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By the Numbers: Structure-Seeking Individuals Prefer Quantitative Over Qualitative Representations of Personal Value to Compensate for the Threat of Unclear Performance Contingencies

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Abstract

What combination of dispositional and situational factors leads people to represent their personal value in quantitative terms (e.g., salary) rather than qualitative terms (e.g., virtue)? Integrating research on quantitative information seeking, dispositional epistemic motivation, and learned helplessness, the current article hypothesized that individuals high, but not low, in uncertainty avoidance (measured with the Personal Need for Structure Scale [PNS]) would prefer quantitative (over qualitative) value representations to compensate for the diminished self-esteem certainty caused by exposure to unclear performance contingencies. Accordingly, in Study 1 high-PNS participants exposed to unclear (vs. clear) performance contingencies in one domain (visual intelligence) preferred a quantitative value representation in another domain (verbal intelligence). Study 2 showed that this effect is mediated by self-esteem certainty, not self-esteem level. Study 3 included a failure feedback condition to further isolate the role of epistemic motivation, as distinct from self-enhancement motivation, in driving the tendency to quantify personal value.

Keywords

self-esteem, information seeking, defensive processes, self-evaluation, motivation and performance

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Many conceptualizations of self-esteem and its important role in human behavior have been proposed over the years (e.g., Allport, 1937/1961; Tesser, 1988). Theory and research has made considerable strides in understanding the many tactics that people use to bolster their self-esteem and defend it against threats (e.g., Fein & Spencer, 1997; Steele, 1988). Research has also made progress in understanding different types of self-esteem (e.g., implicit vs. explicit; Greenwald & Farnham, 2000), individual differences in the stability of self-esteem across social situations (Kernis & Waschull, 1995), and the distal motivations that drive self-esteem enhancement and defense (Pyszczynski, Greenberg, Solomon, Arndt, & Schimel, 2004).

In contrast, relatively little empirical attention has been devoted to understanding how people represent their personal value, and the dispositional and situational factors that influence people's preference for certain value representations over others. In this article we address this issue by studying how personality and contextual factors interact to influence people's preference for quantitative over qualitative

value representations. Quantitative value representations are scores along a numeric metric, such as: 140 IQ, \$30,000 salary, 100 volunteer hours per year, zero first-authored publications. Qualitative value representations are abstract evaluations of one's performance within a domain, such as good friend, devout Christian, creative artist, sloppy mechanic.

Prior research suggests that how people choose to represent their value carries important consequences for social behavior and mental health. For example, Crocker and Wolfe (2001) have shown that individuals who stake their self-esteem on concrete standards (e.g., physical appearance) are more likely to react defensively to personal setbacks than individuals who base their self-esteem on more abstract standards. Researchers (e.g., Pyszczynski, Greenberg, &

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Goldenberg, 2003) have also suggested that quantitative value representations may put the person at risk for self-esteem threats, because variability in concrete quantitative metrics leaves little latitude for flexibility in interpreting the implications of social events for one's worth. Reliance on quantitative value representations may also be associated with investment in materialistic goals (Kasser, Ryan, Couchman, & Sheldon, 2004), which has been linked to reduced happiness (Belk, 1988) and well-being (Kasser & Ryan, 1993). Given these potentially negative consequences of overreliance on quantitative value representations, why might some people gravitate toward these representations over comparable qualitative value representations?

Maintaining Self-Esteem Certainty: A Function of Quantitative Self-Value Representations

One answer is suggested by research showing that people generally perceive quantitative information to be more certain than comparable qualitative information. For example, although qualitative information tends to be perceived as more "natural" and easier to communicate than quantitative information (Bu-descu & Wallsten, 1987), quantitative information is nevertheless perceived as more precise and unequivocal (Behn & Vaupel, 1982; von Winterfeldt & Edwards, 1986).

This work suggests that people will prefer quantitative over qualitative information when they are motivated to maintain certain knowledge. Indeed, studies have shown that when people make decisions about uncertain future events, such as their chance of winning a gambling scenario or experiencing negative side effects from a drug, they prefer and trust quantitative over qualitative information (e.g., "80% chance" vs. "very likely"; Erev & Cohen, 1990; Fischer & Jungarmann, 1996). This is true despite the fact that the ultimate decisions made in these scenarios often do not differ as a function of how the relevant information is communicated (Erev & Cohen, 1990; Gonzalez-Vallejo, Erev, & Wallsten, 1994). This research suggests that people gravitate toward quantitative information not to improve outcomes but to satisfy a motive to maintain certain knowledge.

As it pertains to how people conceptualize their personal value, this prior work suggests that people prefer quantitative value representations because they afford more certain knowledge of their value than comparable qualitative value representations. Thus, although some evidence suggests that qualitative value representations can guard against decreases in overall *level* of self-esteem (Pyszczynski et al., 2003), people may prefer quantitative value representations when they are motivated to avoid threats to their *epistemic certainty* about their self-esteem. If this is the case, the preference for quantitative value representations should be moderated by individual differences in the motivation to avoid threats to self-esteem certainty.

Individual Differences in Sensitivity to Self-Esteem Certainty Threats

Insofar as self-esteem certainty is based on certain knowledge about the self's value (Maracek & Mettee, 1972), individuals who are generally motivated to maintain certain knowledge should be especially sensitive to threats to self-esteem certainty. Researchers have proposed a number of constructs to capture the general motivation to maintain certain knowledge (see Kruglanski, 2004, for discussion). We focus on Personal Need for Structure (PNS; Neuberg & Newsom, 1993; Thompson, Naccarato, Parker, & Moskowitz, 2001) because it is a well-validated and widely used measure of individual differences in the desire to maintain certain knowledge.

It is important to note that high-PNS individuals do not suffer from a chronic lack of certainty; rather, they are characterized by an acute sensitivity to situations that might threaten an existing state of certainty (Neuberg, Judice, & West, 1997). This sensitivity manifests in a range of compensatory efforts to restore certainty in such situations (Neuberg et al., 1997). For example, PNS correlates positively with reliance on simple stereotypes and heuristics in impression formation primarily in situations where information about others is ambiguous (Neuberg & Newsome, 1993). In contrast, low-PNS individuals have a high tolerance for uncertain situations, do not experience them as threatening, and do not respond to such situations with compensatory efforts to restore certainty.

