minded. A meta-analysis showed that the correlation between extraversion and happiness is .27 based on 15 independent samples, and the relationship between extraversion and positive affect is .20 based on 39 independent samples (DeNeve & Cooper, 1998). These studies suggest that extraverts tend to experience more positive emotion than introverts.

Extraversion has also been found to be related to social interaction. Argyle and Lu (1990) measured participants' feelings and the frequency they participated in 37 daily activities (e.g., chatting with friends) and found that extraverts enjoyed

and participated more in social activities than introverts. Oerlemans and Bakker (2014) asked participants to list the activities they engaged in the previous day and how they had felt during each activity and found that extraverts experienced higher level of positive emotion during social interactions than introverts. Moreover, Asendorpf and Wilpers (1998) found that extraverts spent more time interacting with others than introverts in a 21-day diary study. In a recent study, Harari et al. (2019) used smartphone sensing and found that extraversion was positively correlated with the frequency of outgoing phone call, text messaging, messaging application usage, and social media application usage. These studies suggest that social interaction is an important characteristic of extraversion.

Personality and Word Use

A sizable amount of research has shown the connection between personality and verbal behavior. For example, Borkenau and Liebler (1992) videotaped and rated participants in various situations such as reading a standard text, and found that extraversion was positively correlated with powerful voice and negatively correlated with soft voice. Back, Schmukle, and Egloff (2009) videotaped and rated participants in tasks such as self-introduction and description of future vision, and found that extraversion was associated with verbal behaviors such as loudness of voice, number of words, and question-asking during small talk. Similarly, Cuperman and Ickes (2009) randomly paired participants in an unstructured dyadic interaction (i.e., same-sex or opposite sex dyads were seated in a waiting room, and they are not instructed to interact. But their interaction was recorded.) and found that extraversion was negatively associated with the use of

first-person singular pronouns. While the above evidence illustrated personality expression in verbal behaviors such as acoustic features and linguistic styles, this thesis mainly focused on the word use and its relationship with personality. The reasons are as below. Compared with other language features such as acoustic features, word use has received much attention from psychologists and its relationship with personality traits is widely studied (Pennebaker et al., 2003; Zimmermann, Brockmeyer, Hunn, Schauenburg, & Wolf, 2017). In addition, given the huge amount of text available in the era of big data, such as status updates on social media and online conversations, a deeper understanding about personality and word use will have important practical implications such as improving personality prediction using word use (e.g., Park et al., 2015).

Word use unveils important psychological processes (Pennebaker et al., 2003). For example, the use of “I” indicates attention to oneself, and its frequent use predicts depression because excessive attention to the self is usually associated with negative emotion (Edwards & Holtzman, 2017; Tackman et al., 2018; Zimmermann, Brockmeyer, Hunn, Schauenburg, & Wolf, 2017). The pronoun use in “you and I can do this” vs. “we can do this” reveals subtle but critical distinction in the speaker’s emotional ties to the other person (Chung & Pennebaker, 2007). Linguistic Inquiry and Word Count (LIWC; Tausczik & Pennebaker, 2010) is a software tool developed by psychologists to measure emotion, cognitive styles, and social process based on word use (Pennebaker et al., 2003; Tausczik & Pennebaker, 2010). It counts the frequencies of words based on a pre-defined dictionary developed based on the theory, which consist of more than 70 grammatical and

psychologically meaningful word categories. Words in these categories were selected and validated by judges (Pennebaker, Booth, & Francis, 2007) and shown to have profound psychological implications (Tausczik & Pennebaker, 2010).

The LIWC positive emotion word category (e.g., happy, beautiful, nice) includes words indicating positive feelings and positive valence. They have been found to be related to self-reported positive emotion. Kahn, Tobin, Massey, and Anderson (2007) showed that LIWC positive emotion words positively correlated with self-reported amusement after participants watched a comedy film, and participants tended to use more positive emotion words after (vs. before) watching a comedy film. Tov, Ng, Lin, and Qiu (2013) collected participants' daily diary and self-reported emotion status for 3 weeks and found that LIWC positive emotion words were related with self-reported positive emotion. Golder and Macy (2011) used the frequency of positive emotion words in tweets to measure people's affect and revealed diurnal and seasonal mood change around the world. Liu, Chan, Qiu, Tov, and Tong (2018) found that individuals from culturally tight U.S. states (i.e., states with high strength of social norms and high intolerance for deviance from norms) tended to use more positive emotion words on Facebook than those from culturally loose states (i.e., states with weak strength of social norms and high tolerance for deviance from norms), reflecting the effect of cultural tightness-looseness on emotional expression as well as the validity of LIWC positive emotion words in measuring positive emotion experiences. These studies together established the external validity of LIWC positive emotion word category for measuring positive affect.

The LIWC social process word category contains all personal pronouns except *I* as well as verbs indicating social interactions (e.g., talk, share, meet). The inclusion of words related to social interaction provides face validity of using the category to measure thoughts and attention towards social interactions. The category has further been found to indicate social connections and closeness (Stone & Pennebaker, 2002). Sillars, Shellen, McIntosh, and Pomegranate (1997) showed that interdependent couples tended to use more “we” pronouns (included in the social process word category) in discussions about marital problems than independent couples, suggesting that the use of “we” pronouns indicates relationship closeness. Karan, Rosenthal, and Robbins (2019) conducted a meta-analysis and showed that the amount of we-talk predicted relationship satisfaction and functioning in romantic couples, suggesting that we-talk is a reflection of partners’ interdependence. Ritter, Preston, and Hernandez (2014) showed that Christians used more positive emotion words in tweets than atheists, partially mediated by use of social process words. This is consistent with previous results that religious people had stronger social relationships than less religious people, which led to greater life satisfaction (Salsman, Brown, Brechting, & Carlson, 2005). Tov et al. (2013) conducted a diary study and found that LIWC coding of positive family and friends related events (two categories included in social process word category) in the diary predicted self-reported satisfaction towards family and friends, respectively. These studies suggest that LIWC social process words are indicators of social interaction and connection.

Given that linguistic styles convey important information about the speaker (Pennebaker et al., 2003), they have been proposed and shown to be valuable indicators of personality (Hirsh & Peterson, 2009; Pennebaker & King, 1999; Youyou, Stillwell, Schwartz, & Kosinski, 2017). The act frequency approach to personality (Buss & Craik, 1983) posited that individuals higher on a particular trait tend to perform more behaviors related with that trait. For example, people high in quarrelsomeness dimension may enact more behaviors like “I picked a fight with the stranger at the party” than people low in quarrelsomeness. Therefore, it is likely that people tend to use words that reflect feelings, thoughts, and behaviors congruent with their personality characteristics.

As extraversion is defined as the tendency to experience positive emotions and enjoy social interactions (Costa et al., 1981), studies have found that extraversion is related to the use of positive emotion and social process words. For example, Yarkoni (2010) conducted a large-scale analysis of personality traits and word use in blogs and found that extraversion was related with the greater use of positive emotion and social process words. Pennebaker and King (1999) collected participants’ personal essays and their personality traits and revealed that extraversion predicted the use of positive emotion words and social process words. Qiu et al. (2012) collected participants’ tweets over one-month and found that extraversion was related with the use of positive emotion words and social process words. However, the effect size of the relationships varies substantially across studies. For example, the correlation between extraversion and positive emotion words is .28 in a sample of tweets (Qiu et al., 2012) but only .05 in a sample of

daily language use (Mehl et al., 2006). The correlation between extraversion and social process words is .22 in self-narratives samples (Hirsh & Peterson, 2009) but .09 in Facebook profile (Golbeck, Robles, & Turner, 2011). The substantial variations of correlations across studies might suggest potential boundary conditions and moderators affecting the relationships.

Taken together, the inconsistent relationships between traits and word use across different situations suggest that the communication contexts or situations may influence personality expression in language. However, few studies have examined the moderation effect of situation. Mehl et al. (2012) collected participants' language samples from their everyday conversations and writings of their momentary thoughts. They found that the association between neuroticism and emotion words existed in writing samples but not in everyday conversations. In contrast, the association between extraversion and verbal immediacy (i.e., a composite index calculated by aggregating the frequency of first-person singular pronouns, present tense verbs, discrepancy words, inverse scores of articles, and words of more than six letters) existed in everyday conversations but not in writing samples. They speculated that the inconsistency is caused by everyday conversations being in public communication contexts whereas writing samples being in private communication contexts. However, this explanation may not be accurate because everyday conversations may be private when they occur between close friends or spouses. In addition, it is unclear why and how private and public contexts may influence personality expression in language.

In this thesis, we propose to examine how situation affects personality expression in language based on the trait activation theory (Tett & Guterman, 2000) and the situation strength theory (Cooper & Withey, 2009). The trait activation theory considers traits as differential response tendencies and treats trait expressions as responses to trait-relevant situational cues. It proposes that traits can only be expressed in a situation with trait-relevant cues. For example, people high in risk-taking are more likely to exhibit risk-taking behaviors in gambling situations than in the dining-with-a-friend situation. Meanwhile, situation strength is another important situational factor affecting personality expression, suggesting that traits can be expressed in a situation with less constraints but not in a situation with more constraints. For instance, extraverts might be as quiet as the introverts in the library, whereas extraverts tend to talk much more than introverts in a party. Trait activation theory and situation strength theory are two complementary theories, and the main differences lie in quality vs. quantity. Trait activation theory emphasized the type of situation related with certain trait expression, while situation strength theory only focused on the constraints imposed by the situations. Literature review about these two theories is presented below.

Trait Activation Theory

Tett and Guterman (2000) found that the correlations between self-reported trait levels and behavioral intentions were higher in situations relevant for a particular trait (e.g., risk-taking). Haaland and Christiansen (2002) found that in assessment center ratings of targets, the convergence among ratings in exercises highly relevant to a trait (e.g., extraversion) was stronger than those low in that trait

relevance. Similarly, a large-scale study about assessment center ratings analyzed across 30 multitrait-multimethod matrices and found that convergence of ratings for a given dimension (e.g., sensitivity) linked to a specific trait (e.g., agreeableness) was higher among exercises that provided more opportunities to observe behaviors related to that trait (Lievens, Chasteen, Day, & Christiansen, 2006). Recently, Judge and Zapata (2015) identified all existing studies examining the traits-performance relationship and found that traits predicted performance in job contexts relevant to those traits. For example, extraversion predicted performance in jobs which require social skills but not in those requiring independence in completing work. Agreeableness predicted performance in jobs requiring dealing with unpleasant or angry people but not in those requiring creativity.

The trait activation theory highlights the significance of trait relevance and posits that the relationship between traits and behaviors depends on the opportunities provided by the situation for trait expression. As word use can reflect people's inner status and was found to be reliably related with personality traits, people scored high in a trait may use more trait-consistent words than those low in that trait in a trait relevant situation. Therefore, we predict that trait relevance interacts with traits to affect word use.

Trait-relevant Situation Characteristics

Studies have tried to taxonomize situations based on how they affect the manifestation of personality traits. Ten Berge and De Raad (2001) collected 2234 sentences describing situations in which people can manifest their traits. They

reduced the situation pool to a final set of 237 situations and found five dimensions of situations based on participants' judgments about how appropriate the situation is for certain trait-related behaviors, namely "Situations of adversity", "Situations of amusement", "Situations of positioning", "Situations of conduct", and "Situations of daily routine." Using the same set of situations but based on the ratings of the extent to which participants are able to deal with the situation, Ten Berge and De Raad (2002) further found four components of situations, namely "Situations of pleasure", "Situations of individual adversity", "Situations of interpersonal conflict", and "Situations of social demand". Saucier, Bel-Bahar, and Fernandez (2007) analyzed over 7,000 reports of situations which can modify people's expression of their traits, and proposed four dimensions of situations, including locations, associations, activities, and passively experienced processes. However, the above studies did not provide reliable measurements of the proposed taxonomies and lack further validation of their findings.

Wagerman and Funder (2009) developed Riverside Situational Q-sort (RSQ) to comprehensively measure situation characteristics from a personality-relevant perspective. The original version of RSQ was based on the 100-item California Adult Q-sort (CAQ; Block et al., 1978) which is a personality measurement targeted to provide a comprehensive coverage of the personality domain. Items in CAQ was converted to describe characteristics of situations in which personality characteristics might be expected to occur (Wagerman & Funder, 2009). For example, the RSQ item "affords an opportunity to demonstrate intellectual capacity" is adapted from the CAQ item that "appears to have a high degree of intellectual

capacity”. RSQ was not developed based on explicit theories but targeted to include characteristics of situations as comprehensive and inclusive as possible. By examining the dimensional structure of the RSQ in a sample of over 1,500 participants across five countries, Rauthmann et al. (2014) identified eight robust dimensions of situation characteristics, namely Duty, Intellect, Adversity, Mating, pOsitivity, Negativity, Deception, and Sociality (short for DIAMONDS). Duty refers to the extent to which a situation contains work and requires problem-solving. Intellect describes the extent to which a situation involves deep reflection and intellectual engagement. Adversity describes to what extent a situation contains threats and criticism. Mating describes to what extent a situation is possible for sex and romance. pOsitivity describes to what extent a situation is enjoyable and pleasant. Negativity describes to what extent a situation may elicit negative emotions. Deception describes to what extent a situation contains mistrust and betrayal. Sociality describes the degree to which a situation involves interpersonal interaction and relationship formation. Given that extraversion is the trait related with social interaction and interpersonal relationship (Malouff, Thorsteinsson, Schutte, Bhullar, & Rooke, 2010; Tov et al., 2014), sociality is considered as relevant to extraversion. Based on the trait activation theory that traits could be better expressed in a trait relevant situation, we speculated that the correlations between extraversion and social process words/positive emotion words were stronger in high sociality situation than low sociality situation.

Situation Strength Theory

Another important theory about personality expression is situation strength theory (Mischel, 1973, 1977), which argues that behaviors can reflect traits more in a weak situation than a strong situation given that the strength of a situation could constrain behavioral variability and thus suppress the influence of other variables on behaviors. The strength of a situation is defined by the extent to which a situation provides clear cues and guidelines on behaviors. Specifically, a situation with clear behavioral expectations and unambiguous cues to guide behaviors is defined as a strong situation, while a situation that affords people great personal discretion is defined as a weak situation (Mischel, 1977). Furthermore, Meyer, Dalal, and Hermida (2010) proposed a 4-facet model of situation strength, including clarity, consistency, constraints, and consequences. Clarity refers to the extent to which cues about specific behaviors or requirements are easy to understand and unambiguous. Consistency stands for compatibility level among cues about specific behaviors or requirements. Constraints is defined as to what extent the forces beyond one's control could influence one's freedom to decide his own behaviors. Consequences suggest the extent to which one's behavior or decision may affect other people or society positively or negatively. These four facets together frame strong situation as the situation with clear and consistent cues to constrain and reinforce people's behaviors, and define a weak situation as the situation when cues are ambiguous and inconsistent, and no specific behaviors are constrained and reinforced.

