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Highlights

- Several theories suggest that extraverts implicitly associate people with rewards.
 - Study 1 used an implicit association test to test this prediction.
 - Study 2 used a single-category implicit association test.
 - Across studies, extraverts more strongly associated people with rewards.
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Just loving these people: Extraverts implicitly associate people with reward

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ABSTRACT

Several prominent theories have suggested that extraverts implicitly associate people with rewards. Two studies involving 268 participants were conducted in order to test this prediction. Study 1 utilized a traditional implicit association test, and Study 2 utilized a single-category implicit association test capable of providing separate indices for different associations in memory. Across both studies, extraverted participants displayed a more robust association between people and reward. Study 2 also indicates that extraversion was unrelated to the association between punishments and the absence of people. These studies therefore confirm an important prediction following from reward sensitivity theories of extraversion and may help to explain extraverts' increased sociability.

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1. Introduction

1.1. Extraversion and reward sensitivity

It is now well-accepted that extraversion is a prominent dimension of human personality (Wilt & Revelle, 2009). In psychometric research, factor analyses have repeatedly yielded a personality dimension characterized by adjectives such as “talkative”, “assertive”, and, of course, “extraverted” (e.g., Goldberg, 1990; John, 1990; Norman, 1963). Moreover, these results have replicated across languages and cultures (e.g., Saucier, 1997; Saucier, Hampson, & Goldberg, 2000; Somer & Goldberg, 1999). Consistent with extraversion's major markers, early researchers considered individual differences in sociable behaviors as the core, defining feature of this trait (e.g., McCrea & Costa, 1987).

However, more recent theories of extraversion have emphasized its emotional and motivational basis (e.g., Carver, Sutton, & Scheier, 2000; Depue & Collins, 1999; Elliot & Thrash, 2002; Lucas, Diener, Grob, Suh, & Shao, 2000; Smillie, 2013; Watson, Wiese, Vaidya, & Tellegen, 1997; Zelenski & Larsen, 1999). While these theories differ in emphasis and in details, they all propose that individuals high on the extraversion continuum (henceforth “extraverts”) have a more sensitive reward system than individuals low on the extraversion continuum (henceforth “introverts”).

Research on the emotional and motivational consequences of extraversion certainly supports this view. One of the most robust findings in the personality literature is that extraverts report higher levels of positive affect than introverts (see Lucas & Fujita, 2000; Watson, 2000; Wilt & Revelle, 2009, for relevant reviews). This relationship is especially pronounced while individuals are in the process of pursuing a rewarding outcome (Gomez, Cooper, & Gomez, 2000; Larsen & Ketelaar, 1991; Smillie, Cooper, Wilt, & Revelle, 2012). Beyond this, extraverts also condition to rewards more effectively (see Matthews & Gilliland, 1999; Smillie, Pickering, & Jackson, 2006, for relevant reviews). Perhaps as a result, they expect positive situations to be more rewarding (Zelenski & Larsen, 2002; Zelenski et al., 2013), and they actually seek out positive situations more frequently (e.g., Lucas, Le, & Dyrenforth, 2008; Mehl, Gosling, & Pennebaker, 2006; Srivastava, Angelo, & Vallereux, 2008).

Research on the neurological and psychological basis of extraversion is also consistent with this view. For example, extraverts exhibit a stronger response to positive incentive stimuli within areas of the neurological reward system (e.g., the caudate nucleus; Canli et al., 2001), as well as its projections (e.g., the anterior cingulate cortex; Canli et al., 2001; Smillie, Cooper, & Pickering, 2011). At a cognitive level, research shows that extraverts allocate more attention to rewarding stimuli (Derryberry & Reed, 1994; Paelecke, Paelecke-Haberman, & Borkenau, 2012), and they exhibit stronger implicit associations between different positive concepts in memory (Robinson, Moeller, & Ode, 2010).

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1.2. People as rewards

Despite this large body of research on extraversion and reward sensitivity, increased sociability remains an important, defining feature of extraversion (Wilt & Revelle, 2009). Research shows that it is impossible to divorce measures of extraversion from their original focus on sociability (Ashton, Lee, & Paunonen, 2002). Extraverts also seek out social situations more frequently than introverts (Lucas et al., 2008; Mehl et al., 2006; Srivastava et al., 2008), and allocate more attention to social stimuli (Fishman, Ng, & Bellugi, 2011).

This raises an interesting puzzle: If reward sensitivity is a core feature of extraversion, then why does sociability remain so central to this construct? In the current investigation, we built upon an idea proposed by Lucas et al. (2000, p. 455), among others. These authors suggested that extraverts seek out and enjoy social situations so much more than introverts simply because they are a prominent and important reward for human beings (cf. Lucas & Baird, 2004). According to this view, there is nothing truly unique that draws extraverts to social situations other than the fact that these situations are so frequently rewarding.