In summary, research on dispositional epistemic motivation shows that high-PNS individuals are more likely than their low-PNS counterparts to respond to uncertainty-arousing situations with compensatory efforts to restore certainty. Additionally, the aforementioned work on quantitative information seeking suggests that quantitative value representations afford more self-esteem certainty than comparable qualitative representations. Combining these separate lines of research, we would expect individuals high, but not low, in PNS to respond to situations that threaten their self-esteem certainty with an increased preference for quantitative over qualitative value representations. But what type of situations will pose a threat to high-PNS individuals' self-esteem certainty?

Unclear Performance Contingencies as a Situational Threat to Self-Esteem Certainty

Building in part on Seligman's (1975) work on learned helplessness theory, Berglas and Jones (1978) theorized that exposure to tasks that lack clear performance contingencies increase uncertainty about one's worth. More specifically, in situations where people receive feedback that makes it difficult to decipher how their success and failure outcomes are contingent on their performance, they are likely to feel

uncertain about whether that feedback reflects their ability or some external factor, such as luck, and therefore doubt the likelihood of future success.

Berglas and Jones (1978) proposed that people cope with such self-relevant uncertainty by self-handicapping, creating obstacles to their performance to preempt future failures. Supporting this idea, these authors showed that participants led to take part in a task with unclear performance contingencies engaged in more self-handicapping. Harris and Snyder (1986) subsequently showed that individuals who are dispositionally low in self-esteem certainty engage in more self-handicapping behaviors overall, regardless of their self-esteem level. This finding suggests that self-handicapping in response to unclear performance contingencies is specifically driven by the motivation to maintain self-esteem certainty, independent of the motivation to maintain or bolster self-esteem level. Taken together, this work suggests that unclear performance contingencies can induce a situational threat to self-esteem certainty.

Insofar as high-PNS individuals are especially sensitive and reactive to threats to self-esteem certainty, these individuals should be more likely than their low-PNS counterparts to respond to unclear performance contingencies with compensatory efforts to affirm self-esteem certainty. Accordingly, Mikulincer, Yinon, and Kabili (1991) found that when participants received task feedback not clearly contingent on their performance (as opposed to receiving no feedback), those high, but not low, in PNS were especially likely to self-handicap on another, unrelated task. This research clearly demonstrates a Disposition \times Situation interaction centered on self-esteem certainty concerns.

The Current Research

The current studies assess a similar interaction effect as that studied by Mikulincer et al. (1991) but focus on a different type of compensatory response to self-esteem certainty threats, namely, the preference for certain types of personal value representations over others. In light of the aforementioned research showing that quantitative information is perceived as generally more certain than qualitative information, we hypothesized that high-PNS individuals would compensate for the threat to self-esteem certainty posed by unclear performance contingencies by preferring quantitative over qualitative value representations. Because this hypothesized effect involves the interaction of dispositional sensitivity to uncertainty and a situational threat to self-esteem certainty, we did not expect either factor alone to increase preference for quantitative value representations.

Drawing in part on existing manipulations of contingency clarity (e.g., Berglas & Jones, 1978; Mikulincer et al., 1991), we manipulated the perceived clarity of performance contingencies in Studies 1 and 2 by having participants complete an ostensible visual intelligence test that involved

either a line-matching task, in which feedback on success and failure appeared to be clearly contingent on performance, or a card-matching task, in which it was unclear how success and failure feedback was contingent on performance. In Study 3 all participants completed the same card-matching task but were randomly assigned to receive feedback not clearly contingent on performance, no feedback, or feedback clearly indicating they failed. In all studies, following the "visual intelligence test," participants were presented with both quantitative and qualitative indices of their performance on an ostensibly unrelated test of verbal intelligence. We measured how much participants liked each value index and how much they perceived it to be an accurate representation of their value in the verbal intelligence domain.

Our guiding analysis suggests that exposure to a performance task with unclear performance contingencies will increase the preference for quantitative value representations among high-PNS individuals by eliciting feelings of global self-esteem uncertainty. However, an alternative possibility is that unclear performance contingencies threaten high-PNS individuals' overall self-esteem level and will therefore increase preference for quantitative value representations as a means of restoring self-esteem. This is unlikely because there is no prior evidence that variations in PNS predict sensitivity to threats to self-esteem level. Nevertheless, we took three approaches to assessing this alternative possibility. First, in Studies 1 and 2 we predicted that high-PNS participants would prefer the quantitative value index in the unclear contingency condition compared to the clear contingency condition even when participants in both conditions received equivalent feedback about their overall performance on the visual intelligence test. Furthermore, in Study 3 we included a comparison condition in which participants received clear feedback that they failed the test. If the preference for quantitative value representations compensates for threats to self-esteem level, we would expect high-PNS participants in this failure condition to show increased preference for the quantitative value index. However, if this preference compensates for threats to self-esteem certainty elicited by unclear performance contingencies, as we claim, receiving clear failure feedback would not increase high-PNS participants' preference for quantitative value representations.

Second, we predicted that the hypothesized effects would be obtained even if high-PNS participants did not perceive the quantitative value index to be more positive in valence or to serve as a source for self-enhancing social comparisons, compared to the qualitative value index. Third, we predicted that the hypothesized effects would be mediated by high-PNS participants' self-reported feelings of self-esteem certainty, but not self-esteem level, factors that have been shown to be independent in prior research (Harris & Snyder, 1986; Luxton, Ingram, & Wenzlaff, 2006).

Study 1

Study 1 provided an initial test of our hypothesis that high-PNS individuals exposed to unclear performance contingencies on an ego-relevant task would more strongly prefer a quantitative (over a qualitative) representation of their value in another domain. Participants completed what was purported to be a well-validated test of visual intelligence. Depending on condition, participants received success–failure feedback after each trial that was ostensibly either clearly contingent on their responses or not clearly contingent. To isolate the effect of perceived contingency clarity from that of feedback valence, we arranged the feedback so that in both conditions participants were told they were correct on the same number of trials.

Then, in an apparently unrelated part of the study, participants received quantitative and qualitative indices of their verbal intelligence, ostensibly based on an earlier assessment. They rated how much they liked each index and how accurately it represented their verbal intelligence. We predicted that high-PNS participants in the unclear performance contingency condition would show a stronger preference for the quantitative verbal intelligence index compared to high-PNS participants in the clear contingency condition and low-PNS participants in both contingency conditions.

Method

Seventy-three undergraduates (32 men, 41 women) received course credit for participating in what was purported to be an investigation of newly developed computerized methods for assessing verbal intelligence. In private cubicles, participants completed all the study materials on computers using a program developed with MediaLab software (Jarvis, 2004).