Situation strength theory has been directly tested and supported by previous studies (Monson, Hesley, & Chernick, 1982; Withey, Gellatly, & Annett, 2005). In one of the studies, participants self-reported whether they were extraverted or introverted, and were randomly assigned to one of three situations, including facilitating extraverted behaviors, reinforcing introverted behaviors, and neutral condition (Monson et al., 1982). The authors found a significant interaction effect between the trait of participants and the situations on talkativeness level as well as extraverted behaviors level rated by research assistants. Specifically, extraverts differed more from introverts in the neutral condition than the other two conditions with high situation strength (i.e., forced-extraversion and forced-introversion). Further analysis showed that extraverts did not differ from introverts in talkativeness and extraverted behaviors level in either forced-extraversion or forced-introversion conditions. Withey et al. (2005) tested whether situation strength affected the correlation between personality traits and willingness to put in effort toward organizational change (i.e., provision of effort). They manipulated the situation strength of two scenarios, and all participants were randomly assigned to one scenario. After reading the scenarios, participants were asked to report the possibility of engaging in a variety of behaviors related with provision of effort. The results showed significantly stronger correlations between two traits (i.e., neuroticism and conscientiousness) and provision of effort in weak situation than strong situation.

The situation strength theory has also been applied in organizational sciences to help understand how situation strength moderates the expression of

individual differences (Cooper & Withey, 2009; Meyer et al., 2010). A meta-analysis was conducted to investigate how occupation-level situational strength moderate the relationship between conscientiousness and performance among 114 studies (Meyer, Dalal, & Bonaccio, 2009). The occupation-level situational strength was operationalized as the constraints and consequences of the occupations, two facets in Meyer et al. (2010)'s situation strength model. For example, "airline pilots" were coded as strong occupations while "poets" were considered as weak occupations. Consistent with the situation strength theory, the results revealed stronger correlation between conscientiousness and performance in weak occupations than strong occupations. Furthermore, another study was conducted to develop a scale to measure situational strength of job characteristics and investigate how job-level situation strength moderate the relationship between two traits (i.e., agreeableness and conscientiousness) and voluntary work behaviors (Meyer et al., 2014). Results supported the theory and found that both traits had stronger correlations with organizational citizenship behavior in weak job than strong job.

Despite the supporting evidence presented above, results did not always fit the theory. For example, in one of the aforementioned studies, the correlation between three traits (i.e., extraversion, agreeableness, and openness) and the provision of effort was not moderated by situation strength (Withey et al., 2005). Similarly, another study found that the correlations between two traits (i.e., agreeableness and conscientiousness) and counterproductive work behaviors were stronger in jobs with more constraints than jobs with less constraints (Meyer et al.,

2014). Regarding the mixed findings, one possible explanation is the inconsistent conceptualization of situation strength (Judge & Zapata, 2015), varying from a global level of situation strength to sub-facets of situation strength, as well as different measurement. Another possible explanation is the weak cues related with certain traits involved in the situation, which weakens the moderation effect of situation strength. Thus, the integration of the trait activation theory and situation strength theory may contribute insights to explain the mixed findings. To test how situation strength moderates extraversion expression in word use, a social situation may be necessary.

Overview of the Present Research

In this thesis, four studies were performed to answer the research question about how situation characteristics influence personality expression in word use. In study 1, a meta-analysis was conducted to systematically estimate the overall effect size for the relationships between extraversion and its two linguistic markers (i.e., social process words and positive emotion words) and tested the moderation effect of situation trait relevance (i.e., measured by public vs. private context) and situation strength (i.e., measured by real-life vs. lab setting). Study 2 further investigated how situation trait relevance (i.e., measured by social network density) affects the correlations between extraversion and its two linguistic markers in a naturalistic everyday context (i.e., Facebook status updates). Study 3 was a within-subject lab study manipulating the constraints on three speaking tasks to further examine the moderation effect of situation strength on the relationships between extraversion and word use. Study 4 was a replication study of study 3 and involved

social cues to increase situation trait relevance to further investigate the moderation effect of situation strength. These four studies together contribute to the Person x Situation interactionism theory by specifying how trait relevance and situation strength interact with personality to influence language use, and also advance the theory of personality expression in language by integrating situation characteristics into the model. This work has important implications in improving the performance of personality prediction by using word use.

Chapter II Study 1

In this study, we aim to systematically examine the moderation effect of situation trait relevance (i.e., opportunity for certain trait expression) and situation strength (i.e., constraints imposed on behaviors) on the relationship between extraversion and its two linguistic markers. Thus, we conducted a meta-analysis of published as well as unpublished studies regarding the correlation between extraversion and positive emotion words, and the correlation between extraversion and social process words. We further explored how situation trait relevance and situation strength influence the relationship between extraversion and its two linguistic markers.

First, we focused on public vs. private context, which could be considered as an indicator of trait relevant situation. Extraversion has been long posited as the most visible trait among the big five traits and could be most accurately judged by strangers (Borkenau & Liebler, 1992). Along this perspective, extraversion is considered as a public trait and expected to be better expressed in a public context than private context. For example, Mehl et al. (2012) collected participants' daily conversations and stream-of-consciousness essays and found that the personality-word use associations were highly context-dependent. Specifically, they found that extraversion was related with word count in daily conversations but not in stream-of-consciousness essays. Neuroticism was associated with positive and negative emotion words in stream-of-consciousness essays but not in daily conversations. They proposed that public vs. private could be a moderator. Extraversion, characterized as sociable and talkative, is a prototypic public trait that is the most

observable trait and could be judged most accurately by others (Borkenau & Liebler, 1992; John & Robins, 1993). In contrast, neuroticism is considered as a private trait as it is difficult to be judged by strangers (Borkenau & Liebler, 1992; John & Robins, 1993) and characterized by internal emotional tendency such as anxiety and upset. Thus, extraversion is more likely to be expressed in relatively public (i.e., daily conversations) while neuroticism tends to be expressed in relatively private (i.e., stream-of-consciousness essays). Therefore, we also expect that public vs. private context moderates the associations between extraversion and its two linguistic markers. We consider the situation where the utterance or text is accessible to many people as public context, and the situation where the utterance or text is only accessible to a few people as private context. Specifically, our hypotheses are:

H1: Public vs. private context interacts with extraversion to predict the use of social process words, such that the correlation between extraversion and social process words is stronger in public context than private context.

H2: Public vs. private context interacts with extraversion to predict the use of positive emotion words, such that the correlation between extraversion and positive emotion words is stronger in public context than private context.

Second, we examined the moderation effect of real-life vs. lab setting, which is an indicator of situation strength. Compared with real-life setting, laboratory setting is well-controlled and decontextualized. In the research about personality and word use, laboratory studies tend to restrict the topics of word use

and provide more guidelines while real-life setting only collects people's word use without any restrictions. For example, for laboratory settings, Beukeboom et al. (2013) asked participants to orally describe five photos which depict social situations, while Hirsh and Peterson (2009) asked participants to write essays about six significant past experiences and future goals by answering specific questions (e.g., how each of these experiences influenced their lives and how it came about, plans for overcoming any potential obstacles to achieve goals). However, for real-life setting, researchers collected people's natural word use without restrictions, such as status updates on social media (Gill et al., 2006; Hall & Caton, 2014) and daily language use (Mehl et al., 2006). Therefore, it is reasonable to believe that the lab setting has a stronger strength than the real-life setting at least in studies about personality and word use. Accordingly, we expected that the correlations between extraversion and its two linguistic markers would be stronger in real-life settings than lab setting. Specifically, our hypotheses are:

H3: Real-life vs. lab setting interacts with extraversion to predict the use of social process words, such that the correlation between extraversion and social process words is stronger in the real-life setting than the lab setting.

H4: Real-life vs. lab setting interacts with extraversion to predict the use of positive emotion words, such that the correlation between extraversion and positive emotion words is stronger in the real-life setting than the lab setting.

In this meta-analysis, considering that there are two other software tools (i.e., *Text Analysis and Word Count program* and *Oedipus Text*) using word count

to measure people's word use, we have included them as keywords to do literature search. Text Analysis and Word Count program (TAWC) is an open-source program that can take a predefined dictionary (e.g., LIWC 2007 dictionary) to analyze social media texts (Kramer, 2010; Kramer, Fussell, & Setlock, 2004). It has been used to measure positive and negative emotion in Facebook status updates and has shown their associations with self-reported life satisfaction (Kramer, 2010). Oedipus Text is a software program that counts the percentage of emotional words in texts based on a self-defined dictionary (Levenson, 1992). The dictionary contains around 3,500 emotion words, including positive emotion words (e.g., joy, love, amusement) and negative emotion words (e.g., anger, disgust, guilt). Oedipus Text has been used to measure schizophrenia patients' narratives of their positive and negative emotional life experiences (Gruber & Kring, 2008).

Method

Selection of studies

We used the following criteria to include studies in our meta-analysis: (1) The study needs to measure extraversion and use text analysis tools such as LIWC, TAWC, and Oedipus to analyze language data. (2) The study contains at least one of the correlations (the correlation between extraversion and positive emotion words or the correlation between extraversion and social process words), or relevant data are provided to calculate the correlation. (3) The study uses a validated measure to assess extraversion, such as Big Five Inventory (John, Donahue, & Kentle, 1991), the International Personality Item Pool (Goldberg et al., 2006), BFI-2 (Soto & John, 2017), HEXACO-60 (Ashton & Lee, 2009), and

Eysenck Personality Questionnaire-Revised (Eysenck, Barrett, & Eysenck, 1984). Validated measures means that the validity testing procedure of extraversion scale could be found in a published paper.

Two researchers independently searched multiple databases including PsycARTICLES, PsycINFO, Web of Science, ProQuest Dissertations and Theses, and Google Scholar, using “extraver* AND (LIWC OR TAWC OR Oedipus)” as the search query. These five databases yielded a total of 2,057 articles (ProQuest Dissertations and Theses: 1,054; Google Scholar: 1,000; PsycINFO: 8; Web of Science: 5; PsycARTICLES: 0). Then the two researchers scanned the title and abstract of each article to determine if it met criteria 1. An article was included if at least one researcher considered it to meet criteria 1. The inter-rater agreement was 98.86% for ProQuest Dissertations and Theses, 89.50% for Google Scholar, 75% for PsycINFO, and 80% for Web of Science. There were a total of 172 articles met criteria 1. For articles that meet criteria 1, their full texts were screened using criteria 2 and 3. This resulted in 29 articles. Disagreements during this process were resolved through discussion with a third researcher. Specifically, the third researcher would make the final decision after reading the full-text of the article and discussing with the other two researchers.

Next, we scanned the reference section of the 29 articles to identify additional studies that might meet our inclusion criteria. One additional article was added after this procedure, resulting in a total of 30 articles from literature search. When one dataset was used in multiple articles, we chose to include the article that provided more information. For instance, Kern et al. (2014) and Ates (2014) used

the same MyPersonality dataset, but Kern et al. (2014) provided age, gender, and reliability of extraversion while such information was missing in Ates (2014). Therefore, we chose to include Kern et al. (2014) in our meta-analysis. Mehl (2004) and Mehl et al. (2006) used the same dataset, but only Mehl (2004) provided the correlation between extraversion and social process words. Thus, Mehl (2004) was chosen to be included in our analysis.

After the literature search, we posted this meta-analysis project on Researchgate.com, and added all the twenty articles available to the project to notify their authors about this project so that they could share unpublished data with us. We also emailed the corresponding and first author of these articles to request for unpublished data. Furthermore, we requested for unpublished data by emailing the corresponding and first author of the unselected articles in the 172 articles mentioned above due to the lack of information for the correlation between extraversion and the two word categories. This step resulted in an additional 11 samples being included for analysis.

Study coding

Two researchers independently coded each study according to the following eleven variables: total sample size, correlations between extraversion and its two linguistic markers, publication status, content of language tasks, measurement of extraversion, reliability of extraversion, age, percentage of female participants, public vs. private context, and real life vs. lab setting. Their disagreements were resolved through discussion with a third researcher. Two variables were treated as moderators: public vs. private context, and real life vs. lab setting.

Strategy of data analysis

The Fisher z-Transformation is a common way to transform the sampling distribution of Pearson's r so that it becomes normally distributed. The formula to transform r to a z-score is $z = 0.5[\ln(1+r) - \ln(1-r)]$. Thus, we first converted the correlation coefficients to the Fisher's z score, averaged them, and then transformed them back to the correlation coefficients based on guidelines from Borenstein et al. (2009). We used the metafor R package (Viechtbauer, 2010) to analyze the data by using the random effects model. Publication bias was tested by using funnel plots and regression model (Egger, Smith, Schneider, & Minder, 1997). Heterogeneity was tested using Cochran's Q-test (Hedges & Olkin, 1985).

Results

Descriptive of studies

A total of 37 independent samples from 31 articles were included in our meta-analysis (see Table 1 for a descriptive summary). Among them, 34 samples provided the correlation between extraversion and social process words, and 35 samples provided the correlation between extraversion and positive emotion words. A total of 82,132 participants were involved in these samples. Except one sample with 69,792 participants (Kern et al., 2014), the sample size of the rest samples ranged from 8 to 2,927 ($M = 342.78$, $SD = 539.78$). Age was reported in 31

samples¹ ($M = 27.38$, $SD = 12.82$), and the percentage of female participants was reported in 35 samples² ($M = 59.40\%$, $SD = 16.64\%$).

Overall effect size calculation and publication bias

Participants in four samples (sample 9, 15, 16, and 34 in Table 1) completed two language tasks. For example, Mehl (2004) and Mehl et al. (2012) used the same participants but with two different tasks. Mehl (2004) reported the correlation between extraversion and positive emotion words in daily conversations captured by electronically activated recorder (EAR), while Mehl et al. (2012) reported the same correlation in participants' stream-of-conscious (SOC) essays. These two correlations were dependent, and simultaneously including them into the meta-analysis might lead to an improper estimate of the overall effect size. Thus, following Borenstein et al. (2009), we computed the mean of correlations and included this synthetic score as the unit of analysis when estimating the overall effect size. For example, the correlation between extraversion and positive emotion words for the EAR sample ($r = .05$) and SOC sample ($r = .03$) were averaged, and .04 was included in our estimation of overall effect size for the correlation between extraversion and positive emotion words³.

¹ In some studies, some participants did not indicate their age. The mean of age was estimated based on the reported population.

² In some studies, some participants did not indicate their gender. The percentage of female was estimated based on the reported population.

³ The sample size of Mehl (2004)'s EAR sample is 96 while the one for Mehl et al., (2012)'s SOC sample is 90. When estimating the overall effect size, the sample size of the merged results was treated as 96.

The random effects model (see Figure 1) showed that the mean effect size of the correlation between extraversion and social process words was $r = .08$ (95% $CI [.04, .11]$, $p < .001$), suggesting a positive relationship between extraversion and social process words. The I^2 was 71.01%, showing a moderate heterogeneity (Higgins & Thompson, 2002) and large variation across studies' results. The Cochran's Q-test revealed that there was significant heterogeneity, $Q(33) = 84.91$, $p = .001$. Publication bias was tested by funnel plot (see Figure 2) and Egger's regression model (Egger et al., 1997). The funnel plot showed a slightly asymmetrical pattern. Consistently, the Egger's regression model revealed a significant association between effect sizes and standard errors ($z = 2.09$, $p = .04$), suggesting the presence of publication bias. The trim-and-fill method (Duval & Tweedie, 2000a, 2000b) was used to estimate the number of studies missing from our meta-analysis and the corrected effect size. Results showed that the overall effect size became smaller but remained significant ($r = .06$, 95% $CI [.02, .10]$), $p < .01$), with six studies estimated to be missing on the left side of the funnel plot (see Figure 3).