This suggestion is consistent with a multitude of theories (e.g., Baumeister & Leary, 1995; Bowlby, 1969; Maslow, 1968; Ryan, 1991) which have proposed that human beings possess an innate psychological need for relationships with conspecifics. According to Baumeister and Leary's (1995) influential evolutionary analysis, our species evolved in interdependent social groups. Thus, the desire to establish and maintain social relationships promoted survival and reproduction in multiple fashions. Relationships could allow individuals to provide mutual aid and support to one another; to more effectively exchange information and expertise; and to more effectively obtain shared goals (cf. Park & Hinsz, 2006). Consistent with these theories, empirical research indicates that social acceptance (Blackhart, Nelson, Knowles, & Baumeister, 2009), social power (Keltner, Gruenfeld, & Anderson, 2003), and social situations more generally (e.g., Clark & Watson, 1988; Emmons & Diener, 1986; Flesson, Malanos, & Achille, 2002; Pavot, Diener, & Fujita, 1990) all increase positive affect.

1.3. Extraversion, conditioning, and implicit associations in memory

If the increased sociability of extraverts is due to the rewarding nature of social situations, this generates a number of testable predictions regarding the psychological basis of this trait. Given that extraverts condition to reward more effectively (Matthews & Gilliland, 1999; Smillie et al., 2006), these individuals should also develop stronger associations between people and positivity following positive social experiences. Bliss-Morreau, Feldman Barrett, and Wright (2008) provided support for this proposal. Participants were first briefly exposed to pictures of people paired with positive, neutral, or negative social behaviors. Afterward, participants were instructed to make "snap" judgments about the valence of those faces. The results indicated that extraverted participants were more capable of learning that faces paired with positive social behaviors were indeed positive.

While Bliss-Morreau et al.'s (2008) study is extremely important, it focused solely on short-term learning in response to an experimental manipulation. It did not investigate whether such effects endure over time; whether extraverts naturalistically form such memory associations as a result of their daily experiences; or how such associations are stored in memory. The purpose of the current investigation was to build upon this prior research and fill these gaps.

We specifically tested the idea that extraverts have come to automatically associate people in general with reward. Robinson (2007) has proposed that extraversion is specifically linked with a

tendency to form automatic associations in memory with positivity. This emphasis on automaticity is consistent with a longer line of theorizing which suggests that extraversion is linked with subcortical neural systems (i.e., the dopaminergic reward system; Depue & Collins, 1999), which operates on the basis of reflexive information processing systems (see Lieberman, 2000; Lieberman, Gaunt, Gilbert, & Trope, 2002).

Research demonstrates that conditioning procedures do not just affect people's behaviors or conscious judgments. They also affect people's automatic associations in memory (Hermans, Baeyens, & Eelen, 2003). After a previously-neutral stimulus is repeatedly paired with a rewarding stimulus, participants begin to implicitly associate that stimulus with positivity. This result has been obtained using a variety of paradigms, including Fazio, Sanbonmatsu, Powell, and Kardes (1986) affective priming paradigm (e.g., De Houwer, Hermans, & Eelen, 1998) and Greenwald, McGhee, and Schwartz's (1998) implicit association test (e.g., Olson & Fazio, 2001).

Robinson et al. (2010) recently provided evidence that extraverts do indeed display stronger positive implicit associations in memory. Across three studies, these authors found that extraverts displayed more robust interconnections between different positively-valenced concepts in memory. By contrast, extraversion was not systematically related to the strength of negative implicit associations in memory.

If social interactions are indeed rewarding, then they should come to be associated with positivity at a general level. Given that extraverts condition to reward more effectively (Bliss-Morreau et al., 2008; Matthews & Gilliland, 1999; Smillie et al., 2006), these individuals should develop stronger associations between people and reward. Two studies were thus conducted to test the prediction that extraverts would exhibit a more robust implicit association in memory between the broad category of people and reward.

2. Studies 1 and 2

In Study 1, participants completed an implicit association test (IAT; Greenwald et al., 1998), which is one of the most frequently-used and well-validated measures of implicit associations in the social cognition literature (e.g., Fazio & Olson, 2003). The IAT was designed to measure participants' implicit associations between reward and the broad category of people. Following this task, participants completed a well-validated measure of extraversion (Goldberg, 1999). It was predicted that extraverted participants would display a stronger implicit association between people and reward.

In Study 2, we sought to replicate and extend the findings of Study 1. A weakness of the traditional IAT is that it cannot provide separate indices of different associations in memory (Bluemke & Friese, 2008). For example, Quek and Ortony (2012) recently used a computer simulation to demonstrate that IAT compatibility effects can arise from a variety of different underlying memory associations. In the context of the current study, this is important because theories suggest that extraversion is associated with positive affectivity and appetitive conditioning, and not with negative affectivity or aversive conditioning (e.g., Watson, 2000). Thus, participants in Study 2 completed the single-category IAT (Bluemke & Friese, 2008). This is a relatively minor modification of the original IAT which is nonetheless capable of providing separate indices of people-reward associations in memory and no-people-punishment associations in memory (Quek & Ortony, 2012). It was predicted that extraverts would display a stronger implicit association between people and reward, and that they would not display a stronger implicit association between the absence of people and punishment.

In both studies, we also sought to provide evidence of discriminant validity. We specifically sought to show people-reward associations in memory were not systematically related to other potentially pertinent aspects of the Big Five, including both agreeableness and neuroticism. Like extraversion, agreeableness is a highly interpersonal dimension of personality. It is systematically related to prosocial and antisocial behaviors (e.g., Graziano, Habashi, Sheese, & Tobin, 2007; Meier, Robinson, & Wilkowski, 2006). Nonetheless, research has not uncovered any systematic associations between this trait and positive affect or reward processing (e.g., Watson, 2000). Thus, there is little reason to expect this trait to be systematically associated with implicit people-reward associations in memory. This prediction was tested in both studies.