PNS. Participants were first asked to complete questionnaires to provide information on their personal characteristics. Thompson et al.'s (2001) PNS scale followed two filler questionnaires (experimenter-fabricated scales of media preferences and morningness–eveningness) included to support the cover story. Participants indicated their agreement with 12 statements (e.g., “I enjoy having a clear and structured mode of life”) on a 6-point scale (1 = *strongly disagree*, 6 = *strongly agree*). Scores on the 12 items showed good internal reliability ($\alpha = .87$) and were therefore averaged (after appropriate reverse scoring) to form a composite PNS score, with higher scores indicating greater PNS.

Next, participants completed what was purported to be a verbal intelligence test. They were instructed to write an essay on the topic of “tradition versus modernization” (ostensibly chosen at random from a list of topics adapted from the Graduate Records Examination). Participants wrote for 8 min, after which the computer informed them that their essay would be submitted to two text analysis programs that use different, but equally sophisticated, computational methods for assessing verbal intelligence.

Contingency manipulation. The instructions then informed participants that the text analysis programs required a few minutes to run and that in the meantime they would complete a visual intelligence test called the “Carnahan Visual Ability Test.” To convince participants that this test assessed their performance in an ego-relevant domain, we told them that scores on this test are a proven indicator of career success and future earning potential.

The test constituted our contingency clarity manipulation. Participants randomly assigned to the *unclear contingency condition* were presented with a task modeled after the Wisconsin Card Sort Test (Beaumont, 1981). For each of 10 trials, participants were presented on the computer monitor with a “target” card and four “comparison” cards depicting various shapes and colors (e.g., four blue triangles). They were instructed to choose which of the comparison cards matched the target card. Immediately after each response, participants viewed a screen informing them whether their response was correct or incorrect. In actuality, the feedback was prefabricated such that the computer identified half their answers as correct and the other half as incorrect based on a fixed random order. Essentially, although the feedback indicated that participants were performing well above chance levels, the lack of clear contingency between success–failure feedback and performance left them with no certain basis for determining whether the feedback was indicative of their ability.

Participants assigned to the *clear contingency condition* were presented with an image of four entangled lines and instructed to visually track a single “target” line from the left side of the screen to the right side, and to click on the button corresponding to the target line’s end point. Participants were told that they were being timed, and after each response they viewed a screen informing them whether their response was made within the allotted time (correct) or not (incorrect). As in the unclear contingency condition, the feedback was randomized such that participants were told that half their responses were correct and half incorrect. However, in contrast to the unclear contingency condition, participants in this condition could clearly understand why their responses were correct or incorrect, namely, because they either were or were not made within the allotted time. Since participants were unaware of the amount of time (supposedly) being allotted for each trial and the exact amount of time they actually took to respond, they could assume that the feedback they were receiving (which had no actual connection to their performance) was clearly contingent on whether they were giving a correct answer within the time limit.

Quantitative and qualitative indices of verbal intelligence and ratings. After completing the visual intelligence test, participants were presented with the ostensible output of the two text analysis programs purported to have analyzed their writing sample. All participants received both quantitative and qualitative indices of their verbal intelligence, labeled either

as “Scoring Method A” or “Scoring Method B” (order of presentation was counterbalanced).

The qualitative value index presented participants with short comments evaluating their vocabulary, grammar, sentence complexity, and sentence diversity, plus a summary comment evaluating their overall verbal intelligence (see Appendix A). The quantitative value index presented participants with numerical scores (e.g., 17.02 out of 20 possible = 85%) for the same four writing skills as well as a composite verbal intelligence score (see Appendix B). We designed the two value indices to be equivalent in overall valence and to provide no information that participants could use to compare their performance with other people’s performance, such as percentile scores.

After viewing each value index, participants responded to two questions: “How much do you like the feedback provided by this scoring method?” and “In your opinion, to what extent does the feedback provided by this scoring method capture your true intelligence?” Responses were made on a 7-point scale (1 = *not at all*, 7 = *very much*) and were averaged to form separate ratings for the quantitative ($\alpha = .71$) and qualitative ($\alpha = .66$) value indices.

To test the alternative possibility that the hypothesized effect is due to participants’ perception that the quantitative value index was more positive in valence than the qualitative value index, we asked participants to rate the positivity of both indices: “How positive is the feedback provided by this scoring method?” (1 = *not at all positive*, 7 = *very positive*).

Results

Preliminary analyses. In this and the following studies, the analyses were originally conducted with gender and the presentation order of the value indices as between-groups factors. In none of the studies did we observe main effects or interactions involving gender ($ps > .31$) or order ($ps > .35$). To simplify the presentation of results, we do not mention these factors further.

Primary analysis. We created a difference score by subtracting participants’ average rating of the qualitative value index from their average rating of the quantitative value index, such that higher scores indicate greater preference for the quantitative value index. To test whether exposure to unclear contingencies on the visual intelligence test increased high-PNS participants’ preference for the quantitative value index, we regressed these difference scores onto contingency condition (unclear vs. clear; dummy coded), PNS (continuous and centered), and their interaction.¹ We observed a main effect for PNS, which was qualified by the predicted two-way interaction, $\beta = .42$, $SE = .28$, $t(69) = 2.38$, $p = .02$. We plotted the interaction in Figure 1 using 1 *SD* above (high-PNS) and below (low-PNS) the centered mean of PNS (as recommended by Aiken & West, 1991).

As predicted, simple slopes analyses revealed that when it was unclear how task feedback was contingent on one’s performance on the visual intelligence test, PNS was positively

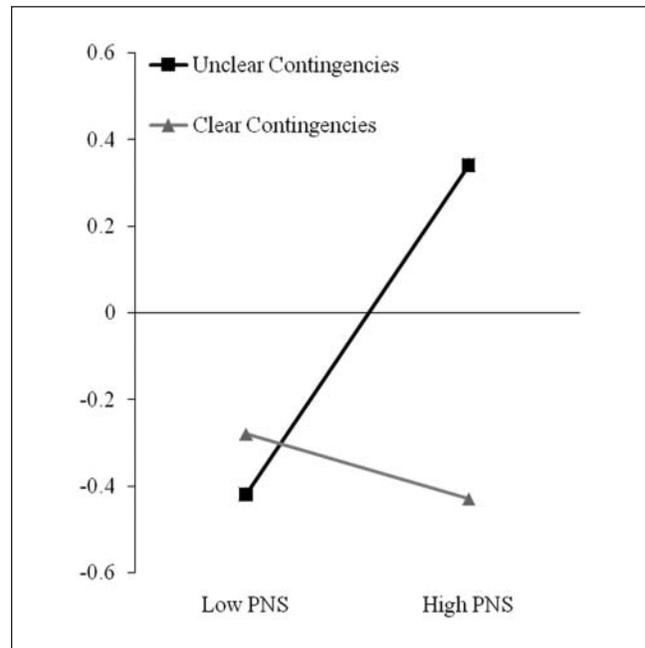


Figure 1. Preference for the quantitative verbal intelligence index (minus the qualitative index) as a function of visual intelligence contingency condition and Personal Need for Structure (PNS), Study 1