Similarly, we performed random effects model (see Figure 4) to estimate the average effect size of the correlation between extraversion and positive emotion words, and found a small positive relationship between extraversion and positive emotion words ($r = .07$, 95% $CI [.04, .10]$, $p < .001$). The I^2 was 60.05%, suggesting the effects across studies have moderate heterogeneity. There was significant variability of effect size across studies, $Q(34) = 93.83$, $p < .001$. Publication bias was tested using funnel plot and the Egger test (Egger et al., 1997).

The funnel plot revealed a symmetrical pattern (see Figure 5) and the Egger test showed non-significant effects ($z = -1.28, p = .20$). They indicated that no publication bias was present.

Figure 1. Forest plot of estimating the overall effect size between extraversion and social process words.

Note. RE model = random-effects model.

Figure 2. Funnel plot for the random effects model of the relationship between extraversion and social process words.

Figure 3. Funnel plot for the random effects model of the relationship between extraversion and social process words after using the trim-and-fill method.

Figure 4. Forest plot of estimating the overall effect size between extraversion and positive emotion words.

Note. RE model = random-effects model.

Figure 5. Funnel plot for the random effects model of the relationship between extraversion and positive emotion words.

Moderation effects

As mentioned above, there are four samples using within-subject design where participants completed two different language tasks (sample 9, 15, 16, and 34 in Table 1). Participants in sample 9, 15, and 34 completed two highly similar tasks. For example, participants in sample 9 (Hawkins et al., 2017) reported their recent and important dreams. For these samples, the two moderators were coded the same value for the two language tasks. To avoid inaccurate estimation caused by including dependent data in the analysis, the correlations between extraversion

and its two linguistic markers were averaged across tasks for each of the three samples, as well as their moderators. Different from these samples, participants in sample 16 (Mehl, 2004; Mehl et al., 2012) completed two different language tasks, EAR in Mehl (2004) and SOC in Mehl et al. (2012). Specifically, EAR was in real-life setting while SOC was in laboratory setting. It is not typical to average the scores of real-life vs. lab setting especially when it is categorical variable. Thus, we conducted two rounds of moderator testing when using real-life vs. lab as a moderator, with each round including either EAR or SOC. They generated highly similar results (see Table 2), and we only reported the results including the EAR sample in the following. When using public vs. private context as a moderator, we only conducted one round of moderator testing as both the EAR and SOC were coded as private context and their correlations and public vs. private context coding were averaged across samples.

First, we examined how the two moderators moderate the correlation between extraversion and social process words. Unexpectedly, public vs. private context did not significantly moderate the strength of the relationship between extraversion and social process words, $Q(1) = 2.33, p = .13$. As expected, real-life vs. lab setting showed a marginal significant moderation effect on the correlation between extraversion and social process words, $Q(1) = 3.24, p = .07$. Specifically, the correlation between extraversion and social process words was stronger in real-life setting ($r = .10$) than lab setting ($r = .04$).

Second, we tested how the two moderators influence the relationship between extraversion and positive emotion words. The results showed a significant

moderation effect of public vs. private context, $Q(1) = 10.62, p = .001$. The correlation was stronger in public communication ($r = .12$) than private communication ($r = .04$), consistent with previous findings that extraversion was better expressed in public than private communication (Mehl et al., 2012). The moderation effect of real-life vs. lab setting was also significant, $Q(1) = 5.91, p = .02$, showing a stronger correlation in real-life setting ($r = .11$) than lab setting ($r = .03$).

Table 1. Description of samples characteristics (Study 1).

Sample	Study	N	Age	Percentage of female	Publication status	Language tasks	Extraversion measure(s)	Extraversion reliability
1	Beukeboom et al. (2013)	40	34.40	.48	Journal	Oral description of five photos	FFPI	.93
2	Burdick et al. (2020) 2015 dataset	1353	18.80	.62	Journal	Captions of five pictures expressing yourself	BFI	-
3	Burdick et al. (2020) 2016 dataset	705	19.05	.61	Journal	Captions of five pictures expressing yourself	BFI	-
4	Gill et al. (2006) study 2 e-mail dataset	105	24.30	.65	Journal	E-mail texts to a good friend	Short EPQ-R	-
5	Gill et al. (2006) study 2 blog dataset	71	28.40	.66	Journal	Blog entries	IPIP FFPI	-
6	Golbeck, Robles, Edmondson, & Turner (2011)	50 and 260 ^b	-	.53 ^c	Conference paper	Twitter status updates	BFI-45	-
7	Golbeck, Robles, & Turner (2011)	167	31.20	.53	Conference paper	Facebook profile	BFI-45	-
8	Hall and Caton (2014)	282	-	-	Conference paper	Facebook status updates	BFI	-
9 ^a	Hawkins et al. (2017) recent dream	629	18.93	.54	Journal	Reports about a recent dream	TIPI	-
	Hawkins et al. (2017) important dream					Reports about an important dream		-
10	Hirsh and Peterson (2009)	94	22.00	.77	Journal	Writing assignment about past experiences and future goals	BFAS	-
11	Holtgraves (2011)	224	19.08	.54	Journal	Latest 20 text messages	TDA	-
12	Kahn et al. (2007) study 3	66	-	.79	Journal	Verbalizations about feelings following film clips	BFI	.89
13	Kern et al. (2014)	69,792	23.36	.62	Journal	Facebook status updates	IPIP & NEO-PI-R	.93
14	Krieger (2016)	128	22.15	.60	Thesis	Writing assignment about experiences reflecting socially skilled or not socially	NEO-PI-R	-

						skilled		
15 ^a	Li and Chignell (2010) blog: commentary journal	8	29.00	.25	Journal	Blog entries in commentary journal style	TIPI	-
	Li and Chignell (2010) blog: personal journal					Blog entries in personal journal style		-
16 ^a	Mehl (2004)	96	18.70	.49	Thesis	Daily conversation captured by electronically activated recorder (EAR)	BFI	.90
	Mehl et al. (2012)	90	18.70	.50	Journal	Stream-of-conscious writing tasks (SOC)		.90
17	Morgan (2014)	171	20.73	.61	Thesis	Online 3-people group chatting in a business simulation game	BFI	-
18	Nowson (2006)	71	28.40	.66	Thesis	Personal weblog	IPIP FFPI	-
19	Pennebaker and King (1999)	841	18.70	.58	Journal	Class writing assignment	BFI	-
20	Pereira et al. (2019) adolescents with cancer	10	15.00	.60	Journal	YouTube video narrative about experiences with cancer	TIPI	-
21	Pereira et al. (2019) adolescents without cancer	10	14.90	.60	Journal	YouTube video narrative about experiences with hardship	TIPI	-
22	Pirzadeh and Pfaff (2012)	42	21.10	.10	Conference paper	Online 6-members group chatting in a simulation	NEO PI-R™	-
23	Qiu et al. (2012)	142	26.98	.65	Journal	Twitter status updates	BFI	.83
24	Qiu et al. (2017) sample 1	470	-	.62	Journal	Sina Weibo status updates	BFI	.69
25	Qiu et al. (2017) sample 2	90	22.40	.74	Journal	Sina Weibo status updates	BFI	-
26	Raess (2018)	62	30.84	.53	Thesis	Twitter status updates	TIPI	-
27	Sandy (2013)	942	19.28	.62	Thesis	Chatting with a stranger online	TIPI	.74
28	Sumner et al. (2012)	2927	-	-	Conference paper	Twitter status updates	TIPI	-
29	Sumner et al. (2011)	537	30.00	.67	Conference paper	Last 25 Facebook status updates	BFI	-
30	Tackman et al. (2020) sample 1	183	33.59	.67	Journal	Daily conversation captured by EAR	BFI	.85

31	Tackman et al. (2020) sample 2	52	59.06	.15	Journal	Daily conversation captured by EAR	BFI	.81
32	Tackman et al. (2020) sample 3	120	44.00	.72	Journal	Daily conversation captured by EAR	BFI	.86
33	Tackman et al. (2020) sample 4	107	76.04	.54	Journal	Daily conversation captured by EAR	TIPI	.72
34 ^a	Tassone (2015) study 3 online action	185	19.95	1.00	Thesis	Writing of reasons about opinions towards four online actions	BFI	.86
	Tassone (2015) study 3 offline action					Writing of reasons about opinions towards four offline actions		.86
35	Tighe and Cheng (2018)	250	22.34	.68	Conference paper	Twitter status updates	BFI	.82
36	Williams et al. (2003)	206	-	.63	Conference paper	One-page free description of reactions to the 9/11 attacks	BFI	-
37	Yarkoni (2010)	694	36.20	.76	Journal	Blog status updates	NEO PI-R™ & IPIP-300	-

Note. **BFI-45** = 45-question version of the Big Five Personality Inventory (John, 1999); **BFAS** = Big Five Aspect Scales (DeYoung, Quilty, & Peterson, 2007); **BFI** = Big Five Inventory; **FFPI** = The Five-Factor Personality Inventory (Hendriks, Hofstee, De Raad, & Angleitner, 1995); **IPIP** = International Personality Item Pool (www.ipip.ori.org; Goldberg, 1999; Goldberg et al., 2006); **IPIP FFPI** = International Personality Item Pool Five Factor Personality Inventory (Buchanan, 2001); **IPIP-300** = 300-item IPIP representation of the NEO-PI-R; **NEO PI-R™** = 50-item IPIP (Goldberg et al, 2006); **NEO-PI-R** = NEO personality inventory (Costa & McCrae, 1992) (240-item); **Short EPQ-R** = Eysenck Personality Questionnaire-Revised short version (Eysenck et al., 1985); **TDA** = 100-item measure using trait descriptive adjectives (Goldberg, 1992); **TIPI** = Ten Item Personality Inventory (Gosling, Rentfrow, & Swann, 2003).

^a Each participant completed two language tasks.

^b The sample size reported for the correlation between extraversion and social process words is 50 while that for the correlation between extraversion and positive emotion words is 260.

^c The percentage of female participants was reported for the sample with 260 participants but not for the sample with 50 participants.

Table 2. Number of effect size (*k*), correlation (*r*), 95% confidence interval (95% *CI*), and significance of moderator analysis (moderator).

Variables	association between extraversion and social process words				association between extraversion and positive emotion words			
	<i>k</i>	<i>r</i>	95% <i>CI</i>	moderator	<i>k</i>	<i>r</i>	95% <i>CI</i>	moderator
public vs. private context	34			ns	35			sig
public context	16	.10	[.06, .15]	REF	16	.12	[.10, .14]	REF
private context	18	.05	[.01, .10]		19	.04	[-.001, .07]	
real-life vs. lab setting	34			marginally sig	35			sig
real-life setting	19 (18)	.10 (.10)	[.06, .14] [.06, .15]	REF	19 (18)	.11 (.11)	[.08, .13] [.09, .13]	REF
lab setting	15 (16)	.04 (.04)	[.001, .08] [.01, .08]		16 (17)	.03 (.03)	[-.01, .08] [-.01, .08]	

Note. Two rounds of moderation testing of real-life vs. lab setting showed very similar results. The mean correlation for the level of the moderators were presented separately for the two rounds. Specifically, the results including Mehl (2004)'s EAR sample were shown without parentheses while the results including Mehl (2012)'s SOC sample were presented in parentheses.

ns=non-significant, $p > .10$; marginally sig = marginally significant, $p = .07$; sig = significant, $p < .05$; REF = reference category.

Discussion

Our meta-analysis found that extraversion is related to the use of social process words ($r = .06$) and positive emotion words ($r = .07$), suggesting small effect sizes similar to those found in previous meta-analysis on the linguistic markers of individual differences (Holtzman et al., 2019; Tackman et al., 2018). These findings are consistent with the conceptualization of extraversion as a trait that reflects the tendency to experience positive emotion and engage in social interactions (Harari et al., 2019; Waton & Clark, 1997). In addition, our moderator analyses demonstrate that the relationship between extraversion and use of positive emotion words is situation dependent. Fitting with the trait activation theory that traits could be expressed better in trait-relevant situations (Tett & Guterman, 2000), extraversion, as a public trait, showed stronger correlations with positive emotion words in public context than private context. In line with the situation strength theory that traits could be expressed better in weaker situation than stronger situation (Cooper & Withey, 2009), our results revealed stronger correlation between extraversion and positive emotion words in real-life than laboratory setting. These results generally highlight the importance of situation in personality expression in language, and support theories about how situation trait relevance and situation strength can influence personality expression in language.

It is worth noting that the magnitude of the two linguistic correlates of extraversion is small. There are several possibilities. Firstly, the small correlations

might be due to the limitation of LIWC itself. LIWC mainly uses word count method to categorize words and may overlook higher-order (e.g., sentence, paragraph) semantic structure (Hirsh & Peterson, 2009), which could lower the accuracy of LIWC in measuring people's internal status and lead to the small correlation. Secondly, the small magnitude may be due to the extraversion measurement itself. We focus on the whole trait of extraversion in this study while correlate it with more specific types of word categories (i.e., social process words and positive emotion words). According to BFI-2 (Soto & John, 2017), extraversion can be divided into three facets, including sociability, assertiveness, and energy. It is possible that more nuanced investigation between subfactors and word use can increase the magnitude (Hall & Matz, 2020). The last possibility is that the relationship between extraversion and word use is indeed small. However, a small effect size is also important especially in the era of big data (Matz, Gladstone, & Stillwell, 2017). As word use has been widely used in personality prediction, a reliable linguistic marker of personality with small predictive effect can achieve more accurate personality prediction thus affecting a large amount of people's life. For example, a 0.5% increase in personality prediction accuracy in 100 million people can have huge social impact on 0.5 million people's life.

As expected, the correlations between extraversion and use of positive emotion words were stronger in public than private context and stronger in real-life than lab setting. This finding highlighted the important role of trait relevance and

situation strength in the relationship between personality and word use and provided insights into how personality expression in word use depends on the situations. However, this study revealed that the relationship between extraversion and use of social process words was neither affected by public vs. private context nor real-life vs. lab setting, which is against our hypotheses. One reason could be due to the limited number of studies involved and small interaction effect between situation and personality on word use. As found in this study, the correlations between extraversion and the two word categories varied from .04 to .12 in the four situations we investigated, suggesting a small moderation effect of situation. Given that the total number of studies was only 37, it may lack enough power to detect the interaction effect between situation and extraversion on word use. Another possibility is that social process words is a relatively robust and situation independent linguistic marker of extraversion, reflecting extraverts' general tendency to persevere about social relationships and activities (Argyle & Lu, 1990; Oerlemans & Bakker, 2014). However, this speculation may be less likely because real-life vs. lab setting marginally significantly moderated the relationship between extraversion and use of social process words.

Chapter III Study 2

Study 1 has provided preliminary evidence regarding the moderation effect of trait relevance on the relationships between extraversion and word use. In study 2, we used naturalistic language data from Facebook to further examine the effect of trait relevance. Specifically, study 2 focused on how situation sociality, the characteristic representing how much a situation involves social interactions and relationship development, moderates the expression of extraversion in word use. Importantly, sociality is one type of situation trait relevance allowing us to assess the variability of situational trait relevance in a real-life setting. In addition, characterized by social cues within a situation, situation sociality maps closely onto extraversion (Sherman, Rauthmann, Brown, Serfass, & Jones, 2015), allowing us to test how social cues activate and affect the expression of extraversion.