Research has also shown that neuroticism is linked to negative affect and punishment-processing (Carver et al., 2000; Elliot & Thrash, 2002; Smillie et al., 2006; Watson et al., 1997; Zelenski & Larsen, 1999). Thus, it is a natural point of comparison for extraversion. Because this trait has not been linked to sociability or reward-processing, we predicted that it would not be related to implicit people-reward associations in memory. This prediction was tested in Study 1. Because this dimension of personality showed no evidence of a unique relationship with the implicit measure in Study 1 (see results from Study 1 regression analysis, below), we did not administer it again in Study 2. In the interests of brevity, the two studies are presented together.

2.1. Method

2.2.1. Participants

One-hundred and forty-two undergraduate psychology students (107 female; 35 male; M age = 19.5) from the University of Wyoming participated in Study 1 in exchange for course credit. One-hundred twenty-six students (89 female; 37 male; M age = 20.4) from the same population participated in Study 2. Hofmann, Gawronski, Gschwender, Le, and Schmitt (2005) found that the average correlation between IAT-based measures and corresponding explicit self-report measures was $r = .24$. Both studies thus achieved adequate power to detect this expected effect size (Study 1: $1 - \beta = .83$; Study 2: $1 - \beta = .79$).

2.2.2. Apparatus and stimuli

All participants completed the studies on one of five Windows-based computers using E-Prime software (version 2.0). All computers were equipped with a specially-altered Empirisoft keyboard with less than 1 ms recording error.

Ten pictures of people socializing in various settings (e.g., restaurants, living rooms, streets, etc.) were gathered from several online sources to serve as “people” stimuli. To provide matched “no-people” stimuli, 10 pictures of the same settings containing no people were also gathered from online sources.

In both studies, 10 words related to the concept of “benefits” (stimuli = aid, allowance, assistance, bonus, gain, gift, income, prize, profit, respect) and 10 words related to the concept of “costs” (stimuli = bill, cost, damage, expense, fee, injury, loss, penalty, punishment, reprimand) were used as stimuli. Words were selected from a thesaurus, and they were matched in terms of word length and word frequency, all $ps > .59$.

We opted for these category labels over alternative possible labels for two reasons. First, the more typical labels of “pleasant” and “unpleasant” were deemed to be overly general. Smillie et al. (2012) recently demonstrated that extraverts do not report increased positive affect in situations involving passive enjoyment (e.g., lying on a beach). Consistent with reward-sensitivity theories (e.g., Smillie, 2013), these individuals instead report positive affect specifically when pursuing rewards (e.g., trying to earn money). Thus, we desired labels more strictly tied to reward. Second, we

were concerned that more explicit category labels (i.e., “reward” and “punishment”) would cue images of radical behaviorism (e.g., Little Albert) for our young, psychology-student participants. In contrast, the labels of “benefit” and “cost” specifically convey the intended meaning without priming superfluous associations in our participant population.

2.2.3. Measures and procedures

2.2.3.1. Study 1 implicit association task. Study 1 participants arrived at the laboratory, provided informed consent, and began the implicit association test (IAT; Greenwald et al., 1998). Participants were told that their job was to categorize each stimulus as it was presented on screen. The task was divided into 5 blocks. At the start of each block, participants were told what categories of stimuli would appear in that block and which button to press for each stimulus category.

The logic of the IAT (Greenwald et al., 1998) is relatively straightforward: If a participant automatically associates two concepts with one another, it should be easier for them to pair these concepts with the same response, relative to different responses. Thus, an automatic association is revealed by faster RTs when the relevant categories are paired with the same response, relative to different responses (see Fig. 1, for a visual illustration).

Thus, there were two target blocks of substantive interest. Both blocks involved a mixed categorization task in which the participant categorized all four stimulus types (i.e., benefits, costs, people, & no-people) using two keys (i.e., the left & right arrow key). In the *congruent* block, response mappings were designed to match the expected association between people and benefits, as well as the expected association between the absence of people and costs (see Fig. 1, upper left, for an example trial). Participants were instructed to press the left arrow key for pictures containing no people and cost words and to press the right arrow key for pictures containing people and benefit words. In the *incongruent* block, these response mappings were altered to contradict the expected associations (see Fig. 1, lower right, for an example trial). Participants were instructed to press the left arrow key for pictures containing people and cost words, and they were instructed to press the right arrow key for pictures containing no people and benefit words.

The order of these two target blocks was counter-balanced across participants. Prior to each target block, participants completed practice blocks in which they were given practice with each categorization task in isolation. Thus, all participants first completed a block in which they practiced the cost/benefit categorization task in isolation (cost = left arrow; benefit = right arrow). These response mappings remained constant throughout the remainder of the task. Immediately prior to the congruent and incongruent target blocks, participants were given practice at the response mappings for the upcoming people/no-people categorization task in isolation (congruent practice: no-people = left arrow, people = right arrow; incongruent practice: people = left arrow, no-people = right arrow).