Higher scores indicate greater preference for the quantitative value index.

associated with preference for the quantitative value index, $\beta = .46$, $SE = .18$, $t(69) = 3.23$, $p < .01$. In contrast, when performance contingencies were clear, PNS did not predict preference for the quantitative value index, $\beta = -.08$, $t = -0.45$, $p = .65$. Also supporting predictions, comparison of the predicted means at 1 *SD* above the centered PNS mean showed that high-PNS participants reported a stronger preference for the quantitative value index in the unclear contingency condition compared to the clear contingency condition, $\beta = .41$, $SE = .30$, $t(69) = 2.56$, $p = .01$. Comparison of the predicted means for low-PNS participants revealed no simple effect of contingency condition, $\beta = -.13$, $t = -0.81$, $p = .42$.

Secondary analysis. We assessed possible differences in the perceived valence of the two value indices by submitting the two positivity ratings to a Value Index Type \times Contingency Condition \times PNS mixed-model ANOVA, with value index type serving as a within-subjects factor. We found a marginal main effect for value index type, such that participants tended to rate the qualitative value index more positively than the quantitative value index, $F(1, 69) = 3.14$, $p = .08$. As expected, no interactions emerged as significant ($F_s < 0.81$, $ps > .22$). To further ensure that our effect of primary interest was not the result of differences in the perceived valence of the value indices, we conducted the primary regression analysis controlling for positivity ratings, and the predicted Contingency Condition \times PNS interaction remained statistically intact ($p = .04$).

Discussion

Supporting the hypotheses, Study 1 found that when it was unclear (vs. clear) how success–failure feedback was contingent on performance in one esteem-relevant domain, individuals dispositionally high in PNS preferred a quantitative over a qualitative representation of their value in another domain. The absence of main effects for PNS and contingency condition is consistent with our hypothesis that these variables interact to influence preference for self-value quantification. More specifically, high-PNS individuals' dispositional sensitivity to certainty threats predicted a preference for a quantitative value representation in the presence of a situational certainty threat (i.e., unclear performance contingencies), whereas PNS did not predict preference for a quantitative value representation in the absence of a certainty threat. This interaction effect is consistent with prior research showing that individual differences in PNS predict efforts to affirm certainty most reliably in situations where uncertainty is salient (Mikulincer et al., 1991; Neuberg & Newsome, 1993).

The findings of Study 1 support our broad claim that self-value quantification stems from the motive to maintain certain self-knowledge, independent of the motive to bolster self-esteem level. For one, the hypothesized effect emerged despite participants rating the qualitative value index as marginally more positive overall, and it remained intact after controlling for the perceived positivity of the two value indices. An alternative explanation of this effect based on self-enhancement motivation would also have difficulty explaining the moderating role of PNS, since there is no evidence that high-PNS individuals are more motivated than low-PNS individuals to bolster self-esteem level.

Of course, an even stronger case for the unique role of epistemic motivation would be provided by evidence that the hypothesized effect is mediated by a decrease in global self-esteem certainty following unclear performance contingencies but is not mediated by variations in self-esteem level. Study 2 tested this possibility.

Study 2

The first goal of Study 2 was to directly test whether the Contingency Condition \times PNS interaction found in Study 1 is mediated by feelings of self-esteem certainty, not self-esteem level. Following the contingency manipulation used in Study 1, we measured self-esteem level and self-esteem certainty following Luxton et al.'s (2006) procedure.

A second goal of Study 2 was to address a possible alternative explanation for the effect found in Study 1. Even though across conditions participants received equivalent success–failure feedback on their overall performance (five correct and five incorrect), it is possible that participants

in the unclear contingency condition perceived the visual intelligence test as more difficult, or perceived themselves as performing worse, compared to those in the clear contingency condition. As a result, they may have inferred that they also performed poorly on the verbal intelligence test. Because we found in Study 1 that participants perceived the quantitative value index as (marginally) less positive than the qualitative index, perhaps participants simply preferred information that validated that they performed poorly (an interpretation that would follow, for example, from self-verification theory; Swann, Rentfrow, & Guinn, 2003). To assess this alternative, we measured participants' perceptions of the visual intelligence test's difficulty and their own test performance. Because our guiding analysis emphasizes the role of perceived performance contingencies, we did not expect ratings on these dimensions to differ as a function of condition or to account for the effects of primary interest.

Method

Sixty-five undergraduates (27 men, 38 women) took part in the study for course credit. The procedure for Study 2 was identical to Study 1 except that we measured self-esteem, self-esteem certainty, and participants' perceptions of the visual intelligence test's difficulty and their own performance.

Self-esteem and self-esteem certainty. As in Study 1, participants completed the PNS scale ($\alpha = .74$), completed the writing portion of the verbal intelligence test, and completed the visual intelligence test, which again served as our manipulation of contingency clarity. Directly following the visual intelligence test, participants completed Rosenberg's (1965) Self-Esteem Scale (RSES), indicating their agreement with 10 statements such as, "On the whole, I am satisfied with myself" (1 = *strongly disagree*, 4 = *strongly agree*). Following a procedure described by Luxton et al. (2006), we measured self-esteem certainty by asking participants to rate how certain they felt about their response to each RSES item (1 = *not at all certain*, 10 = *very certain*). Separate self-esteem ($\alpha = .84$) and self-esteem certainty ($\alpha = .92$) scores were created by averaging responses across the relevant items (after appropriate reverse scoring).

Perceived test difficulty and performance ratings. Afterward, participants received the quantitative and qualitative value indices of verbal intelligence (counterbalanced in order). They were asked to complete the same items used in Study 1 to assess liking for and perceived accuracy of the quantitative ($\alpha = .80$) and qualitative ($\alpha = .67$) value indices, and the same measure of perceived positivity of each value index type. Participants then responded (on a 7-point scale) to two questions about the visual intelligence test: "How difficult would you rate the visual intelligence test you took earlier in this study?" and "How would you rate your performance on the visual intelligence test?"