Situation sociality is an important situation dimension identified in the DIAMONDS situational models (Rauthmann et al., 2014), revealing how much social interaction and relationship formation in the situation. It has been consistently identified in different situation taxonomies (Ten Berge & De Raad, 2002; Van Heck, 1984, 1989). Developed based on the lexical method, a study included all possible nouns that could be used to describe a situation, and the results classified them into ten dimensions of situation (Van Heck, 1984, 1989). Intimacy and interpersonal relations situation was identified as one of ten

dimensions. Another study collected situation descriptions that could reflect personality traits and asked participants and their friends to rate to what extent the participants could deal with that situation (Ten Berge & De Raad, 2002). The factor analysis yielded a 4-factor model of situation, and situation of social demand was one of the identified factors. Examples of items measuring social demand are “Being at a social gathering” and “Doing the talking”. The consistent findings revealed that situation sociality is probably a basic dimension of situation characteristics, and existing studies also suggested that social situation plays important roles in affecting people’s emotion, behaviors, and cognition (Mueller et al., 2019). Thus, it is worthwhile to investigate how it affects personality expression in language as well given the significance of social situation.

Several studies have investigated how situation sociality moderates the personality expression in actual behaviors. One study measured participants’ self-reported personality and used experience sampling methods to survey their real-time situation perception and self-reported behaviors and feelings (e.g., how sociable they are) eight times each day over one week, and found that situation sociality interacted with extraversion to predict self-reported sociable level (Sherman et al., 2015). Another study collected participants’ overall extraversion score and used event-based experience sampling methods to ask participants to report at least 10 times per week about their situation information based on a list of 17 situation categories (e.g., partying), and self-reported as well as partner-rated

sociable behaviors in that situation over 5-week period (Breil et al., 2019). The sociality level of 17 situation categories was rated by research assistants independently, and the results suggested a significant interaction effect of extraversion and situation sociality on self-reported sociable behaviors (Breil et al., 2019). Further analysis showed that the association between extraversion and self-reported sociable behaviors was stronger in more social situation than less social situation (Breil et al., 2019). However, situation sociality did not interact with extraversion to predict partner-rated sociable behaviors (Breil et al., 2019). Overall, these findings imply that situation sociality may contribute to the variety of correlations between extraversion and its linguistic markers and could be further investigated in this study.

To respond to the call for more naturalistic data of personality research (Funder, 2001), this study used a large sample of Facebook users' status updates as our language sample and social network density as a measure of situation sociality. On Facebook, users' social network contains people ranging from close friends to mere acquaintances. Users usually make their status updates available to their whole social network rather than to a particular group of individuals. An important characteristic of social network is network density. Social network density reflects the closeness level as well as the social interaction frequencies among network members (Burt, 2000). Members within a dense social network tend to be closely connected and familiar (Burt, 2000; Hogan, 2009), have higher possibility to gain

social support (Skowronski, Gibbons, Vogl, & Walker, 2004) and receive help from each other (Walker, Wasserman, & Wellman, 1993). In contrast, members within a sparse social network are less likely to be close to each other (Burt, 2000). Given that social network density reflects the strength of interpersonal relationships and familiarity (Hogan, 2009) as well as the amount of support and trust one may receive from others (Kilburn, 2011; Lin, 1999), it can be a proximate measure of how likely one may trigger social interactions and strengthen interpersonal relationships with other members within the network when posting a status update. In line with the opinion by Schmälzle et al. (2017), members in a dense network are more close-knit and more likely to stimulate social interactions, communication, and sharing. Thus, the denser the social network is, the higher the situation sociality is. Past research has also considered social company (e.g., with friends or family members) as a situational factor in the study of how traits and situations affect behaviors in daily life (e.g., Wilt & Revelle, 2019). We expect that this situation characteristic influences the expression of extraversion because it is concerned with social activities and interpersonal relationship.

Extraversion is a trait that represents the dispositional tendency to be interested in social interactions and experience positive emotions (Costa & McCrae, 1992; Eysenck, 1981; Lucas et al., 2000; Tobin et al., 2000). Extraverts have been found to be more likely to participate in and enjoy social activities than introverts (Ashton, Lee, & Paunonen, 2002). Therefore, in situations that are high in sociality,

extraverts are more likely to behave socially and take part in social interactions as well as experience more positive feelings. Given that the use of social words reflects people's social concerns and intentions while the use of positive emotion words reflects people's positive feelings, it is likely that extraverts would use more social words and more positive emotion words in situations with high sociality. Therefore, we hypothesized that situation sociality will moderate the relationship between extraversion and the use of social process words as well as positive emotion words, such that the relationship between extraversion and the use of social words as well as positive emotion words will be stronger in situations with high (vs. low) sociality. Specifically, our hypotheses are:

H1: Social network density interacts with extraversion to predict the use of social process words, such that the correlation between extraversion and social process words is stronger in high network density than low network density.

H2: Social network density interacts with extraversion to predict the use of positive emotion words, such that the correlation between extraversion and positive emotion words is stronger in high network density than low network density.

Method

Participants

MyPersonality is an application developed by David Stillwell and Michal Kosinski to provide a list of psychometric tests such as Big Five personality to volunteer participants and offer participants immediate feedback on their results. In addition, participants could choose to share their Facebook information with researchers. This project has lasted for six years from 2007 to 2012 and obtained data from around six million Facebook users. Benefiting from the large amount of real-life digital data and data sharing among researchers, *MyPersonality* dataset has been used in more than 100 papers and answered important research questions in social sciences (Liu, Chan, Qiu, Tov, & Tong, 2018; Saef, Woo, Carpenter, & Tay, 2018; Youyou, Stillwell, Schwartz, & Kosinski, 2017). For example, based on a subsample of *MyPersonality* project, one study revealed that Facebook Likes could be used to accurately predict participants' traits and private attributes like sexual orientation (Kosinski, Stillwell, & Graepel, 2013), while another study successfully used an open-vocabulary tool to assess participants' big five personality via participants' Facebook status updates (Park et al., 2015).

Our sample was a subset of participants in the *MyPersonality* project (Kosinski, Matz, Gosling, Popov, & Stillwell, 2015) who had granted researchers access to their Facebook status updates and social network information (e.g., the total number of Facebook friends and connections between friends) and completed

measures of personality traits. This resulted in a sample of 27,235 users (10,896 male, 16,172 female, and 167 without gender indication). A total of 27,058 participants indicated their age ($M = 26.20$, $SD = 9.99$).

Focal Variables

Extraversion. All participants completed personality measures obtained from the International Personality Item Pool (IPIP; Goldberg et al., 2006) ranging from 20-item to 100-item scales (in intervals of ten). All items were rated on a five-point Likert scale (1 = Disagree to 5=Agree). The reliability score for extraversion was .94 in 100-item version, which was completed by 6,766 participants. A large sample of participants ($N=16,895$) completed 20-item version, and the reliability score for extraversion was .65. The remaining participants completed personality measures with varying items (from 30 to 90 items), and the reliability of extraversion ranged from .77 to .92. Details regarding the reliability scores could be found in the Appendix.

Social network density. Network density is computed by dividing the total number of existing connections over all potential connections (Borgatti, Jones, & Everett, 1998). The network density value approaching '0' suggests a sparse network where few members connect to each other while '1' represents a dense

network where members are connected to each other. The range of social network density in this study is from .001 to .951 ($M = .05$, $SD = .09$)⁴.

Social process words and positive emotion words. LIWC was used to analyze participants' status updates and calculate the frequency of social process words and positive emotion words. Social process words include all personal pronouns (e.g., we, they) except "I" and verbs that suggest human interaction (e.g., talk, share, and listen). Positive emotion words consist of words related with positive emotion (e.g., love, sweet). In this study, social process words ranged from .00 to 44.59 ($M = 6.08$, $SD = 2.64$) while positive emotion words ranged from .00 to 25.00 ($M = 3.83$, $SD = 1.63$).

Social network size. Social network size is the total number of friends one has on Facebook. In this study, social network size varied from 22 to 2,000 ($M = 309.09$, $SD = 272.43$). It is used as a control variable because of its association with personality (Gosling, Augustine, Vazire, Holtzman, & Gaddis, 2011) and emotional expression on Facebook (Lin, Tov, & Qiu, 2014).

Results

shows the mean, standard deviation, and correlations across all variables involved in this study. Consistent with previous studies, extraversion was found to

⁴ Due to skewness of network density (skewness = 5.08) and network size (skewness = 1.76), we conducted additional analysis by using square root of social network density and network size in the regression to test our two hypotheses. The results revealed the same patterns.

be positively correlated with the use of social process words ($r = .06, p < .001$) and positive emotion words ($r = .09, p < .001$). Interestingly, although extraversion was associated with larger social networks, those networks tended to be somewhat looser. Overall, network size was inversely related to network density ($r = -.36, p < .001$).

Table 3. Correlations and descriptive data across variables ($N = 27,235$).

	Mean	SD	1	2	3	4	5
1. Extraversion	3.55	.81	-				
2. Social network density	.05	.09	-.05*	-			
3. Social network size	309.09	272.43	.20*	-.36*	-		
4. Social process words	6.08	2.64	.06*	-.002	.01	-	
5. Positive emotion words	3.83	1.63	.09*	-.004	.003	.48*	-

Note. * $p < .001$, two tailed.

Multiple linear regressions were conducted using PROCESS (Hayes, 2017) to examine the moderation effect of social network density on the relationship between extraversion and word use after controlling social network size. In the analysis, the predictors were centered prior to computing the interaction term.

Moderating Effects of Social Network Density

First, we conducted a multiple linear regression with four predictors: extraversion, social network density, the resulting interaction term (extraversion *

social network density), and social network size (as a covariate), and social process words as the outcome variable (see Table 4). Results showed that the interaction of extraversion and social network density significantly predicted the use of social process words ($b = .50, p = .02$). In Figure 6, we plotted the simple slopes of extraversion at different levels of social density⁵. Simple slopes analyses revealed that extraversion was associated with greater use of social process words even among the most loosely connected networks (density = 0). This tendency increased as social density increased (+1 SD). We also tested the simple slope of social density at high and low levels of extraversion. Introverts in low density networks tended to use more social words than those in higher density networks ($b = -.46, p = .09$). However, the use of social process words did not differ between extraverts in low vs higher density networks ($b = .34, p = .15$).

We repeated the moderator analysis with positive emotion words as the outcome variable (see Table 5). Results showed that the interaction of extraversion and social network density significantly predicted the use of positive emotion words ($b = .39, p = .004$). Similarly, simple slopes analyses (see Figure 7) suggested that extraversion was positively related to use of positive emotion words

⁵ We define “low density” as a density of zero; the minimum possible value was selected because one SD below the mean fell outside of the scale range. We define “higher density” as a density of .15—one SD above the mean. We use the term “higher density” instead of “high density” because a value of .15 may not be considered high in the absolute sense (given the scale range of 0 to 1).

in the most loosely connected networks (density = 0), This correlation became stronger as social density increased (+1SD). The simple slope of social density at high and low levels of extraversion was tested as well. The results showed that introverts tended to use more positive emotion words in low density networks than those in higher density networks ($b = -.46, p = .006$), while extraverts used similar frequency of positive emotion words in low and higher density networks ($b = .17, p = .25$).

Given that age and gender may affect people's word use, the two regressions were repeated after adding age and gender as control variables. The results remained the same, and details could be found in the Appendix (i.e., Table B2.1, B2.2, B3.1, and B3.2).

Table 4. Moderated regression analyses of extraversion and social network density on social process words after controlling social network size ($N = 27,235$).

	Social process words				
	<i>B</i>	<i>SE B</i>	<i>t</i>	<i>p</i>	<i>CI</i>
constant	6.08	.02	379.97	<.001	(6.05, 6.11)
extraversion	.20	.02	9.91	<.001	(.16, .24)
social network density	-.06	.18	-.32	.75	(-.42, .30)
extraversion * social network density	.50	.22	2.26	.03	(.07, .93)
social network size	.00	.0001	-.67	.50	(-.0002, .0001)

Note. CI = 95% confidence intervals.

Figure 6. Interaction effect of extraversion and social network density on social process words after controlling for social network size. The 95% confidence intervals of slope β : low density (density=0), [.13, .22]; higher density (+1SD), [.19, .30].

Table 5. Moderated regression analyses of extraversion and social network density on positive emotion words after controlling social network size ($N = 27,235$).

	Positive emotion words				
	<i>B</i>	<i>SE B</i>	<i>t</i>	<i>p</i>	<i>CI</i>
constant	3.83	.01	389.66	<.001	(3.81, 3.85)
extraversion	.18	.01	14.24	<.001	(.15, .20)
social network density	-.15	.11	-1.32	.19	(-.37, .07)
extraversion * social network density	.39	.14	2.89	.004	(.13, .66)
social network size	-.0001	.00	-2.62	.01	(-.0002, .00)

Note. CI = 95% confidence intervals.

Figure 7. Interaction effect of extraversion and social network density on positive emotion words after controlling for social network size. The 95% confidence intervals of slope β : low density (density=0), [.13, .19]; higher density (+1SD), [.18, .25].

Moderating Effect of Network Size

Table 3 showed that social network size is significantly negatively correlated with social network density ($r = -.36$). In addition, social network size has been found to be related with need for impression management (Lin et al., 2014). Taken together, it is possible that impression management may play a role in affecting the relationship between extraversion and word use. Although we have considered network size as control variable in our analysis testing the moderation effect of network density, we would also like to further explore whether social network size also play an important role in the extraversion expression and rule out

the possible influence of impression management. Thus, we examined whether network size moderate extraversion expression in word use (i.e., positive emotion words and social process words) in the following analysis as well. Two multiple regressions were conducted, and density was included as a covariate.

The results showed that extraversion interacted with social network size to predict use of positive emotion words ($b = -.0001, p = .01$). Simple slope analysis revealed that association between extraversion and positive emotion word use was stronger in smaller networks ($-1SD; b = .21, p < .001$) than larger networks ($+1SD; b = .14, p < .001$). However, given that the coefficient of the interaction term is near zero ($b = -.0001$), the effect was too trivial to be meaningful. No other moderating effects of network size were observed.

Discussion

Past literature has shown the importance of situation trait relevance in the relationship between personality and trait-corresponding behaviors. In this study, we examined how situation sociality, measured by social network density, moderates extraversion expression in word use. On the one hand, in alignment with the tendency of extraverts to engage in social interactions and experience positive emotions, we found that extraversion positively predicted the use of social process words and positive emotion words. On the other hand, consistent with our expectation, our results showed that people were more likely to express their personality in the context where there is a higher possibility of social interaction as

suggested by greater social network density. In particular, the connections between extraversion and positive emotion/social process words were stronger in social networks with higher density. These findings provided important evidence to further establish the moderation effect of situation trait relevance on the relationships between extraversion and its linguistic markers.

In this study, we expected that the interaction effect between social network density and extraversion on word use was mainly driven by extraverts because extraverts are more likely to behave socially and experience more positive feelings in situations that are high in sociality. Surprisingly, the results revealed that the interaction effect was mainly driven by introverts, showing that introverts in high social network density tend to use more social process/positive emotion words than those in low social network density. This unexpected finding might be attributed to the online behaviors. Previous studies have showed that introverts tended to manipulate their Facebook to appear more extraverted than they were offline and strive to become more popular online (Zywica & Danowski, 2008). Thus, it is possible that introverts tend to use more impression management strategy (i.e., use more social process/positive emotion words) to appear extraverted especially in front of strangers (i.e., low network density). More studies should be conducted on this line to further confirm this speculation.