Each stimulus word was presented as center screen, and response mappings were displayed throughout the task. Participants were instructed to categorize each stimulus as quickly and accurately as possible using the displayed mappings. The word remained on-screen until a response was registered, and there was a 500 ms blank delay following correct responses. Incorrect responses were followed by a 1000 ms error message. Each exemplar of the relevant categories was presented once during each block in a random order. Thus, there were 20 trials during each practice block and 40 trials during each target block.

2.2.3.2. Study 2 single-category implicit association task. Study 2 participants arrived at the lab, provided informed consent, and



Fig. 1. Example trials from implicit association test, Study 1. Note: All stimuli appeared in both block types. Different stimuli types are inserted for illustration only.

337 completed a single-category implicit association test (SC-IAT; 338 Bluemke & Friese, 2008). The SC-IAT uses the same underlying 339 logic as the traditional IAT, and thus it provides an opportunity 340 for replication of Study 1’s results. Nonetheless, the SC-IAT 341 provides important additional information beyond the traditional 342 IAT, in that it can simultaneously provide separate indices of differ- 343 ent memory associations.

344 To do so, only one word type (i.e., either cost words or benefit 345 words) was presented during each target block (see Fig. 2 for a 346 visual illustration). “People” and “no-people” pictures were pre- 347 sented during all target blocks. As a result, participants completed 348 four block types of substantive interest: In the congruent-benefit 349 blocks, response mappings were designed to match the expected

350 association between people and benefits (i.e., press one key for 351 people & benefits; press another key for no-people; see Fig. 2, 352 upper left, for an example trial). In the incongruent-benefit blocks, 353 response mappings were designed to contradict the expected asso- 354 ciation between people and benefits (i.e., press one key for no-peo- 355 ple & benefits; press another key for people; see Fig. 2, upper right, 356 for an example trial). In the congruent-cost blocks, response map- 357 pings were designed to match the expected association between 358 the absence of people and costs (i.e., press one key for no-people 359 and costs; press another key for people; see Fig. 2, lower left, 360 for an example). In the incongruent-cost blocks, response mappings 361 were designed to contradict the expected association between 362 the absence of people and costs (i.e., press one key for people



Fig. 2. Example trials from single-category implicit association test, Study 2. Note: “People” and “no-people” pictures appeared in all block types; while “benefit” and “cost” words appeared only in benefit and cost blocks, respectively.

and costs; press another key for no-people; see Fig. 2, lower right, for an example).

The strength of participants' people–benefit association is revealed by faster responding during the benefit-congruent block, relative to the benefit-incongruent block. Similarly, the strength of each participant's no-people–cost association is revealed by faster responding during the cost-congruent block, relative to the cost-incongruent block.

Participants completed two target blocks of each type. For each block type, response mappings were counter-balanced across the two completions of that block type (e.g., 1st congruent-benefit block: left arrow = people & benefits; right arrow = no-people; 2nd congruent-benefit block: left arrow = no-people; right arrow = people & benefits). Prior to each target block, participants completed a practice block in which they practiced the response mappings for the upcoming people/no-people categorization task in isolation.

All blocks were completed in a random order. Participants were given instructions regarding which categories of stimuli would be presented within a given block and which keys to press for each category. Response mappings were displayed on screen throughout the task.

Within each block, all stimuli for the relevant categories were presented at least once. To ensure an equal frequency of both responses in the target blocks, each stimulus from the category requiring a unique response (e.g., the no-people pictures in the congruent-benefit block) was also presented a second time (Bluemke & Friese, 2008). Thus, there were 40 trials in each target block and 20 trials in each practice block. All stimuli were presented in a random order. Each stimulus was presented at center screen and remained on screen until a response was registered. There was a 500 ms blank pause following correct responses. Incorrect responses were followed by a 1000 ms error message.

2.2.3.3. Personality assessment. Following the IAT, participants from both studies completed a series of questionnaires containing Goldberg's (1999) freely-available, broad-bandwidth measure of extraversion (Study 1: $\alpha = .88$; Study 2: $\alpha = .89$). This scale contains 10 statements (e.g., "I am the life of the party") indicative of a person's tendencies toward extraversion. Five items are reverse-scored. Participants were asked to indicate how accurately each statement described them, using a 1 (extremely inaccurate) to 5 (extremely accurate) response scale. Goldberg is one of the leading advocates of the Big Five as a descriptive taxonomy of human personality (e.g., Goldberg, 1990), and he has extensively validated this scale (Goldberg, 1999). For example, it correlates highly with other widely-used and copyrighted measures of extraversion (e.g., Costa & McCrae's, 1992, NEO-PI extraversion scale). It exhibits superb discriminant validity (e.g., it exhibits lower correlations with other dimensions of the Big Five). Furthermore, it possesses superb test–retest reliability and internal consistency.

To provide evidence of discriminant validity, we also administered Goldberg's (1999) agreeableness and neuroticism scales. Agreeableness was assessed in both studies (10 items; 4 reverse-scored; Study 1: $\alpha = .82$; Study 2: $\alpha = .81$). Neuroticism was assessed in Study 1 only (10 items; 2 reverse-scored; $\alpha = .84$). Due to highly non-significant results with this construct in Study 1, neuroticism was not measured again as part of Study 2. These scales have also been extensively validated by Goldberg (1999). All additional questionnaires were included to distract participants' attention from the central hypothesis, and they are not of substantive interest. All questionnaires were administered to participants in a random order, and all questions within each questionnaire were administered in a random order as well.