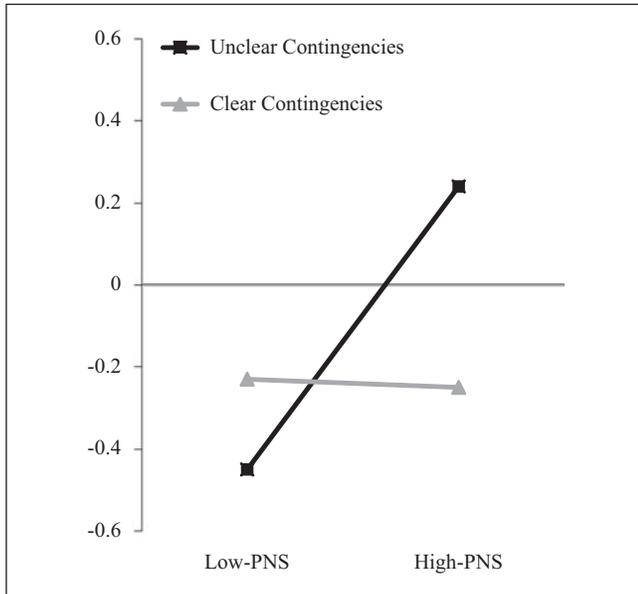


Figure 2. Preference for the quantitative verbal intelligence index (minus the qualitative index) as a function of visual intelligence contingency condition and Personal Need for Structure (PNS), Study 2
Higher scores indicate greater preference for the quantitative value index.

Results

Primary analysis. As in Study 1, we created a difference score such that higher scores indicate stronger preference for the quantitative over the qualitative value index. To test our primary hypothesis, we regressed these difference scores onto contingency condition (unclear vs. clear; dummy coded), PNS (continuous and centered), and their interaction. This analysis yielded no main effects ($ps > .48$) but did yield the predicted interaction, $\beta = .31$, $SE = .37$, $t(61) = 2.05$, $p = .04$. We plotted the interaction in Figure 2.

Supporting predictions and replicating the results of Study 1, simple slopes analyses revealed that when participants were exposed to unclear contingencies during the visual intelligence test, PNS was positively associated with preference for the quantitative value index of their verbal intelligence, $\beta = .59$, $SE = .29$, $t(61) = 2.88$, $p = .01$. In contrast, in the clear contingency condition PNS did not predict preference for the quantitative value index, $\beta = .07$, $t = 0.46$, $p = .65$. Also supporting predictions, comparison of the predicted means at 1 *SD* above the centered PNS mean revealed that high-PNS participants reported stronger preference for the quantitative value index after exposure to unclear (versus clear) contingencies, $\beta = .35$, $SE = .27$, $t(61) = 2.10$, $p = .04$. Comparison of the predicted means for low-PNS participants revealed no simple effect of contingency condition, $\beta = -.17$, $t = -0.94$, $p = .35$.

Secondary analyses. As in Study 1, we tested for differences in the perceived valence of the two value indices by submitting the positivity ratings to a Value Index Type \times Contingency Condition \times PNS mixed-model ANOVA. As in Study 1, we found a main effect for value index type, $F(1, 61) = 4.24$, $p = .04$, such that participants rated the qualitative value index as more positive than the quantitative value index. As expected, no interactions reached significance ($F_s < 3.24$, $ps > .08$). To further ensure that our effect of primary interest was not the result of differences in perceived valence, we conducted the primary regression analyses controlling for positivity ratings, and the Contingency Condition \times PNS interaction remained statistically intact ($p = .05$).

We then separately regressed ratings of visual test difficulty and perceived test performance onto contingency condition, PNS, and their interaction. As expected, these analyses returned no significant main effects or interactions ($ps > .32$). To assess whether these variables accounted for the effect of primary interest, we conducted the primary regression analysis, simultaneously controlling for these variables, and the predicted Contingency Condition \times PNS interaction remained statistically intact ($p = .04$).

Self-esteem certainty. To test our hypothesis that high-PNS, but not low-PNS, participants in the unclear (vs. clear) contingency condition would show decreased self-esteem certainty, we regressed self-esteem certainty scores onto contingency condition, PNS, and their interaction. We observed the predicted two-way interaction, $\beta = -.31$, $SE = .56$, $t(61) = -2.24$, $p = .03$. Simple slopes analyses revealed that when participants were exposed to unclear contingencies, PNS was negatively associated with self-esteem certainty, $\beta = -.73$, $SE = .45$, $t(61) = -3.89$, $p < .01$. In contrast, PNS did not predict self-esteem certainty in the clear contingency condition, $\beta = -.21$, $t = -1.53$, $p = .13$. Also as predicted, comparison of the predicted means indicated that high-PNS participants reported less self-esteem certainty in the unclear contingency condition than high-PNS participants in the clear contingency condition, $\beta = -.40$, $SE = .42$, $t(61) = -2.65$, $p = .03$. In contrast, the same comparison at 1 *SD* below the centered PNS mean revealed no simple effect of contingency ($p = .49$).

Self-esteem level. To assess whether contingency manipulation had any effect on participants' overall self-esteem level, we submitted self-esteem scores to the same Contingency Condition \times PNS regression analysis. Although we observed a main effect for PNS, $\beta = -.45$, $SE = .13$, $t(61) = -3.86$, $p < .01$, such that PNS was negatively associated with self-esteem, we observed no main effect for contingency ($p = .74$) and no two-way interaction ($p = .13$).

Mediation analyses. We conducted a mediation analysis to test our hypothesis that the increase in preference for the quantitative value index among high-PNS participants in the unclear contingency condition is mediated by self-esteem certainty. Using the bootstrapping procedure and corresponding

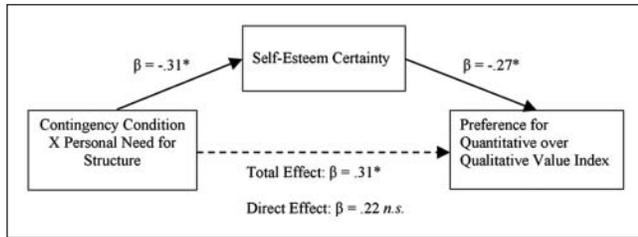


Figure 3. Study 2 mediation model

Total adjusted R^2 for the model = .15, $F(4, 60) = 3.72$, $p < .01$. All path coefficients represent standardized regression weights. The direct effect coefficient represents the effect of the interaction on the dependent variable after controlling for the effect of the proposed mediator.

* $p < .05$.