Chapter IV Study 3

Both study 1 and study 2 provided empirical evidence highlighting the importance of situation trait relevance, including public vs. private situation or social network density. Besides situation trait relevance, situation strength is another important factor affecting personality expression in word use. Study 1 has provided some preliminary evidence showing that the associations between extraversion and its two linguistic markers are stronger in weaker situation (i.e., real-life setting) compared with stronger situation (i.e., laboratory). However, study 1 did not directly manipulate the situation strength, and it is necessary to conduct an experiment to further establish the moderation effect of situation strength on the relationships between personality and word use.

In study 3, we aimed to investigate how situation strength moderates the expression of extraversion in word use. In our study design, the situation strength was manipulated by the various level of constraints on different language tasks. That is, the stronger the constraints are, the more restricted the topic is and the clearer the guideline is. Importantly, recent studies revealed that LIWC emotional words failed to predict self-reported emotions on Facebook status updates and spoken language (Kross et al., 2019; Sun et al., 2019). Thus, in this study we focused on human coding of extraverted behaviors expressed via the language use while at the same time we used LIWC to analyze word use.

According to the situation strength theory, we hypothesized that the expression of extraversion in human-coded extraverted behaviors or word use is stronger in weaker situation than stronger situation. Specifically, our hypotheses are:

H1: Situation strength interacts with extraversion to predict extraverted behaviors, such that the correlation between extraversion and extraverted behaviors is stronger in weaker situation than stronger situation.

H2: Situation strength interacts with extraversion to predict the use of social process/ positive emotion words, such that the correlation between extraversion social process/ positive emotion words is stronger in weaker situation than stronger situation.

Method

Participants

Institution review board from Nanyang Technology University has approved our study (IRB code: PSY-IRB-2019-026). It is difficult to calculate the sample size needed for multilevel analyses. Considering that within-subject design has greater statistical power than between-subject design, we used a traditional power analysis for multiple regression model to estimate the minimum sample size required for study 3. Based on the studies about how personality interacts with situation to predict behaviors (Sherman et al., 2015), the R^2 for the full model will

be 0.40, and the interaction effect will contribute 0.10 to R^2 , resulting an effect size of Cohen's f^2 0.14. A power analysis for multiple regression model with five predictor was conducted by G*Power 3.1 (Faul, Erdfelder, Buchner, & Lang, 2009) with a corrected alpha of 0.025, a power of 0.80, and an effect size of 0.14. The results showed that 73 participants are needed.

In this study, we recruited Singaporean participants from NTU via mass email, and each participant received SGD\$5 for their participation. Ninety-one participants (Females =59, males =32) were included in the final sample with an average age of 21.43 ($SD = 1.86$). There were 78 ethnic Chinese (85.7%), 7 ethnic Malay (7.7%), 3 ethnic Indian (3.3%), and 3 other ethnicities (3.3%).

Speaking Tasks

As shown in previous studies, situation strength was manipulated through changing the probability that an individual will exhibit a particular response. For example, Withey et al. (2005) created two scenarios with strong or weak situation strength by providing various cues to convey clear or ambiguous expectations of behavioral response (i.e., leave the organization if unsatisfied with the workplace or not sure leave or not). Similarly, in study 3, we tried to manipulate situation strength by providing various cues to guide clear or ambiguous language use. In our manipulation, we considered that topic is one of the important factors to affect people's language use. The broader the topic is, the more variances the language

use has. In addition, the structure of the language use could also restrict the language use variances. Thus, we also changed the guideline to manipulate situation strength in this study.

The stronger situation was manipulated by providing more constraints (i.e., clearer guidelines and more restricted topic) upon the responses, while the weaker situation was designed by less constraints (i.e., more ambiguous guidelines and less restricted topic). Specifically, the self-introduction task was designed to be the situation with the weakest situation strength with the least restricted topic and most ambiguous guideline, while the storytelling task was designed to be the strongest situation with the most restricted topic and least ambiguous guideline. Hobby-telling ranked second to be the moderate situation with moderately restricted topic and ambiguous guideline.

Procedure

Participants were required to come to a lab and complete their speaking tasks in a room alone. A recorder was used to record their speeches. Each participant was told that he/she will complete three speaking tasks and fill in a survey. Instructions of the three speaking tasks (see Appendix) were displayed via Qualtrics. Specifically, the three speaking tasks were shown in order, including 1) introducing yourself, 2) telling hobbies, and 3) telling a complete story based on each of two pictures. The two pictures were displayed in random order.

Participants had 2 minutes to complete each speaking task. Once the participant informed the experimenter that he/she has completed the speaking tasks, the participant was directed to sit in front of a computer to complete an online survey, which measured their personality traits and demographics variables including age, gender, and ethnicity.

All speeches were transcribed to text by research assistants. Then each transcription was divided into four parts, including self-introduction, hobby-telling, two stories based on the two pictures. Each part was saved as an independent document and analyzed by LIWC separately. To code their behaviors, each audio file was split into four audio files as well. Ninety-one recordings of each task for each participant were listened and rated by four independent research assistants by using trait-related behaviors scales.

Measures

Extraversion. The Big Five Personality Inventory (BFI; John, Donahue, & Kentle, 1991) was used to measure participants' extraversion. Participants were asked to report their agreement with each item on a 5-point scale from 1(disagree strongly) to 5(agree strongly). The scale reached good reliability with Cronbach's alpha of .89. Scores for extraversion were calculated by averaging relevant items.

LIWC2015. LIWC2015 (Pennebaker et al., 2015) was used to calculate the word frequency of specific word categories, namely social process words and positive emotion words.

Trait-relevant behaviors and state expressions. Twenty items (i.e., 4 items for each Big Five trait-related behaviors) from the Riverside Behavioral Q-Sort (RBQ 3.0; Funder, Furr, & Colvin, 2000) were selected to represent trait-related behaviors based on the conceptual considerations and previous findings (Rauthmann et al., 2014), and they have been found to show good reliability (Rauthmann et al., 2014). Behaviors of participants in each audio file was coded using a 9-point Likert-type scale from 0 (not at all) to 8 (completely). Items measuring extraverted behaviors include “Exhibiting high enthusiasm and energy level”, “Being talkative”, “Being expressive in voice”, and “Behaving in a cheerful manner”. The score of extraverted behavior was calculated by averaging the scores of these items, and they showed good reliability (Cronbach’s $\alpha = .96, .92, .96$ in the self-introduction task, hobby-telling task, storytelling task, respectively). The rest 16 items measuring agreeable, conscientious, neurotic, and open behaviors, respectively. Full items can be found in the appendix. In addition, seven items measuring trait-related state expressions were used to measure speakers’ state expressed via the language use (Sherman et al., 2015). These items were rated on 7-point bipolar scale. For example, the sociality was measured by “outgoing, sociable – reserved, quiet”, where 1 refers to outgoing and sociable while 7

suggests reserved and quiet. Similarly, happiness was measured by “happy, positive – sad, negative”. Full items could be found in the appendix as well. The interrater reliability of 20 RBQ items and 7 trait-related state expressions items was showed in the Appendix Table C1 and C2. The coding for each recoding was aggregated across raters to form a composite rating of an item measuring behaviors.

Results

Merging results of two storytelling parts

Given that the two storytelling parts are highly similar in structure (i.e., topic and guidelines), they are considered as one task in this study. The results of LIWC and human-coded trait-relevant behaviors were computed by averaging them across these two parts. We conducted a paired t-test to see if there are any differences between the two parts regarding the situation strength. Following the methods used in previous studies (Keeler, Kong, Dalal, & Cortina, 2019), the variances of dependent behaviors/states in a specific situation were considered as a reflection of situation strength. The stronger the situation is, the more people tend to perform similarly, thus the smaller the variances of dependent behaviors/states are. Thus, the variances of selected trait-relevant behaviors and states were compared. According to previous studies, interrater reliability can be considered as acceptable when it reaches 0.40 (McHugh, 2012). Thus, we only selected behaviors and states with interrater reliability higher than .40 across the two parts, which resulted 15 items. The variances of selected 5 trait-related state expressions items

were calculated after converting the raw score from 7-point scale to 9-point scale. The results showed non-significant differences between the behavioral variances of the two parts ($differences = .20$, $t(14) = 2.07$, $p = .06$), supporting our argument that these two parts should be merged as one task.

Descriptive results

Table 6 shows the overall correlations among key variables across three tasks in this study. The results showed that extraversion was positively correlated with extraverted behaviors ($r = .27$, $p < .01$), sociable state ($r = .26$, $p < .05$) and positive state ($r = .32$, $p < .01$). However, extraversion was not related with social process words ($r = .02$, $p = .87$) or positive emotion words ($r = .003$, $p = .97$). Extraverted behaviors were found to be highly correlated with sociable state ($r = .92$, $p < .001$) and positive state ($r = .82$, $p < .001$), suggesting that the measure of extraverted behaviors concerns about people's sociable and positive emotion status. In addition, social process words or positive emotion words were unrelated with their corresponding human-coded status ($rs = -.07$ and $.04$, $ps > .50$), suggesting that LIWC may fail to capture people's inner status in oral communications.

Table 6. Descriptive statistics and intercorrelations among variables (Study 3).

	Mean	SD	1	2	3	4	5	6
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1. Extraversion	2.75	.85	1.00					
2. Social process words	8.89	2.04	.02	1.00				
3. Positive emotion words	4.50	1.53	.003	.02	1.00			
4. Extraverted behaviors	3.72	.97	.27*	-.10	-.01	1.00		
5. Reserved, quiet – Outgoing, sociable	3.83	1.15	.26*	-.07	-.01	.92***	1.00	
6. Sad, negative – Happy, positive	4.37	.72	.32**	-.03	.04	.87***	.82***	1.00

Note. $N = 91$. The correlation was conducted based on between-subject level.

* $p < .05$, ** $p < .01$, *** $p < .001$, two tailed.

Manipulation check

As mentioned above, the variances of dependent behaviors/states under certain situation could be treated as a reflection of situation strength (Keeler, Kong, Dalal, & Cortina, 2019). In our manipulation check, repeated measures were conducted to test differences of behavioral variances across the three tasks. Only the behavioral items with interrater reliability higher than .40 across all tasks were selected, which resulted in 11 items. The repeated measure revealed significant differences among the three tasks ($F(2, 20) = 29.48, p < .001$). Specifically, self-introduction showed highest variances in word use ($M = 2.22$), hobby-telling task ranked second ($M = 1.56$), and storytelling task had the lowest variances ($M = 1.19$), Bonferroni adjusted $ps < .01$. The results implied that the situation strength of self-introduction is the weakest, followed by hobby-telling and storytelling ranked second and third. According to the results, our manipulation of situation strength is successful.

Moderation effect of tasks on extraversion expression in extraverted behaviors

The Linear mixed-effect models with random intercept were used to test the interaction effect of tasks (i.e., within-subject) and extraversion (i.e., between-subject) on human-coded extraverted behaviors⁶. In this model, extraversion was centered by subtracting its grand-mean. The analyses were conducted in R by using the lmerTest package (Kuznetsova, Brockhoff, & Christensen, 2017). Self-introduction task was considered as the reference group compared with hobby-telling and storytelling task.

The intraclass correlation coefficient (ICC) was .57 for the model of extraverted behaviors. The results showed that extraversion significantly predicted extraverted behaviors, $F(1, 91) = 7.04, p = .01$. Tasks also significantly predicted extraverted behaviors, $F(2, 182) = 4.42, p = .01$. However, the interaction effect between extraversion and tasks was not significant, $F(2, 182) = 1.31, p = .27$. Post hoc analysis of the main effect of tasks showed participants behaved more extraverted via language in the hobby-telling task ($M = 3.87$) than self-introduction task ($M = 3.56$), $p = .01$. There were no differences in extraverted behaviors

⁶ People might be interested in how the situation strength affects the relationships between extraversion and sociable state and positive state, respectively. We conducted another two linear mixed-effect models by using the human-coded sociable state and positive state as dependent variable as well. The results revealed similar patterns. Details could be found in the Appendix.

between self-introduction task and storytelling task ($M = 3.75$), and storytelling task and hobby-telling task, $ps > .05$.

Given that age, gender, and ethnicity may affect language use, the same analysis was conducted after adding them as control variables. The result remained the same, and the interaction effect between extraversion and tasks did not significantly predict extraverted behaviors, $F(2, 182) = 1.31, p = .27$.

Moderation effect of tasks on personality expression in word use

Similar to the model conducted above, two linear mixed-effects models were conducted to test the moderation effects of tasks on the relationships between extraversion and social process words and positive emotion words. In these two models, traits were centered by subtracting their grand-mean respectively. Again, the analyses were conducted in R by using the lmerTest package (Kuznetsova, Brockhoff, & Christensen, 2017). Self-introduction task was considered as the reference group compared with hobby-telling and storytelling task.

The ICCs for social process words and positive emotion words were .04 and .29 respectively for the two models related to extraversion. For the analysis of interaction between extraversion and tasks on social words, the results showed that tasks significantly predicted use of social words, $F(2, 182) = 210.34, p < .001$. However, neither the interaction between tasks and extraversion ($F(2, 182) = 1.22$,

$p = .30$) nor extraversion itself ($F(1, 91) = .03, p = .87$) predicted the use of social process words. Post hoc analysis showed that at the mean level of extraversion, participants used significantly more social words during storytelling task ($M = 14.73$) than self-introduction task ($M = 6.30$) and hobby-telling task ($M = 5.63$), $ps < .001$, while no differences were found between self-introduction and hobby-telling task, $p = .44$. For the analysis of positive emotion words, tasks showed significant main effect, $F(2, 182) = 37.64, p < .001$, and no significant main effect of extraversion was found, $F(1, 91) = .001, p = .97$. Furthermore, tasks did not significantly interact with extraversion to predict use of positive emotion words, $F(2, 182) = 2.50, p = .08$. Post hoc analysis revealed that at the mean level of extraversion, participants used more positive emotion words when telling their hobbies ($M = 5.80$) than introducing themselves ($M = 4.01$) and telling stories ($M = 3.67$), $ps < .001$. There were no differences between self-introduction and storytelling task, $p = .52$.

The two analyses were repeated after adding age, gender, and ethnicity as control variables. The results remained the same, and the interaction effect between tasks and extraversion was not significant for both analyses, $ps > .05$.

Discussion

In this study, we tested how situation strength moderates the personality expression in language use. We found that extraversion positively predicted extraverted behaviors across three different tasks, which is consistent with previous findings. More importantly, participants significantly differed in their language use in the three tasks, with their language being more extraverted in the hobby-telling task than the self-introduction task. It suggests the effect of situation strength on language use, although no specific hypotheses were made regarding the main effect of situation strength on language use. Importantly, extraversion was not related with its two linguistic markers in this study, indicating that LIWC may not be able to capture people's inner status in spoken language. Furthermore, we failed to find any moderation effect of situation strength on the relationship between extraversion and extraverted behaviors or its two linguistic markers.

It is worth noting that this study revealed no correlations between extraversion and social process words and positive emotion words. As discussed in the introduction part of this study, LIWC may not be able to capture people's internal status through spoken language (Sun et al., 2019). Compared with written language, people in oral communication can express their internal status not only via word use but also other cues such as volume, tone, and facial expression, which may reduce the importance of word use in expressing internal status. The

disappearances of correlations may be due to the limitation of LIWC measurement, which ignored the acoustic cues like tone and volume.