2.2.3.4. Preparation of RT data. RT data was prepared for analysis according to the recommendations of Greenwald, Nosek, and

Banaji (2003). Specifically, we calculated the *D* algorithm recommended by these authors. Greenwald et al. found that this algorithm outperformed several alternative algorithms in terms of convergent validity (i.e., increased correlations with explicit attitude measures), discriminant validity (i.e., decreased correlations with overall RT, removal of other procedural artifacts), internal consistency, and experimental validity (i.e., sensitivity to known experimental influences on the IAT). Although this algorithm was originally designed specifically for use with the traditional IAT, we also applied it to the SC-IAT in Study 2 for the sake of consistency.

In accordance with Greenwald et al.'s (2003) recommendations, we first took two steps designed to eliminate the undue impact of outliers. Trials involving RTs longer than 10,000 ms were discarded (Study 1 & 2: <.01% of trials), and participants exhibiting RTs faster than 300 ms on greater than 10% of target trials were dropped from analyses (Study 1: 1 participant; Study 2: 0 participants). Next, participants' mean RT for each block type and their pooled SD across block types was calculated. To provide a RT-based index which also reflected error rates, RTs for trials involving an error were then replaced with each participant's average RT for that block plus 600 ms (Study 1: 5.4% of trials; Study 2: 4.5% of trials). Finally, participants' average error-corrected RT for each block type was calculated. These error-corrected RTs formed the basis of all normative analyses of patterns within the IATs themselves.

In order to test the hypothesized relationships between IAT performance and extraversion, we calculated Greenwald et al.'s (2003) *D* statistic itself. In Study 1, each participant's average error-corrected RT in the congruent block was subtracted from their average error-corrected RT in the incongruent block. This difference score was then divided by the participant's pooled SD (calculated prior to error-correction). In Study 2, this same procedure was performed separately for benefit and cost blocks.

3. Results

3.1. Study 1 normative analysis

A paired samples *t*-test indicated that the congruency manipulation significantly affected error-corrected RTs in Study 1, $t(141) = 13.38, p < .0001$. Participants responded faster during the congruent block ($M = 792$ ms; $SD = 168$) than the incongruent block ($M = 981$ ms; $SD = 222$ ms). Thus, the average participant responded faster when people were paired with the same response as benefits, and when the absence of people was paired with the same response as costs.

3.2. Study 1 extraversion analyses

Consistent with hypotheses, extraversion was positively correlated with the magnitude of the congruency effect in Study 1, $r = .18, p = .03$. To illustrate the nature of this effect, we next estimated the magnitude of the IAT congruency effect for participants high ($M + 1$ SD) and low ($M - 1$ SD) in extraversion (Aiken & West, 1991). These results are displayed in Fig. 3. The congruency effect was significant among introverted participants (mean $D = .48$; mean incongruent RT = 941 ms; mean congruent RT = 790 ms), $t(140) = 8.32, p < .0001$. However, this congruency effect was stronger among extraverted participants (mean $D = .66$; mean incongruent RT = 1021 ms; mean congruent RT = 795 ms), $t(140) = 11.43, p < .0001$.

3.3. Study 1 discriminant validity analysis

We next sought to test whether the IAT congruency effect was uniquely related to extraversion. Consistent with expectations, the

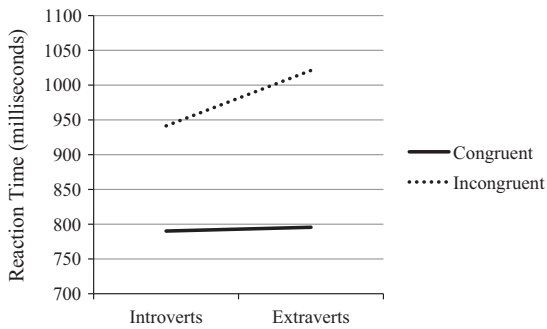


Fig. 3. Reaction time as a function of congruency and extraversion, Study 1.

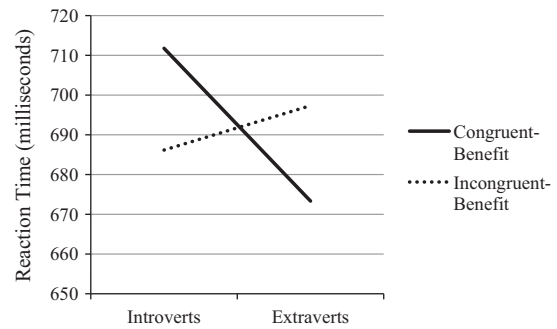


Fig. 4. Reaction time as a function of congruency and extraversion within Study 2's benefit blocks.

magnitude of the congruency effect was not significantly related to either agreeableness, $r = .13$, $p = .12$, or neuroticism, $r = -.09$, $p = .27$, at the zero-order level. Moreover, when extraversion, neuroticism, and agreeableness were simultaneously entered as predictors of the congruency effect in a multiple regression analysis, extraversion emerged as a nearly-significant predictor, $\beta = .15$, $p = .08$. However, neither neuroticism, $\beta = -.02$, $p = .78$, nor agreeableness, $\beta = .09$, $p = .28$, emerged as significant predictors. Because neuroticism's unique relationship with the congruency effect very closely approximated a null effect in Study 1, it was not assessed again in Study 2.