SPSS macro of Preacher and Hayes (2008), we regressed the quantitative–qualitative difference scores onto the interaction of contingency condition (dummy coded: *clear* = 0, *unclear* = 1) and PNS (centered), with self-esteem certainty scores entered as the proposed mediator, and our main effects (contingency condition and PNS) entered as covariates. Five thousand bootstrap resamples were performed. The 95% confidence interval obtained for the indirect effects of the Contingency Condition X PNS interaction on the difference scores through the mediator of self-esteem certainty did not contain zero (.02, .57). Therefore, we are confident at $\alpha = .05$ that the increase in preference for the quantitative value index among high-PNS participants in the unclear contingency condition was mediated by the corresponding decrease in self-esteem certainty (see Figure 3 for a graphical depiction of the mediation model).

To test the alternative possibility that this effect was mediated by self-esteem level, we performed a second mediation model in which self-esteem scores were entered as the mediator. The obtained confidence interval for this model contained zero (–.02, .66), suggesting that self-esteem did not mediate the primary predicted effect.

Discussion

Replicating the effects found in Study 1, Study 2 showed that participants high, but not low, in PNS responded to unclear (vs. clear) contingencies on a visual intelligence test by preferring a quantitative (over a qualitative) index of their verbal intelligence. Study 2 provides additional evidence that the observed increase in self-value quantification stems from the motivation to maintain self-esteem certainty rather than the motivation to self-enhance. Specifically, our hypothesized effects emerged even though: (a) the feedback on the visual intelligence test was equal in valence across the contingency conditions, (b) the quantitative value index was not useful for social comparison, (c) the quantitative value index was not perceived as more positive than the qualitative value index (indeed, the opposite was true), and (d) entering positivity ratings for the two value indices as covariates did not attenuate the primary predicted effect. Likewise, entering

ratings of visual test difficulty and self-perceived visual test performance as covariates did not attenuate the primary predicted effect.

Study 2 goes beyond Study 1 by providing evidence for the hypothesized mediated moderation process. Unclear contingencies between feedback and performance led to a decrease in self-esteem certainty among high-PNS participants, but not low-PNS participants. This decrease predicted high-PNS participants' increased preference for a quantitative value index. Critically, however, self-esteem was not found to mediate the predicted interaction. These results support our conceptual claim that a lack of clear contingencies in an esteem-relevant performance context poses a threat to global self-esteem certainty among individuals predisposed to avoid uncertainty and in this way leads these individuals to compensate by preferring quantitative representations of their value in another domain.

Study 3

Although the results of Studies 1 and 2 support our primary hypotheses, potential alternative explanations for these findings remain. First, we interpreted the interaction found in Studies 1 and 2 as showing that high-PNS participants display an increased preference for quantitative value representations after exposure to unclear performance contingencies. It is possible, however, that the unclear contingency condition was inert and the observed pattern of results was instead due to a decrease in high-PNS participants' baseline preference for the quantitative value representation after receiving clear contingencies. In other words, individuals high (vs. low) in PNS may generally prefer quantitative representations, but exposure to clear contingencies relaxed that preference. To rule out this potential explanation, we included in Study 3 a neutral comparison condition (similar to controls used in previous research; Berglas & Jones, 1978; Mikulincer et al., 1991) in which participants received no feedback on their performance. We predicted that high-PNS participants' preference for the quantitative value index would be higher in the unclear contingency condition than in the clear feedback and no-feedback conditions, whereas the latter two would not differ.

Second, in Studies 1 and 2 participants in the unclear and clear contingency conditions completed different types of tasks (either a card-matching task or a timed line-matching task). Although both visual tests were presented as valid assessments of visual intelligence, and were thus likely to involve participants in their performance, the task types were nevertheless confounded with contingency condition. Consequently, the observed effects could have been due to cross-condition differences in participants' perceptions of the type of ability being assessed (e.g., timed vs. untimed judgments) rather than to differences in perceived contingency clarity per se. To control for this possibility in Study 3, we asked participants in all conditions to complete the same type of visual intelligence test—specifically, the card-matching

task—and we manipulated only the type of performance feedback they received.

Third, despite our attempts to control for valence across contingency conditions by providing equivalent success–failure feedback, participants could have still perceived the unclear contingency condition as generally more negative. Although this interpretation would have difficulty explaining the full pattern of results across Studies 1 and 2, which include null effects of the contingency manipulation on ratings of test difficulty and self-perceived performance, moderation by PNS, and mediation by self-esteem certainty (but not self-esteem), it has yet to be assessed with a between-subjects comparison.

Therefore, in Study 3 we included a clear failure condition for comparison with the unclear contingency condition (in addition to the neutral, no-feedback condition just mentioned). Participants in the clear failure condition received feedback indicating that *all* their answers on the visual intelligence test were incorrect. We expected that participants in this condition would not be uncertain about their performance given their unequivocal failure. If the effects found in Studies 1 and 2 were simply due to high-PNS participants responding to negatively valenced feedback, then high-PNS participants should show the strongest preference for a quantitative value index when they receive feedback that they unambiguously failed. If, however, those effects were the result of high-PNS participants' efforts to compensate for a self-esteem certainty threat triggered by a lack of predictable and consistent contingencies, then we should again find that high-PNS participants show the strongest preference for a quantitative value index in the unclear contingency condition.

Finally, in Study 3 we added two additional items assessing participants' preferences for the quantitative and qualitative indices of their verbal intelligence. These new items were intended to assess participants' perceptions that the different value representations match how they understand their value in this domain.

Method

Sixty-two undergraduates (28 men, 34 women) took part in the study for course credit.

Contingency manipulation. After completing the PNS scale ($\alpha = .79$) and the purported verbal intelligence test, all participants completed the same card-matching task used in the unclear contingency condition in Studies 1 and 2. We manipulated the performance feedback participants received. The unclear contingency condition was the same as the one used in Studies 1 and 2: Participants ostensibly performed at 50% correct with no certain basis for understanding how their correct and incorrect responses reflected their ability. Participants in the no-feedback condition were told that their visual intelligence would be evaluated based on the complexity of the matching pattern they chose, but they received no information about their performance while completing the

test. Participants in the clear failure comparison condition received feedback indicating that all their answers were incorrect.

Perceived visual test performance. As a check on our manipulation, following the visual intelligence test we had participants answer the same item assessing perceived test performance used in Study 2: "How would you rate your performance on the visual intelligence test?" We expected that because participants in the unclear contingency condition were informed that they failed on half the trials, they would rate their performance as poorer than participants in the no-feedback condition, whereas participants in the clear failure condition would rate their performance as poorer than participants in both of the other conditions.