Surprisingly, this study revealed no moderation effect of situation strength on the relationships between extraversion and word use as well as for the human-coded extraverted behaviors. According to previous studies, the moderation effect of situation strength on extraversion and its dependent behaviors was mixed. For example, one study found a significant interaction effect of extraversion and situation strength on talkativeness level (Monson et al., 1982) while another study showed that the relationship between extraversion and willingness to put in effort toward organization change remained consistent across situation with different strength. One confounding variable among these studies could be the inconsistent distributions or the low extraversion-related cues across different situations. The reason is that the lack of extraversion-related cues may limit the expression of extraversion, thus leading to the failed moderation effect. More studies may work towards this direction to investigate this possibility.

Chapter V Study 4

In study 3, we found that extraversion was unrelated with use of social process/positive emotion words, which is inconsistent with previous studies. One possibility is that participants completed speaking tasks alone in a room, which lacks extraversion-relevant cues (i.e., social cues). The lack of social cues may limit the expression of extraversion regardless of situation strength, leading to unrelated relationships between extraversion and word use as well as the non-significant moderation effect of situation strength. To rule out this possibility, study 4 involved social cues to ensure the expression of extraversion in word use and further examined how situation strength interacts with extraversion to affect word use. According to Jakobs et al. (1996), the sociality level could be manipulated by the physical presence of the other person, changing the possibility level to which individuals can interact with others through the auditory and visual channels of language. Thus, in study 4, we involved a confederate to provide the possibility of interacting with someone else when participants are doing speaking tasks.

Similar to study 3, we hypothesized that the expression of extraversion in human-coded extraverted behaviors or word use is stronger in weaker situation than stronger situation. Specifically, our hypotheses are:

H1: Situation strength interacts with extraversion to predict extraverted behaviors, such that the correlation between extraversion and extraverted behaviors is stronger in weaker situation than stronger situation.

H2: Situation strength interacts with extraversion to predict the use of social process/ positive emotion words, such that the correlation between extraversion social process/ positive emotion words is stronger in weaker situation than stronger situation.

Method

Participants

Institution review board from Nanyang Technology University has approved our study (IRB code: PSY-IRB-2019-026). The same power analysis was conducted as study3, and minimum 73 participants were required. Ninety-two Singaporean participants from NTU were recruited via mass email, and each participant received SGD\$5 for their participation. One participant was excluded because he failed to follow the instructions and said little words in all tasks. There were ninety-one participants (Females = 63, males = 28) included in the final sample. The average age was 21.52 with a SD of 2.19. The ethnicity distribution was 81 ethnic Chinese (89.0%), 6 ethnic Malay (6.6%), 2 ethnic Indian (2.2%), and 2 other ethnicities (2.2%).

Speaking Tasks

Same as study 3, the situation strength was manipulated by varying the constraints (i.e., clearer guidelines and more restricted topic) upon the responses across three speaking tasks. The three tasks were the same as study 3, including self-introduction task with the least restricted topic and most ambiguous guideline, hobby-telling task with moderately restricted topic and ambiguous guideline, and storytelling task with the most restricted topic and least ambiguous guideline.

Procedure

The procedure was similar to study 3 except that participants were required to sitting face-to-face with a confederate who was introduced as a fellow participant when doing the speaking tasks. A recorder was used to record their speeches. The confederate was trained to keep direct eye-contact with the participant and remained neutral face all the time. If being asked questions, the confederate was instructed to use minimum words to respond. Each participant was told that he/she and the other participant (i.e., the confederate) would take turns to complete three speaking tasks and fill in a survey. Instructions of the three speaking tasks (see Appendix) were displayed via Qualtrics. Specifically, the three speaking tasks were shown in order, including self-introduction, telling hobbies, and telling a complete story based on each of two pictures. The two pictures were displayed in random order. Participants were provided 2 minutes to complete each section. The confederate was invited out once the real participant informed the experimenter that he/she has completed the speaking tasks. Then the participant

was directed to sit in front of a computer to complete the online survey, which measured their personality traits and demographics variables including age, gender, and ethnicity.

Same as study 3, each audio file was transcribed to text by trained research assistants. Research assistants then divided each transcription to four parts according to the four sections listed above. We used LIWC to analyze each part independently. In addition, recordings of each section were listened by four independent research assistants and rated based on the 27 behavioral items (i.e., RBQ and state expressions).

Measures

Extraversion. The 44-item Big Five Personality Inventory (BFI; John, Donahue, & Kentle, 1991) was used to measure participants' extraversion. The Cronbach's alpha of extraversion is .89.

LIWC2015. LIWC2015 (Pennebaker et al., 2015) was used to calculate the word frequency of social process words and positive emotion words.

Trait-relevant behaviors and state expressions. Same as study 3, twenty items (i.e., 4 items for each Big Five trait-related behaviors) from the RBQ 3.0 (Funder, Furr, & Colvin, 2000) were used to measure trait-related behaviors. Seven items about trait-related state expressions were used to measure speakers' state expressed via the speeches (Sherman et al., 2015). The score of extraverted

behavior was calculated by averaging the scores of the four items from RBQ scale, and they showed good reliability (Cronbach's $\alpha = .94, .95, .97$ in the self-introduction task, hobby-telling task, storytelling task, respectively). The interrater reliability was showed in the Appendix Table D1 and D2. The coding for each recoding was aggregated across raters to form a composite rating of an item measuring behaviors.

Merging results of two storytelling tasks

Similar to study 3, the results of two storytelling tasks were merged as one task because of their highly similar structure. We conducted a paired t-test to test whether there are any differences between these two tasks regarding the situation strength. Only human-coded items with reliability higher than .4 for both storytelling tasks were selected (McHugh, 2012), resulting 18 items. The variances of selected 6 trait-related state expressions items were calculated after converting the raw score from 7-point scale to 9-point scale. The results revealed no significant differences between the behavioral variances of the two storytelling tasks (difference = $-.07$, $t(17) = -.72$, $p = .49$). Thus, in the following analyses, we combine the results of two stories into one as the result of storytelling task.

Results

Table 7 shows the overall correlations among key variables across three tasks in this study. Consistent with study 3, the results showed that extraversion was positively correlated with extraverted behaviors ($r = .30, p = .004$) but unrelated with the use of social words ($r = -.11, p = .32$) and positive emotion words ($r = -.004, p = .97$). Extraverts also tended to be more sociable ($r = .29, p = .01$) and positive ($r = .22, p = .04$). Consistent with study 3, extraverted behaviors were highly related with sociable state ($r = .95, p < .001$) and positive state ($r = .81, p < .001$), while social process words and positive emotion words were not associated with their corresponding human-coded status ($r_s = -.02$ and $.16, p_s > .10$).

Table 7. Descriptive statistics and intercorrelations among variables (Study 4).

	Mean	SD	1	2	3	4	5	6
1. Extraversion	2.80	.85	1.00					
2. Social process words	9.17	2.24	-.11	1.00				
3. Positive emotion words	3.97	1.37	-.004	-.08	1.00			
4. Extraverted behaviors	4.05	1.08	.30**	-.03	.04	1.00		
5. Reserved, quiet – Outgoing, sociable	4.28	1.17	.29**	-.02	.08	.95***	1.00	
6. Sad, negative – Happy, positive	4.48	.75	.22*	-.04	.16	.81***	.76***	1.00

Note. * $p < .05$, ** $p < .01$, *** $p < .001$, two tailed. The correlation was conducted based on between-subject level. $N = 91$.

Manipulation check

Repeated measures were conducted to test the behavioral variances among these three tasks. Similarly, only items with interrater reliability higher than .40 were included, which resulted 14 items. The results showed that there were significant differences among the behavioral variances of these three tasks, $F(2, 26) = 20.33, p < .001$. Specifically, post hoc analysis revealed that self-introduction showed highest behavioral variances ($M = 2.14$), hobby-telling section ranked second ($M = 1.65$), and storytelling task had lowest variances ($M = 1.36$), $ps < .05$. According to the results, our manipulation of situation strength is successful.

Moderation effect of tasks on extraversion expression in extraverted behaviors

A linear mixed-effect models were conducted to test how tasks interact with extraversion to predict human-coded extraverted behaviors⁷. Extraversion was centered by subtracting its grand-mean in this model. The analyses were conducted in R by using the lmerTest package (Kuznetsova, Brockhoff, & Christensen, 2017). Self-introduction task was considered as the reference group compared with hobby-telling and storytelling task. The ICC of extraverted behaviors for the model

⁷ Same as study 3, we conducted another two linear mixed-effect models by using the human-coded sociable state and positive state as dependent variables as well. The results of positive state showed similar patterns as extraverted behaviors, while the results of sociable state revealed no significant interaction effect. It might suggest that tendency of extraverts to engage in social activities is relatively robust across situations (Ashton, Lee, & Paunonen, 2002) while the tendency of extraverts to experience positive emotion is more restricted by situations. Details could be found in the Appendix.

was .61. The results showed that the moderation effect of tasks on extraversion and extraverted behaviors was significant, $F(2, 182) = 3.60, p = .03$, and the main effect of extraversion was significant, $F(1, 91) = 8.98, p = .004$. Tasks did not significantly predict extraverted behaviors, $F(2, 182) = .91, p = .40$. Simple slope analysis (see Figure 8) revealed that in self-introduction task, extraverted people tended to act in more extraverted way ($b = .46, p = .002$). Similarly, in hobby-telling task, extraversion was positively correlated with extraverted behaviors ($b = .50, p = .001$). However, in storytelling task, extraversion was not related with extraverted behaviors ($b = .18, p = .23$).

After adding age, gender, and ethnicity as control variables, the results were the same. Tasks significantly interacted with extraversion to predict extraverted behaviors, $F(2, 182) = 3.60, p = .03$. Simple slope testing revealed same pattern that extraverted people tended to act in more extraverted way in self-introduction ($b = .43, p = .006$) and hobby-telling tasks ($b = .7, p = .003$) but not in storytelling tasks ($b = .14, p = .35$).

Figure 8. Interaction effect of extraversion and tasks on extraverted behaviors.

Moderation effect of tasks on personality expression in word use

Again, linear mixed-effect model with random intercept was used to test the interaction effect of tasks (i.e., within-subject) and extraversion (i.e., between-subject) on word use. Specifically, two models were conducted to test the moderation effects of tasks on two relationships, respectively (i.e., extraversion and social process words, extraversion and positive emotion words).

The ICCs for social process words and positive emotion words were .17 and .21 respectively for the two models related to extraversion. For the analysis of interaction between extraversion and tasks on social words, the results showed that tasks significantly predicted use of social words, $F(2, 182) = 213.35, p < .001$. However, neither the interaction between tasks and extraversion ($F(2, 182) = 1.00$,

$p = .37$) nor extraversion itself ($F(1, 91) = 1.01, p = .32$) predicted social words. Post hoc analysis showed that at the mean level of extraversion, participants used significantly more social words during storytelling task ($M = 14.51$) than self-introduction task ($M = 6.88$) and hobby-telling task ($M = 6.14$), $ps < .001$, while no differences were found between self-introduction and hobby-telling task ($p = .33$). For the analysis of positive emotion words, tasks showed significant main effect, $F(2, 182) = 31.15, p < .001$, and no significant main effect of extraversion was found, $F(1, 91) = .001, p = .97$. Furthermore, tasks did not significantly interact with extraversion to predict use of positive emotion words, $F(2, 182) = .50, p = .61$. Post hoc analysis revealed that at the mean level of extraversion, participants used more positive emotion words when telling their hobbies ($M = 5.14$) than self-introduction ($M = 3.61$) and storytelling ($M = 3.16$), $ps < .001$. There were no differences between self-introduction and storytelling task, $p = .24$.

We repeated the two models with age, gender, and ethnicity as control variables. The results remained the same that tasks did not significantly interact with extraversion to predict the use of social processes words or positive emotion words, $ps > .40$.

Discussion

In this study, we tested how situation strength moderates the personality expression in language use. We observed that extraverted people tend to express their extraverted traits via language more in weaker situation than stronger

situation. Specifically, the correlation between extraversion and extraverted behaviors rated based on the language is stronger in self-introduction task and hobby-telling task than storytelling task, which had more constraints compared to the two former tasks. However, no moderation effect of situation strength was found either on the correlations between extraversion and its two linguistic markers measured by LIWC. Notably, the current findings highlighted the important role of situation strength in the relationships between extraversion and language use.

Same as study 3, extraversion was unrelated with its two linguistic markers measured by LIWC. It provided evidence that the pre-defined dictionary of LIWC may not be applicable to spoken language (Sun et al., 2019). Another possibility might be due to the poor validity of LIWC in Singapore context. English spoken in Singapore (i.e., Singlish) is developed from multiple languages including English, Chinese, Chinese dialects (e.g., Hokkien, Teochew), Malay, and Indian languages. Given that LIWC was developed in the U.S., it may not fit Singapore context very well. Regarding this concern, we compared the dictionary words in study 3 and 4 with that of previous studies. Dictionary words refers to the percentage of words included in the LIWC dictionary file over all words. Thus, we assumed that if LIWC poorly fits Singapore context, dictionary words would be dramatically smaller than that in U.S. context. The results revealed that mean value of dictionary words in study 3 and 4 varies from 88.93 to 95.75, which is similar to the mean value of dictionary words reported in previous studies (Pennebaker et al., 2007;

Pennebaker et al., 2015). For example, the mean value of dictionary words is 91.49 in the transcripts collected from people who talked in real world (Pennebaker et al., 2007), while it is 91.60 in the natural speech about multiple contexts such as strangers' oral communication in a waiting room and audio recordings of people over days and weeks (Pennebaker et al., 2015). This comparison partially supports that LIWC may also fit Singapore context well. However, we have to acknowledge the possibility that meaning of words might differ among different countries, causing poorer validity of LIWC when applied to Singapore context. More research should be done on this line to investigate the validity of LIWC in Singapore. The two reasons may also help explain why this study did not find the moderation effect of situation strength on the relationships between extraversion and word use, which is consistent with study 3.

According to the situation strength theory, we hypothesized that the relationship between extraversion and extraverted behaviors expressed via language would be stronger in weaker situation than stronger situation with the order of self-introduction, hobby-telling, and storytelling ranking from the strongest correlation to the weakest correlation. However, the results of this study only partially supported our hypotheses showing that the associations in self-introduction and hobby-telling task were stronger than storytelling task but there were no differences between self-introduction and hobby-telling task. It is probably due to the similar weak situation that both self-introduction and hobby-telling task

fall into. That is, the difference is not huge enough to induce the change of relationships, although the situation strength was weaker in the self-introduction and hobby-telling. More research is required to examine the cut-points of the associations change.

There were several limitations of study 3 and 4 regarding the study design. Firstly, although we manipulated situation strength by changing the topic range and guidelines, the manipulation may be confounded by trait relevance. For example, self-introduction and hobby-telling can be more relevant to extraversion than storytelling as the former two tasks often happen in social situation. Future study should rule out this possibility and may use between-subject design by varying guidelines for the same speaking task to rule out the confounding effect of trait relevance. Secondly, it is important to acknowledge that there might be order effects of speaking tasks in study 3 and 4 as the three speaking tasks were not randomly displayed. For example, participants might perform differently in the last task (i.e., storytelling) because they are tired. Future studies should randomly display these tasks and avoid the confounding effect of order.