3.4. Study 2 normative analysis

In Study 2, error-corrected RTs were examined within a 2 (Word Type: benefit vs. cost) \times 2 (Congruency: congruent vs. incongruent) repeated measures ANOVA. The main effects of Word Type, $F(1, 125) = 4.58$, $p = .03$, and Congruency, $F(1, 125) = 9.44$, $p = .003$, were both significant. However, these main effects were qualified by a significant interaction, $F(1, 125) = 6.32$, $p = .01$.

Subsequent t -tests indicated that the congruency effect was significant within the cost blocks, $t(126) = 3.42$, $p = .0008$, such that RTs were faster in the congruent-cost blocks ($M = 686$ ms; $SD = 177$) relative to the incongruent-cost block ($M = 737$ ms; $SD = 215$) block. Counter to expectations, however, the congruency effect was not significant within the benefit blocks (congruent-benefit blocks: $M = 692$ ms; $SD = 179$; incongruent-benefit blocks: $M = 691$ ms; $SD = 151$), $t = .07$, $p = .94$. It therefore appears as though the average participant in this sample associates the absence of people with punishment, but does not associate the presence of people with rewards. Regardless, though, our main interest was in individual differences in these tendencies and their relation to extraversion. We now turn to analyses addressing this main hypothesis.

3.5. Study 2 extraversion analysis

Consistent with hypotheses, extraversion exhibited a significant positive correlation with the magnitude of the congruency effect in the benefit blocks, $r = .19$, $p = .03$, but not in the cost blocks, $r = -.12$, $p = .17$. To illustrate the nature of the significant hypothesized effect, we estimated the magnitude of the benefit-block congruency effect for participants high ($M + 1$ SD) and low ($M - 1$ SD) in extraversion (Aiken & West, 1991). These results are displayed in Fig. 4. As can be seen there, introverted participants did not display a significant benefit-block congruency effect (mean $D = -.05$; mean congruent RT = 711 ms; mean incongruent RT = 686), $t(124) = -1.27$, $p = .20$. In fact, these participants exhibited a non-significant tendency to respond faster in the incongruent-benefit blocks, relative to the congruent-benefit blocks. In contrast,

extraverted participants exhibited a nearly-significant benefit-block congruency effect (mean $D = .07$), $t(124) = 1.71$, $p = .09$, such that they were somewhat faster to respond in the congruent-benefit blocks ($M = 673$ ms) relative to incongruent-benefit blocks ($M = 697$ ms).

3.6. Study 2 discriminant validity analysis

We next sought to determine if effects were specific to extraversion or generalized to another aspect of the Big Five model, namely agreeableness. Consistent with expectations, agreeableness did not exhibit a significant zero-order correlation with the magnitude of the congruency effect in the benefit blocks, $r = .12$, $p = .15$, or the cost blocks, $r = -.02$, $p = .78$. Moreover, when agreeableness and extraversion were simultaneously entered as predictors of the benefit-block congruency effect in a multiple regression analysis, extraversion emerged as a significant predictor, $\beta = .18$, $p = .049$, but agreeableness did not, $\beta = .09$, $p = .28$.

3.7. Study 2 residual analysis

Because the SC-IAT provides an index which uniquely represents the strength of the people/benefit association in memory, it was possible to ask an additional question in Study 2: Are extraverts truly faster to pair people with reward during the benefit-congruent block specifically? Or are the above-obtained effects solely due to slower RTs in the incongruent block? This is an important question because it is most straightforward to propose the extraverts have a stronger excitatory connection between the concept of people and reward, which is most directly reflected by faster RTs during the benefit-congruent block of Study 2.

To answer this question, it was first important to remove variance in RT which could be explained in terms of general-purpose processing speed. Processing speed has been linked to fluid intelligence in past research (e.g., Fry & Hale, 1996) and is generally considered a nuisance variable when using RT measures to assess implicit associations in memory (e.g., Greenwald et al., 2003). Consistent with the presence of such a nuisance variable, RTs within the benefit-congruent and benefit-incongruent block were strongly correlated with one another, $r = .73$, $p < .0001$. To remove this variance, we used a linear regression analysis to calculate a residual score. This score represents variance in benefit-congruent block RTs which could not be explained in terms of variance in benefit-incongruent block RTs. While this variable remained highly correlated with error-corrected RTs in the benefit-congruent block, $r = .69$, $p < .0001$, it was completely uncorrelated with RTs in the benefit-incongruent block (i.e., $r = 0$).

Consistent with hypotheses, extraversion exhibited a significant, inverse correlation with this residual score at the zero-order level, $r = -.20$, $p = .03$, indicating that extraverts were faster to

respond when people were paired with benefits. Agreeableness was not significantly correlated with this variable at the zero-order level, $r = -.15$, $p = .10$. Moreover, when extraversion and agreeableness were simultaneously entered as predictors of residual RTs in the benefit-congruent block, extraversion emerged as a significant predictor, $\beta = -.18$, $p = .046$, but agreeableness did not, $\beta = -.12$, $p = .17$. This suggests that high levels of extraversion are uniquely related to a stronger excitatory connection in memory between the categories of people and reward.