Quantitative and qualitative indices and ratings. As in Studies 1 and 2, participants next received the quantitative and qualitative indices of their verbal intelligence and were asked the same two questions assessing their liking for those indices. To better gauge how much participants liked and believed in the indices, we added two new items: "To what extent does this kind of feedback resemble how you think about your own abilities?" and "To what extent does this scoring method provide a 'real' measure of your verbal intelligence?" Responses were made on a 7-point scale (1 = *not at all*, 7 = *very much*) and were averaged to form composite ratings for the quantitative ($\alpha = .72$) and qualitative ($\alpha = .83$) indices. As in the previous studies, the difference between both composite scores constituted the primary dependent measure.

Results

Check on feedback manipulation. Submitting participants' ratings of self-perceived performance on the visual intelligence test to a one-way ANOVA comparing the three contingency conditions revealed a significant omnibus effect, $F(2, 59) = 47.22, p < .01$. Supporting predictions, participants in the unclear contingency condition rated their performance as poorer ($M = 3.00, SD = 1.13$) than participants in the no-feedback condition ($M = 4.57, SD = 1.03; p < .01$). Participants in the clear failure condition rated their performance as significantly poorer ($M = 1.39, SD = 0.85$) than participants in the other conditions ($ps < .01$).

Primary analysis. We used an orthogonal coding method to test two questions of interest regarding high-PNS participants: (a) whether preference for the quantitative value index differed between the no-feedback and clear failure conditions (we expected it would not) and (b) whether, as predicted, this preference was higher in the unclear contingency condition compared to the two comparison conditions. Specifically, we regressed preference for the quantitative value index onto contingency condition, PNS (continuous and centered), and their interaction using two contrast coding schemes for the contingency condition. The first contrast tested for possible differences between the comparison conditions by coding contingency condition as follows: *unclear*

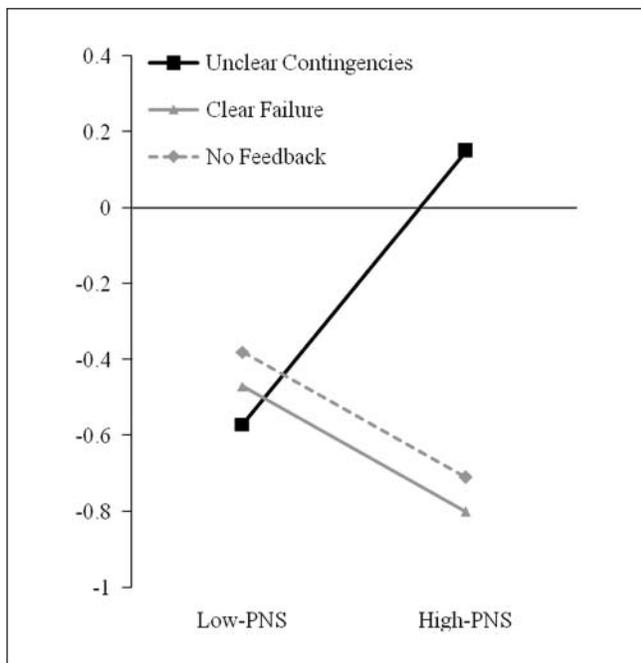


Figure 4. Preference for the quantitative verbal intelligence index (minus the qualitative index) as a function of visual intelligence contingency condition and Personal Need for Structure (PNS), Study 3
Higher scores indicate greater preference for the quantitative value index.

contingency = 0, *clear failure* = 1, *no feedback* = -1. This contrast yielded no significant main effects or interactions ($ps > .34$), indicating that the two comparison conditions did not differ independently or in interaction with PNS.

The primary contrast of interest compared the unclear contingency condition against a single combined comparison condition, which involved coding the contingency variable as follows: *unclear contingency* = 2, *clear failure* = -1, *no feedback* = -1. We observed the predicted two-way interaction, $\beta = .28$, $SE = .16$, $t(56) = 2.06$, $p = .04$ (all main effects, $p > .12$). We plotted the interaction in Figure 4. As in Studies 1 and 2, when participants were exposed to unclear contingencies, PNS was positively associated with preference for the quantitative value index, $\beta = .42$, $SE = .36$, $t(58) = 1.98$, $p = .05$. PNS did not predict this preference in the composite comparison condition, $\beta = -.20$, $t = -1.32$, $p = .20$. Also supporting predictions, comparison of the predicted means revealed that high-PNS participants showed stronger preference for the quantitative value index in the unclear contingency condition compared to the composite comparison condition, $\beta = .56$, $SE = .33$, $t(58) = 2.84$, $p < .01$. Comparison of the predicted means for low-PNS participants revealed no simple effect of contingency, $\beta = -.09$, $t = -0.52$, $p = .61$.

Discussion

High-PNS participants who were exposed to feedback that was not clearly contingent on their performance showed a

stronger preference for a quantitative representation of their value in an unrelated domain compared to participants in the clear failure and no-feedback comparison conditions, which did not differ from each other. Low-PNS participants showed no such effect. In addition to replicating the results of Studies 1 and 2, the findings of Study 3 helped to rule out potential alternative explanations for our hypothesized effect. First, the predicted Contingency Condition \times PNS interaction was *not* due to a decrease in high-PNS individuals' baseline preference for value quantification in response to clear feedback (i.e., baseline preference for the quantitative value index did not differ between the clear failure condition and the neutral no-feedback condition). Second, because all participants completed the same type of task, it is highly unlikely that the results were due to cross-condition differences in the perception of which domain or ability was being assessed. Third, it is highly unlikely that our effects were due to variations in the perceived negativity of feedback in the unclear contingency condition; if this were the case, we would have expected the strongest effect on preference for the quantitative value index in the clear failure condition.

General Discussion

The goal of this research was to gain a better understanding of how dispositional and situational factors interact to determine people's occasional desire to represent their personal value in terms of simple quantitative metrics. Prior research on quantitative information seeking suggests that quantitative value representations are perceived as affording more certain self-evaluations than comparable qualitative value representations. Prior research on dispositional epistemic motivation shows that high-PNS individuals are more likely than low-PNS individuals to respond to threats to certain knowledge with compensatory efforts to affirm certainty. Finally, prior research on learned helplessness shows that situations in which performance feedback is not clearly contingent on one's performance threaten certain knowledge of one's personal value. Synthesizing these diverse lines of work, we hypothesized that high-PNS, but not low-PNS, individuals would experience unclear performance contingencies as a threat to their self-esteem certainty and would compensate for this threat by liking and identifying with quantitative (over qualitative) value representations. We also hypothesized that this effect would be specifically due to high-PNS individual's motivation to maintain certain knowledge and not to self-enhancement motivation.