Chapter VI General Discussion

In summary, the current thesis examined how situation trait relevance and situation strength influence the expression of extraversion in word use. Specifically, based on a meta-analysis of 37 studies (study 1), we found that the relationship between extraversion and positive emotion words was stronger in public than private contexts, and stronger in real-life than lab settings. We further revealed that on social media the connections between extraversion and its two linguistic markers became stronger in higher social network density, which affords a higher possibility to develop relationships and engage in social interactions (study 2). Regarding the situation strength, we found that it failed to moderate the relationships between extraversion and word use as well as extraverted behaviors (study 3), which could be due to the low situation trait relevance across the three language tasks. After involving extraversion-related cues across all three tasks, we demonstrated that the more constraints involved in the situation, the weaker the correlation between extraversion and extraverted language was (study 4). These four studies together revealed that the relationships between extraversion and word use are stronger in trait more relevant situation than trait less relevant situation, and stronger in weaker situation than stronger situation, respectively. They depicted a picture of how personality expression in word use varies across different situations and have several theoretical and practical implications.

Theoretical and Practical Implications

Firstly, this thesis expands the Person x Situation interactionism theory (Endler & Magnusson, 1976) by specifying how trait relevance and situation strength interact with personality to influence language use and unveils why the relationship between personality and word use varies across situations. Although Person x Situation interactionism theory points out that situations interact with personality to affect people's behaviors, it did not specify the processes about which situation dimension interact with which personality trait to produce behavior. Trait activation theory and situation strength theory provide some insights about the processes. However, the person X situation interaction as posited by trait activation theory was rarely tested in previous studies, while studies about situation strength theory got mixed findings. There is only one study, to my best knowledge, directly testing how personality traits interact with trait-relevant situation to predict behaviors (Sherman et al., 2015). In this study, researchers used experience sampling method to collect participants' real-time situation characteristics and behaviors. They revealed two statistically significant person X situation interaction effects among nine models, providing weak supports to the trait activation theory. One limitation of this study is that they only collected self-reported situation rating and behaviors. As found in previous studies, people's perception towards situations may be biased by personality traits (Sherman, Nave, & Funder, 2013) while self-reported behaviors might not perfectly reflect actual behaviors. Study 1 and study 2

addressed this gap by measuring word use, an objective measure of behavior, and provided further empirical evidence to the trait activation theory. Regarding the research about situation strength, the empirical evidence was found to be mixed across different studies (Meyer et al., 2014; Withey et al., 2005), which might be confounded by trait relevance as previous studies did not consider the effect of trait relevance when testing the effect of situation strength. Study 3 and 4 provided some evidence to this possible and highlighted the important role of situation strength in the person X situation interactionism theory.

Secondly, this thesis advances the theory of personality expression in language by integrating situation characteristics into the model. This theoretical contribution is important because of an urgent need to explain the various and inconsistent correlations across studies while a large body of papers identified word use as behavioral manifestations of personality traits. We demonstrated that situation trait relevance and situation strength are two important situational factors affecting the associations between traits and word use. Additionally, this thesis reveals which specific situation characteristic (e.g., sociality) and how situation strength affects the expression of extraversion in word use. This has important practical implications in personality prediction. For example, more and more human-computer interactions involve natural conversations (e.g., Amazon Echo). A tremendous number of natural conversations will be digitalized and available for use. By understanding which types of situations are suitable to predict which

personality trait using a particular linguistic marker, algorithms can be developed to accurately predict personality. This finding will provide a new way of assessing personality besides the traditional self-reported survey methods. It also has important implications for personality judgment. Based on the lens model (Brunswik, 1956), valid utilization of cues can help individuals form accurate personality judgment about others (Carney, Colvin, & Hall, 2007). People can be trained to focus on these valid language cues in particular situations and increase their personality judgment ability, which is vital in employee recruitment and interpersonal interaction.

Thirdly, this thesis establishes how objective situational characteristics affect personality expression. Most studies about situation usually relied on relatively subjective ratings of situation such as self-reported, which might be biased by participants' psychological attributes like personality traits (Sherman, Nave, & Funder, 2013). For example, extraverts tend to rate the situation as ones where they are in the focus of attention (Rauthmann et al., 2014). Study 2 introduces an objective measure of situation sociality, allowing researcher to test the effect of situation more objectively. This measurement is important as it could tease out the potential influences of personality on situation ratings.

Fourthly, personality psychologists have long called for the study of how personality is related to what people actually do in the various contexts of their lives, to improve our understanding of personality constructs (Baumeister, Vohs, &

Funder, 2007; Digman, 1990; Funder, 2001). Study 2 contributes to this line of work by using social media data from a very large sample. This data provides insights into the expression of personality in a naturalistic, everyday context that differs from previous contributions in this area (Mehl et al., 2006; Sherman, Rauthmann, Brown, Serfass, & Jones, 2015).

Lastly, this research contributes to the limited literature about the validity of LIWC word categories. Only a few studies have explored whether LIWC word categories could accurately reflect people's internal status (Kross et al., 2019; Sun, Schwartz, Son, Kern, & Vazire, 2019). Kross et al. (2019) revealed that LIWC emotional words fail to capture the fluctuation of emotional expression on Facebook and found no relationship between LIWC emotional words and self-reported emotion. Sun et al. (2019) also failed to find significant relationship between LIWC emotional words in daily communication and self-reported emotion. However, both studies share a common limitation in matching real-time emotional level with word use. For example, Kross et al. (2019) matched participants' Facebook posts with the experience-sampling self-reported emotional level after these posts. This method can only capture how people feel after they posted the status on Facebook instead of people's actual feeling when writing the words. Similarly, Sun et al. (2019) sampled 30 s recordings of sounds for every 9.5 minutes and measured how participants feel emotionally for a particular hour, and they matched the word use within a particular one hour plus one hour before and

after the designated hour with the overall self-reported emotion within that one hour (e.g., they matched the word use between 1pm and 4pm with the emotional experience report between 2pm and 3pm). To fill in the gap, the authors also recruited observers to rate participants' emotion based on the recordings during a particular hour (e.g., observers listened to valid audio files between 2pm-3pm), and matched it with corresponding language sample. However, the limited number of words within each recording might weaken the accuracy of observer's judgement. Study 3 and 4 filled in the gap by involving relatively rich language data and providing relatively accurate real-time internal status ratings. It further establishes that LIWC word categories may not accurately capture people's internal status under some contexts such as oral communication.

Limitations and Future Directions

It is worthwhile to acknowledge several limitations in this thesis. Firstly, this thesis only focuses on extraversion, and it is still unclear how situations affect the linguistic expression of other personality traits such as conscientiousness and agreeableness. For example, it is possible that the duty situation characteristic may affect the relationship between conscientiousness and task-related words. Future studies may consider integrating DIAMONDS taxonomy (Rauthmann et al., 2014) with the rest three personality traits to investigate how other trait-relevant situational characteristics affect personality expression. This is important as it will

provide a more comprehensive picture of the triangle relationships among situation, traits, and language (Sherman et al., 2015).

Secondly, the current research mainly focuses on objective characteristics of situation (e.g., social network density), avoiding the potential influences of personality traits on situation ratings (Sherman, Nave, & Funder, 2013). However, it is unknown whether the moderation effects of situation remain the same for situation perception. Mischel (1977) said “any given, objective stimulus condition may have a variety of effects, depending on how the individual construes and transform it”, arguing that subjective situation might better influence behaviors than objective situation. The perceptions of situation are theorized to be the mechanism through which objective situations influence behaviors (Cantor, Mischel, & Schwartz, 1982), and researchers found that subjective perception partially mediated the effect of objective situation on behaviors (Sherman, Nave, & Funder, 2010). Thus, it will be interesting to examine whether the effect size and directions of moderation effect of situations would change given the individual differences in situation perceptions. Future research may collect people’s subjective perception of situations to examine the triangle relationships among personality, situation, and word use.

Thirdly, the scope of this thesis is to explore how the whole trait of extraversion associated with word use across different situations. However, it is worthwhile to note that extraversion is comprised of three facets, namely

sociability, assertiveness, and energy level (Soto & John, 2017). As suggested by Möttus (2006), researchers should seek to conduct more rigorous investigation between personality trait and their outcomes. It is meaningful and necessary to conduct a more nuanced examination about how facets of extraversion correlate with word use under different situations. For example, facets of extraversion may have stronger correlations with certain word use, which was less likely be affected by situations. Future research about how situation affects the relationships between facets of personality traits and word use can further our understandings about the relationships among situation, traits, and word use.

This thesis used two means of word production, including word use in written language and spoken language. Compared with written language, word use in spoken language may be less reflective of personality traits. The reason is that oral communication has multiple ways to express personality, including facial expression, acoustic features, body language, and word use. The multiple ways may weaken the importance of word use in personality expression. This speculation was partially supported by the unrelated correlations between extraversion and use of social process words/positive emotion words in study 3 and 4, which collected people's spoken language. In addition, spoken language has more grammatical errors compared to written language (Bushnell, 1930), and is more spontaneous and less manipulated (Chafe & Tannen, 1987). From this perspective, spoken language may better reflect people's personality than written

language. However, study 3 and 4 did not find this effect. More research is needed in this stream.

Conclusion

Situations play an important role in personality expression in language. In this thesis, we conducted four studies to reveal how the expression of traits in word use is influenced by different situations. Specifically, situation trait relevance strengthens the expression of extraversion in word use, and situation strength weakens the expression of traits in language use. These findings together expand the Person x Situation interactionism theory by specifying how trait relevance and situation strength interact with personality to influence word use and contribute to the personality and word use theory by integrating the impacts of these two situational characteristics. Our work makes important theoretical contributions to personality science and has important practical implications in improving personality prediction based on linguistic data.

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Appendix

Supplementary Materials of Study 1.

Table A. Coding of moderators of included studies (Study 1).

Study	Language tasks	Public vs. Private	Real life vs. Lab
Beukeboom et al. (2013)	Oral description of five photos	private	lab
Burdick et al. (2020) 2015 dataset	Captions of five pictures expressing yourself	private	lab
Burdick et al. (2020) 2016 dataset	Captions of five pictures expressing yourself	private	lab
Gill et al. (2006) study 2 e-mail dataset	E-mail texts to a good friend	private	lab
Gill et al. (2006) study 2 blog dataset	Blog entries	public	real life
Golbeck, Robles, Edmondson, & Turner (2011)	Twitter status updates	public	real life
Golbeck, Robles, & Turner (2011)	Facebook profile	public	real life
Hall and Caton (2014)	Facebook status updates	public	real life
Hawkins et al. (2017) ^a	Reports about a recent dream or important dream	private	lab
Hirsh and Peterson (2009)	Writing assignment about past experiences and future goals	private	lab
Holtgraves (2011)	Latest 20 text messages	private	real life
Kahn et al. (2007) study 3	Verbalizations about feelings following film clips	private	lab
Kern et al. (2014)	Facebook status updates	public	real life
Krieger (2016)	Writing assignment about experiences reflecting socially skilled or not socially skilled	private	lab
Li and Chignell (2010) blog	Blog entries	public	lab
Mehl (2004)	Daily conversation captured by electronically activated recorder (EAR)	private	real life
Mehl et al. (2012)	Stream-of-conscious writing tasks (SOC)	private	lab
Morgan (2014)	Online 3-people group chatting in a business simulation game	private	lab
Nowson (2006)	Personal weblog	public	real life
Pennebaker and King (1999)	Class writing assignment	private	lab
Pereira et al. (2019) adolescents with cancer	YouTube video narrative about experiences with cancer	public	lab

Pereira et al. (2019) adolescents without cancer	YouTube video narrative about experiences with hardship	public	lab
Pirzadeh and Pfaff (2012)	Online 6-members group chatting in a simulation	private	lab
Qiu et al. (2012)	Twitter status updates	public	real life
Qiu et al. (2017) sample 1	Sina Weibo status updates	public	real life
Qiu et al. (2017) sample 2	Sina Weibo status updates	public	real life
Raess (2018)	Twitter status updates	public	real life
Sandy (2013)	Chatting with a stranger online	private	lab
Sumner et al. (2012)	Twitter status updates	public	real life
Sumner et al. (2011)	Last 25 Facebook status updates	public	real life
Tackman et al. (2020) sample 1	Daily conversation captured by EAR	private	real life
Tackman et al. (2020) sample 2	Daily conversation captured by EAR	private	real life
Tackman et al. (2020) sample 3	Daily conversation captured by EAR	private	real life
Tackman et al. (2020) sample 4	Daily conversation captured by EAR	private	real life
Tassone (2015) study 3	Writing of reasons about opinions towards four online actions or offline actions	private	lab
Tighe and Cheng (2018)	Twitter status updates	public	real life
Williams et al. (2003)	One-page free description of reactions to the 9/11 attacks	private	lab
Yarkoni (2010)	Blog status updates	public	real life

Note.

^a The sample size reported for the correlation between extraversion and social process words is 50 while that for the correlation between extraversion and positive emotion words is 260. The percentage of female participants was reported for the sample with 260 participants but not for the sample with 50 participants.

Supplementary Materials of Study 2.

Table B1. Reliability scores of extraversion across varied IPIP scales (study 2).

IPIP scales	Number of participants	Extraversion
20-item	16895	.651
30-item	1064	.766
40-item	703	.836
50-item	784	.859
60-item	401	.878
70-item	269	.905
80-item	196	.894
90-item	157	.921
100-item	6766	.936

Table B2.1. Moderated regression analyses of extraversion and social network density on social process words after controlling social network size, gender and age ($N = 26,892$).

	Social process words				
	<i>B</i>	<i>SE B</i>	<i>t</i>	<i>p</i>	<i>CI</i>
constant	4.68	.05	87.57	< .001	(4.57, 4.78)
extraversion	.19	.02	9.33	< .001	(.15, .23)
social network density	.46	.19	2.45	.01	(.09, .82)
extraversion * social network density	.50	.23	2.24	.03	(.06, .95)
social network size	.0001	.0001	1.46	.15	(.0000, .0002)
gender	.53	.03	16.43	< .001	(.47, .59)

age	.04	.002	25.39	< .001	(.037, .044)
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Note. CI = 95% confidence intervals.

Table B2.2. Effects of extraversion on social process words at low and higher level of social network density.

	Social process words				
	<i>B</i>	<i>SE B</i>	<i>t</i>	<i>p</i>	<i>CI</i>
Low network density = .00	.16	.02	6.88	<.001	(.12, .21)
Higher network density = .15	.23	.03	8.31	<.001	(.18, .29)

Note. CI = 95% confidence intervals.

Table B3. Moderated regression analyses of extraversion and social network density on positive emotion words after controlling social network size, gender and age ($N = 26,892$).

	Positive emotion words				
	<i>B</i>	<i>SE B</i>	<i>t</i>	<i>p</i>	<i>CI</i>
constant	2.90	.03	89.02	<.001	(2.84, 2.96)
extraversion	.17	.01	13.72	<.001	(.14, .19)
social network density	.14	.11	1.23	.22	(-.08, .36)
extraversion * social network density	.39	.14	2.85	.004	(.12, .66)
social network size	.0000	.0000	-.89	.37	(-.0001, .0000)
gender	.57	.02	29.08	<.001	(.53, .61)

age	.02	.001	23.88	<.001	(.02, .03)
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Note. CI = 95% confidence intervals.

Table B3.2. Effects of extraversion on positive emotion words at low and higher level of social network density.

	Positive emotion words				
	<i>B</i>	<i>SE B</i>	<i>t</i>	<i>p</i>	<i>CI</i>
Low network density = .00	.15	.01	10.34	<.001	(.12, .18)
Higher network density = .15	.20	.02	11.90	<.001	(.17, .24)

Note. CI = 95% confidence intervals.