4. General discussion

4.1. Summary of hypotheses and results

Recent theories have contended that high levels of extraversion are the result of a highly sensitive reward system (e.g., Carver et al., 2000; Depue & Collins, 1999; Elliot & Thrash, 2002; Smillie, 2013). A large amount of data is consistent with this assertion (see Smillie, 2013; Wilt & Revelle, 2009, for reviews). Nonetheless, individual differences in sociable behaviors remain an important feature of this personality dimension (Ashton et al., 2002). It is not immediately clear why sociable behaviors would be so central to a personality dimension which is determined by the sensitivity of the reward system. To help understand why this is the case, we built upon proposals suggesting that social situations are quite frequently rewarding for human beings (Lucas et al., 2000). Because extraverts more effectively condition to reward (Matthews & Gilliland, 1999; Smillie et al., 2006), these individuals should have developed stronger implicit memory associations between people and rewards.

Two studies were conducted to test this prediction. In Study 1, participants completed an IAT (Greenwald et al., 1998), assessing the strength of participant's automatic association between people and rewards. A shortcoming of this paradigm is that it cannot provide separate indices of the people–reward association and the no-people–punishment association (Quek & Ortony, 2012). To provide separate indices along these lines, Study 2 used a single-category IAT (Bluemke & Friese, 2008). Across studies, the results were consistent: Relative to introverts, extraverts displayed a stronger implicit association between people and reward.

Several features of these studies also helped to rule out alternative explanations. First, this effect could not be explained in terms of other pertinent aspects of the Big Five. Extraversion's relationship with implicit people–reward associations remained largely significant after controlling for agreeableness and neuroticism. Second, Study 2 indicated that extraversion was not systematically related to the implicit memory association between punishments and the absence of people. Finally, extraversion was also significantly related to faster RTs within the benefit-congruent blocks of Study 2, thus providing a rather specific and rigorous test of the proposal that extraversion is related to the strength of an excitatory connection between people and reward.

Beyond this, several features of the results indicate that these results are due to a true memory association between people and rewards, and not to procedural artifacts. For example, Rothermund and Wentura (2004) contended that congruency effects in the IAT can sometimes result from salience rather than memory associations. When each category contrast within an IAT involves a more salient category, participants are faster to pair these two salient categories with the same response even in the absence of a true memory association. However, the current results cannot be explained in this manner. Within the current study, the concept of “people” was clearly more salient than the background category of “no-people”. Rothermund and Wentura argued that negative concepts are more salient than positive concepts (cf.

Pratto & John, 1991; Wentura & Rothermund, 2003). Thus, a salience account would suggest that participants would be faster to pair the salient category of people with the negative concept of costs. In contrast to this, participants in the current studies were actually faster to pair costs with the background category of “no-people”. Thus, a salience-based explanation of these results is not viable.

Deutsch and colleagues have also suggested that negation exhibits many characteristics of controlled processing (Deutsch, Gawronski, & Strack, 2006; Deutsch, Kordts-Freudinge, Gawronski, & Strack, 2009), calling into question whether our IATs can appropriately measure associations to the category of “no-people”. This may be problematic if this category was a central aspect of the current studies' results. However, Study 2 indicated that extraverts specifically displayed a stronger implicit association between people and rewards, and that the category of “no-people” or punishments was not central to these findings. In summary, the current findings appear to reflect a true memory association between people and rewards, rather than procedural artifacts.

Nonetheless, the current studies can of course not answer all questions related to this topic. An important debate in the literature is whether extraversion is uniquely related to sociability or not. Ashton et al. (2002) have argued that the tendency to seek social attention is indeed central to extraversion; while Lucas et al. (2000) and Lucas and Baird (2004) have argued that the increased sociability of extraverts is simply one reflection of a broader tendency to seek out rewarding situations. According to this latter perspective, then, extraverts would exhibit an equally strong tendency to associate reward with non-social incentive stimuli (e.g., food, money, intoxicants); while the theory of Ashton et al. would suggest that extraverts would more strongly associate people with reward, relative to non-social incentives. The current study was not designed to address this debate. Because of the centrality of sociability to extraversion, we deemed it important to first assess whether extraversion was related to the implicit people–reward association in memory at all. Nonetheless, we strongly encourage future researchers to study this issue by examining whether extraverts more strongly associate non-social incentives with reward, relative to social stimuli.

4.2. Does the average person associate people with rewards?

A surprising aspect of Study 2's results was that the average participant did not implicitly associate people with rewards. Based on a straightforward people-as-rewards model (e.g., Lucas et al., 2000), one would expect this association to appear in the population at large. Past research suggests that social situations are experienced as rewarding. Many social situations – including social acceptance (Blackhart et al., 2009), social power (Keltner et al., 2003), and simply interacting with another person (e.g., Clark & Watson, 1988; Emmons & Diener, 1986) – all evoke positive emotions.

We would first like to emphasize that the null association between people and reward at the normative level should be replicated before any strong conclusions are made. This finding neither predicted nor a central focus of the current studies. Moreover, it may also depend upon the particular nature of the social stimuli employed. While past studies indicate that, in general, social interactions are experienced as positive in people's daily lives (e.g., Clark & Watson, 1988), these interactions do not consist of a participant passively staring at a static image of strangers. Instead, it is likely that most daily social situations consist of a participant actively interacting with friends and loved ones who are known to accept and like the participant. Thus, past studies focus on very different stimuli than the current study.

Beyond this, research shows that not all social situations are experienced as enjoyable. The experiences of social rejection (Blackhart et al., 2009; Nezlek, Wesselman, Wheeler, & Williams, 2012) and low power (Keltner et al., 2003) are most certainly not enjoyable. Moreover, shallow conversations (Mehl, Vazire, Holleran, & Clark, 2010) and impersonal interactions (e.g., with classmates or co-workers; Csikszentmihalyi & Hunter, 2003) are also not associated with positive emotional reactions. It may therefore be important to dissect social situations in more detail in order to discover the situations which the average person associates with reward. It seems quite likely that the average person would implicitly associate the concepts of “friends” or “social acceptance” with reward. As the current studies demonstrate, though, only some individuals associate strangers or the broader category of “people” with reward. These tendencies are systematically linked to the trait of extraversion.

4.3. *Introversion and the anticipation of positive affect in social situations*

It is interesting to note that when introverts are in a highly social situation, even they respond with positive affect (see Zelenski et al., 2013). Nonetheless, these individuals do not expect this to be the case. Instead, these individuals expect to feel embarrassed and self-conscious in social situations. Based on such findings, Zelenski et al. (2013) has argued that introverts display an *affective forecasting error* (see Wilson & Gilbert, 2005). These individuals do not expect socializing to be enjoyable, but in fact they do find it enjoyable once they engage in it. Viewed from this perspective, the current results may suggest that this cognitive error may extend even to the implicit level. Even though social situations are quite enjoyable, introverts have failed to form memory associations accurately reflecting that this is the case. Perhaps as a result, they fail to seek out these situations.

An alternative (and perhaps complementary) way of viewing these results is from a motivational perspective. Neurological researchers have long distinguished between *wanting* and *liking* (Berridge, 2009; Berridge & Robinson, 2003). Wanting refers to the anticipatory desire to obtain a reward, while liking refers to the feeling of satisfaction that occurs following the attainment of a reward. Research indicates that wanting and liking are distinct psychological states supported by separate neurological regions. It has been argued that extraversion is specifically related to *wanting* and not to *liking* (Smillie, 2013). Consistent with this, Smillie et al. (2012) recently found that extraverts only report higher levels of positive affect when they are actively pursuing rewards. In situations involving passive enjoyment, extraverts report levels of positive affect which are statistically equivalent to introverts.

Viewed from this perspective, implicit associations to reward may be viewed as part of the *wanting* system. Such associations form following the attainment of reward from a specific stimulus (e.g., other people), but their main function is to motivate individuals to seek out the relevant stimulus in the future (Custers & Aarts, 2007). Thus, introverts may find social situations as enjoyable as extraverts (see Zelenski et al., 2013). Nonetheless, they possess a less active *wanting* system and fail to implicitly associate social situations with reward. Perhaps as a result, introverts fail to seek out rewarding social situations in the future. Future research should systematically examine this possibility.

4.4. *The function of implicit associations between people and reward*

The current results may also help to explain the typical consequences of extraversion. Many studies have shown that introverts seek out social situations less frequently (Lucas et al., 2008; Mehl et al., 2006; Srivastava et al., 2008), report higher levels of

loneliness (e.g., Asendorpf & van Aken, 2003; Cacioppo et al., 2006; Stokes, 1985) and depression (see Kotov, Gamez, Schmidt, & Watson, 2010, for a meta-analysis). Implicit associations between people and reward may provide one psychological mechanism explaining these outcomes.

Aarts and colleagues have conducted an impressive body of research on the function of implicit positive affect (see Aarts, 2007, for a review). These authors have argued that when positive affect is implicitly associated with a goal object, individuals become more strongly motivated to attain that goal. Consistent with this, Custers and Aarts (2007) found that individuals who display stronger implicit associations between socializing and positive affect invested more effort to enter a social situation. Beyond this, Custers and Aarts (2005) also found that experimentally creating implicit associations to positive affect increased the effort participants would invest to obtain a desired outcome (cf. Aarts, Custers, & Marien, 2008). Given this, future research should investigate whether people–reward associations mediate the effects of extraversion on socialization.

Perhaps more substantively, though, this account may provide a non-obvious means of motivating introverts to seek out social situations and overcome feelings of loneliness. Studies clearly show that implicit associations can be experimentally created through conditioning procedures (Hermans et al., 2003). While introverts may take longer to form these implicit associations due to their less sensitive reward system (Smillie, 2013), extended conditioning procedures should eventually be successful even for these individuals. If successful, such conditioning procedures could motivate introverts to seek out social situations. Beyond this, these protocols may even prove to be an effective means of alleviating the increased levels of loneliness (e.g., Cacioppo et al., 2006) and depression (Kotov et al., 2010) associated with introversion.

5. **Uncited reference**

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