Supplementary Materials of Study 3.

Table C1. Interrater reliability based on 38 participants' audio files (study 3).

items	ICC For self-introduction	ICC For hobby-telling	ICC For storytelling based on picture 1	ICC For storytelling based on picture 2
Liking other(s) ^a	.62	.37	.44	.55
Exhibiting high enthusiasm and energy level ^{ab}	.76	.79	.77	.75
Expressing agreement frequently	.28	.19	.44	.36
Being talkative ^{ab}	.80	.80	.84	.83
Expressing sympathy ^a	.62	.09	.57	.47
Acting irritated	.04	.62	.59	.27
Expressing warmth	.66	.27	.25	.57
Behaving in fearful or timid manner ^{ab}	.80	.63	.83	.84
Being expressive in voice ^{ab}	.67	.68	.72	.76
Saying negative things about self	.80	.08	.20	-.05
Displaying ambition	.64	.70	.48	.34
Displaying wide range of interests	.68	.62	.19	.40
Expressing self-pity or victimization	.74	-.06	.10	.78

Behaving in a cheerful manner ^a	.57	.39	.67	.77
Emphasizing accomplishments	.76	.72	.16	.25
Exhibiting high degree of intelligence ^{ab}	.81	.62	.58	.61
Behaving in competitive manner	.65	.60	.15	.70
Exhibiting an interest in intellectual/cognitive matters	.70	.67	.33	.66
Concentrating; working hard at task ^a	.72	.22	.67	.64
Saying/Doing something interesting ^{ab}	.68	.60	.63	.71
1= reserved/quiet, 7= outgoing/sociable ^{ab}	.82	.74	.78	.86
1=submissive/unassertive, 7=dominant/assertive ^{ab}	.73	.57	.73	.77
1=cold/quarrelsome, 7=warm/agreeable	.54	.57	.15	.68
1=disorganized/lazy, 7=organized/hardworking ^{ab}	.65	.47	.60	.77
1=calm/unemotional, 7=nervous/emotional	.56	.15	.47	.38
1=unintelligent/uncreative, 7=intelligent/creative ^{ab}	.61	.53	.51	.74
1= sad/negative, 7= happy/positive ^{ab}	.65	.48	.58	.82

Note. ^a These items with interrater reliability higher than .40 in both storytelling sections are included in the behavioral variance comparison between the two storytelling tasks. ^b These items with interrater reliability higher than .40 in all tasks are included in the manipulation check regarding the behavioral variance differences among the three tasks.

Table C2. Interrater reliability based on 53 participants' audio files (study 3).

items	ICC For self-introduction	ICC For hobby-telling	ICC For storytelling based on picture 1	ICC For storytelling based on picture 2
Liking other(s) ^a	.62	.43	.63	.46
Exhibiting high enthusiasm and energy level ^{ab}	.86	.62	.82	.72
Expressing agreement frequently	.29	.41	.30	.45
Being talkative ^{ab}	.85	.67	.82	.72
Expressing sympathy ^a	.65	.30	.55	.51
Acting irritated	.82	.31	.51	.50
Expressing warmth	.79	.60	.64	.73
Behaving in fearful or timid manner ^{ab}	.57	.46	.58	.69

Being expressive in voice ^{ab}	.79	.63	.80	.75
Saying negative things about self	.67	.00	.17	.32
Displaying ambition	.91	.54	.57	.44
Displaying wide range of interests	.87	.67	.51	.60
Expressing self-pity or victimization	.25	.27	.30	.43
Behaving in a cheerful manner ^a	.86	.65	.61	.74
Emphasizing accomplishments	.78	.49	.57	.31
Exhibiting high degree of intelligence ^{ab}	.77	.63	.77	.67
Behaving in competitive manner	.59	.19	.57	.39
Exhibiting an interest in intellectual/cognitive matters	.85	.62	.57	.42
Concentrating; working hard at task ^a	.71	.68	.74	.61
Saying/Doing something interesting ^{ab}	.81	.72	.76	.78
1= reserved/quiet, 7= outgoing/sociable ^{ab}	.83	.63	.81	.78
1=submissive/unassertive, 7=dominant/assertive ^{ab}	.82	.74	.67	.66
1=cold/quarrelsome, 7=warm/agreeable	.73	.47	.68	.65
1=disorganized/lazy, 7=organized/hardworking ^{ab}	.70	.60	.68	.67
1=calm/unemotional, 7=nervous/emotional	.57	.43	.53	.41
1=unintelligent/uncreative, 7=intelligent/creative ^{ab}	.82	.57	.76	.72
1= sad/negative, 7= happy/positive ^{ab}	.78	.60	.69	.66

Note. ^a These items with interrater reliability higher than .40 in both storytelling sections are included in the behavioral variance comparison between the two storytelling tasks. ^b These items with interrater reliability higher than .40 in all tasks are included in the manipulation check regarding the behavioral variance differences among the three tasks.

Results of sociable state and positive state in study 3

The ICCs were .55 and .37 for the linear mixed-effect models of sociable state and positive state, respectively. The analysis of sociable state revealed significant main effect of extraversion and tasks on sociable state, $ps < .05$, but not significant interaction effect, $F(2, 182) = 1.34, p = .26$. Post hoc analysis revealed

that participants were more sociable in the hobby-telling task ($M = 4.06$) than self-introduction task ($M = 3.48$), $p < .001$. Participants behaved more sociable in the storytelling task ($M = 3.96$) than self-introduction task, $p = .002$. There were no significant differences in sociable state between hobby-telling task and storytelling task, $p = 1.00$.

For the analysis of positive state, the results were similar. Extraversion and tasks significantly predicted positive state, $ps < .01$. However, no interaction between extraversion and tasks were found, $F(2, 182) = 1.07$, $p = .34$. Further analysis about the main effect of tasks on positive state showed that hobby-telling task ($M = 4.58$) was significantly higher than self-introduction task ($M = 4.12$), $p < .001$. People acted more positive in the storytelling task ($M = 4.43$) than hobby-telling task, $p = .01$. There were no differences in positive state between hobby-telling task and storytelling task, $p = .40$.

Materials of instructions (study 3)

Self-introduction. “Please introduce yourself. You will have about 2 minutes to complete this task. Please keep introducing yourself until this page jumps to another page.”

Hobby-telling. “Please talk about your hobbies. You will have about 2 minutes to complete this task. Please keep talking about your hobbies until this page jumps to another page.”

Storytelling. “This is a picture story telling task. You will view two pictures. Your task is to tell a complete story about each picture – an imaginative story with a beginning, a middle, and an end. Each picture will be presented for 15 seconds. After it has disappeared, please tell whatever story comes to your mind. You will have about 2 minutes for each story.”

One of the pictures is displayed for 15 seconds. After that, the following instruction was shown:

“Please start to tell a story based on the picture just showed.

What is happening? Who are the people?

What happened before?

What are the people thinking about and feeling? What do they want?

What will happen next?

Please keep telling the story until this page jumps to another page.”

picture 1

picture 2

Items measuring trait-relevant behaviors (study 3 & 4)

Extraverted behaviors: Exhibiting high enthusiasm and energy level; Being talkative; Being expressive in voice; Behaving in a cheerful manner

Agreeable behaviors: Liking other(s); Expressing agreement frequently; Expressing sympathy; Expressing warmth

Conscientious behaviors: Displaying ambition; Emphasizing accomplishments; Behaving in competitive manner; Concentrating working hard at task

Neurotic behaviors: Acting irritated; Behaving in fearful or timid manner; Saying negative things about self; Expressing self-pity or victimization

Open behaviors: Displaying wide range of interests; Exhibiting high degree of intelligence; Exhibiting an interest in intellectual cognitive matters; Saying/Doing something interesting

Items measuring trait-corresponding state expressions (study 3 & 4)

reserved, quiet – outgoing, sociable

submissive, unassertive – dominant, assertive

cold, quarrelsome – warm, agreeable

disorganized, lazy – organized, hardworking

calm, unemotional – nervous, emotional

unintelligent, uncreative – intelligent, creative

sad, negative – happy, positive

Supplementary Materials of Study 4.

Table D1. Interrater reliability based on 40 participants' audio files (study 4).

items	ICC For self- introduction	ICC For hobby-telling	ICC For storytelling based on picture 1	ICC For storytelling based on picture 2
Liking other(s) ^a	.77	.39	.69	.73
Exhibiting high enthusiasm and energy level ^{ab}	.90	.82	.81	.91
Expressing agreement frequently	.59	.41	-.14	-.04
Being talkative ^{ab}	.91	.86	.82	.92
Expressing sympathy ^a	.74	.50	.45	.54
Acting irritated	.58	.40	.33	.46
Expressing warmth ^a	.83	.59	.59	.88
Behaving in fearful or timid manner ^{ab}	.80	.62	.67	.80
Being expressive in voice ^{ab}	.86	.79	.83	.87
Saying negative things about self	.90	-.04	.41	.36
Displaying ambition	.84	.55	.36	.69
Displaying wide range of interests	.84	.68	.22	.69
Expressing self-pity or victimization	.78	.12	.52	.77
Behaving in a cheerful manner ^{ab}	.92	.68	.74	.73
Emphasizing accomplishments	.84	.71	.23	.68
Exhibiting high degree of intelligence ^{ab}	.81	.65	.80	.77
Behaving in competitive manner ^{ab}	.73	.62	.57	.73
Exhibiting an interest in intellectual/cognitive matters	.78	.60	.19	.79
Concentrating; working hard at task ^a	.85	.28	.73	.88
Saying/Doing something interesting ^{ab}	.90	.79	.84	.90
1= reserved/quiet, 7= outgoing/sociable ^{ab}	.90	.78	.81	.90
1=submissive/unassertive, 7=dominant/assertive ^{ab}	.81	.78	.73	.87
1=cold/quarrelsome, 7=warm/agreeable ^{ab}	.83	.54	.50	.76
1=disorganized/lazy, 7=organized/hardworking ^{ab}	.76	.57	.79	.92
1=calm/unemotional, 7=nervous/emotional	.44	.59	.31	.53
1=unintelligent/uncreative, 7=intelligent/creative ^{ab}	.80	.65	.84	.88
1= sad/negative, 7= happy/positive ^{ab}	.87	.59	.73	.87

Note. ^a These items with interrater reliability higher than .40 in both storytelling sections are included in the behavioral variance comparison between the two

storytelling tasks. ^b These items with interrater reliability higher than .40 in all tasks are included in the manipulation check regarding the behavioral variance differences among the three tasks.

Table D2. Interrater reliability based on 51 participants' audio files (study 4).

items	ICC For self-introduction	ICC For hobby-telling	ICC For storytelling based on picture 1	ICC For storytelling based on picture 2
Liking other(s) ^a	-.15	.38	.57	.61
Exhibiting high enthusiasm and energy level ^{ab}	.82	.61	.78	.66
Expressing agreement frequently	.04	.47	.34	.38
Being talkative ^{ab}	.86	.69	.71	.65
Expressing sympathy ^a	.57	.16	.54	.49
Acting irritated	.68	.37	.83	.79
Expressing warmth ^a	.78	.17	.41	.63
Behaving in fearful or timid manner ^{ab}	.64	.52	.48	.64
Being expressive in voice ^{ab}	.79	.40	.69	.61
Saying negative things about self	.86	.31	-.18	.06
Displaying ambition	.87	.72	.47	.35
Displaying wide range of interests	.89	.52	.45	.45
Expressing self-pity or victimization	.70	-.08	.24	.34
Behaving in a cheerful manner ^{ab}	.74	.51	.64	.68
Emphasizing accomplishments	.72	.57	.20	.38
Exhibiting high degree of intelligence ^{ab}	.63	.40	.56	.55
Behaving in competitive manner ^{ab}	.50	.55	.57	.41
Exhibiting an interest in intellectual/cognitive matters	.82	.53	.35	.10
Concentrating; working hard at task ^a	.72	.34	.77	.61
Saying/Doing something interesting ^{ab}	.81	.69	.76	.67
1= reserved/quiet, 7= outgoing/sociable ^{ab}	.74	.67	.79	.71
1=submissive/unassertive, 7=dominant/assertive ^{ab}	.67	.68	.61	.49
1=cold/quarrelsome, 7=warm/agreeable ^{ab}	.69	.48	.75	.71
1=disorganized/lazy, 7=organized/hardworking ^{ab}	.63	.70	.59	.74
1=calm/unemotional, 7=nervous/emotional	.50	.09	.43	.17

1=unintelligent/uncreative, 7=intelligent/creative ^{ab}	.71	.63	.69	.66
1= sad/negative, 7= happy/positive ^{ab}	.71	.48	.73	.74

Note. ^a These items with interrater reliability higher than .40 in both storytelling sections are included in the behavioral variance comparison between the two storytelling tasks. ^b These items with interrater reliability higher than .40 in all tasks are included in the manipulation check regarding the behavioral variance differences among the three tasks.

Results of sociable state and positive state in study 4

The ICCs of sociable state, and positive state for the two linear mixed-effect models were .55 and .34, respectively. For the analysis of sociable state, the main effect of extraversion was significant, $F(1,91) = 8.27, p = .01$. However, the interaction effect between extraversion and tasks was not significant, $F(2,182)=1.62, p = .20$. The main effect of tasks on sociable state was not significant, $F(2,182)=2.86, p = .06$.

Regarding the analysis of positive state, extraversion significantly interacted with tasks to predict positive state, $F(2,182) = 4.83, p = .01$. In addition, extraversion significantly predicted positive state as well, $F(1, 91) = 4.54, p = .04$. Furthermore, the main effect of tasks was not significant, $F(2, 182) = 1.67, p = .19$. Simple slope analysis (see Figure 9) showed that extraversion was positively related with positive state in self-introduction task ($b = .30, p = .01$) and hobby-telling task ($b = .33, p = .01$). However, extraversion was not related with positive state in storytelling task ($b = -.05, p = .65$).

Figure A. Interaction effect of extraversion and tasks on positive state.

Materials of instructions (study 4)

Self-introduction. “Please introduce yourself to the other participant. You will have about 2 minutes to complete this task. Please keep introducing yourself until this page jumps to another page.”

Hobby-telling. “Please talk about your hobbies to the other participant. You will have about 2 minutes to complete this task. Please keep talking about your hobbies until this page jumps to another page.”

Storytelling. “This is a picture story telling task. You will view two pictures. Your task is to tell a complete story about each picture – an imaginative story with a beginning, a middle, and an end. Each picture will be presented for 15 seconds.

After it has disappeared, please tell whatever story comes to your mind to the other participant. You will have about 2 minutes for each story.”

One of the pictures is displayed for 15 seconds. After that, the following instruction was shown:

“Please start to tell a story based on the picture just showed to the other participant.

What is happening? Who are the people?

What happened before?

What are the people thinking about and feeling? What do they want?

What will happen next?

Please keep telling the story until this page jumps to another page.”

picture 1

picture 2

List of Publications During Candidature

Chen, J., Qiu, L., & Ho, M. H. R. (2020). A Meta-analysis of Linguistic Markers of Extraversion: Positive Emotion and Social Process Words. *Journal of Research in Personality*, 89, 104035.

Qiu, L., **Chen, J.**, Ramsay, J., & Lu, J. (2019). Personality predicts words in favorite songs. *Journal of Research in Personality*, 78, 25-35. (Content not included in this thesis)