The current studies supported these hypotheses. In Study 1, participants high, but not low, in PNS who were given visual intelligence test feedback that was not clearly (vs. clearly) contingent on their performance showed a stronger preference for a quantitative index of their verbal intelligence. Study 2 replicated this effect and showed that it was mediated by self-esteem certainty. Specifically, only high-PNS participants exposed to unclear (vs. clear) performance contingencies on a

visual intelligence task reported reduced self-esteem certainty, which in turn predicted their preference for a quantitative index of their verbal intelligence. In contrast, self-esteem level was not affected by the contingency manipulation and did not mediate the observed increase in preference for the quantitative value index.

Study 3 showed that high-PNS participants were more likely to prefer the quantitative value index after exposure to unclear performance contingencies compared to no feedback or feedback indicating they unequivocally failed. These results suggest that the primary predicted effect is due specifically to exposure to unclear performance contingencies and not, alternatively, to between-condition differences in perceptions of the two task types used in Studies 1 and 2, a suppression of baseline preference for quantitative value representations in response to feedback that is clearly contingent on one's performance, or perceptions that the feedback in the unclear contingency condition was more negative.

In addition to the divergent patterns of mediation for self-esteem certainty and self-esteem level, and the null effects in the clear failure condition, several findings provide converging evidence countering the possibility that the observed increase in preference for a quantitative value representation was motivated by self-enhancement concerns. First, we found a consistent pattern of moderation by PNS across the three studies, and we know of no prior evidence that PNS predicts self-enhancement motivation or reactivity to self-esteem threats. Second, the primary predicted effect emerged after controlling for differences in perceptions of the positivity of the quantitative and qualitative value indices, test difficulty, and self-perceived performance. Indeed, our primary predicted effect emerged despite the qualitative value index being rated as overall more positive in valence (Figures 1, 2, and 4 illustrate that people generally preferred the qualitative value index).

Connections to Past Research

Previous research has shown that performance situations marked by a lack of clear contingencies create uncertainty about one's abilities (Berglas & Jones, 1978) and that dispositional levels of PNS can moderate reactivity to the threat of unclear contingencies (Mikulincer et al., 1991). The current research builds on these findings and extends them in important ways. Most notably, whereas previous research focused on how exposure to unclear contingencies influences outcome expectations and future task performance, the current studies investigated how a high dispositional motivation to maintain certain knowledge interacts with unclear performance contingencies to engender a shift in one's preferred construal of personal value. Also, whereas past research on self-handicapping outcomes focused on how individuals react to unclear performance contingencies by avoiding uncertain future diagnostic evaluations (Berglas & Jones, 1978), our findings show, somewhat in contrast, that high-PNS participants react to such contingencies by preferring quantitative assessments of their ability, which

are generally perceived to be more precise and unequivocal than qualitative assessments. An integration of past and present research suggests that high-PNS individuals' reactions to unclear contingencies depend on important features of the situation. While these individuals may self-handicap to preemptively reduce the threat of future performance uncertainties, these same individuals may choose to identify their value with precise quantitative indexes to restore undermined self-esteem certainty in the presence of previously obtained evaluative information.

Much of the extant research on representations of personal value discussed in the Introduction (e.g., Crocker & Wolfe, 2001) suggests that abstract value representations offer psychological advantages over more concrete value representations because they are less vulnerable to disconfirmation. The current research does not contradict these findings; rather, it highlights a unique combination of dispositional and situational factors that determine when people prefer to represent their value in more concrete, quantitative terms. These findings suggest that the self-esteem literature would benefit from a broader understanding of the psychological benefits afforded by different types of personal value representations.

Broader Implications

As mentioned in the Introduction, identifying one's value with simple quantitative metrics, although useful for compensating for feelings of uncertainty about one's worth, may carry negative psychological consequences. For example, personal value quantification might render individuals vulnerable to seemingly indisputable evidence of their worthlessness. Becker (1971) suggested that the stock market executives who threw themselves from skyscrapers during the crash of 1929 were convinced that when their portfolio numbers went to zero, so did their value as individuals. In more commonplace examples, individuals and groups who are convinced of the link between numbers and value may overlook important moral implications of the actions they undertake to gain a higher salary, grade point average, or military victory (e.g., Lakoff, 1991).

Other potentially negative consequences of personal value quantification are highlighted by research on materialism. In line with our current findings, research shows that uncertainty primes increase people's investment in materialistic goals (Chang & Arkin, 2002; Sheldon & Kasser, 2008). This work has also found that materialistic identification can have negative personal, social, and environmental consequences (Brown & Kasser, 2005; Kasser et al. 2004). This research suggests that a shift toward quantitative value representations may not only have deleterious effects at the individual level but may also undermine collective efforts to live a more sustainable lifestyle. Future research should further investigate the different ways in which high-structure-seeking individuals invest in quantitative value representations under conditions of situational uncertainty and the consequences of these processes for personal and collective well-being.

Appendix A

Qualitative Index of Performance on the Verbal Intelligence Test

Evaluation Dimensions	Results
Vocabulary	Writing sample contains a fairly wide range of vocabulary usage.
Grammar Mastery	Writing sample shows a good grasp of grammatical structure with some errors.
Sentence Complexity	Writing sample contains predominately complex sentence construction.
Sentence Diversity	Writing sample contains a highly varied pattern of sentence structure.
Composite Verbal Intelligence Rating	Good: Writing sample has few problems and indicates a good level of verbal intelligence.

Appendix B

Quantitative Index of Performance on the Verbal Intelligence Test

Evaluation Dimensions	Results
Vocabulary	17.02 points out of 20 possible = 85%
Grammar Mastery	16.90 points out of 20 possible = 84%
Sentence Complexity	18.00 points out of 20 possible = 90%
Sentence Diversity	17.45 points out of 20 possible = 87%
Composite Verbal Intelligence Rating	69.37 points out of 80 possible = 87%

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Note

1. We report difference scores to simplify presentation and because we are interested in the extent to which participants liked and identified with the quantitative value index relative to the qualitative value index. In Study 1, the complete ANOVA including value index type (quantitative vs. qualitative) as a within-subjects factor and contingency condition (unclear vs. clear), PNS, and value index type order as between-subjects factors revealed the predicted three-way interaction between value index type, contingency condition, and PNS, $F(1, 69) = 5.64$, $p = .02$. Looking only at ratings of the quantitative value index, we observed the predicted Contingency Condition \times PNS interaction, $\beta = .43$, $SE = .29$, $t(69) = 2.32$, $p = .02$. Simple slopes analyses revealed that within the unclear contingency condition, PNS was positively (although marginally) associated with liking for the quantitative value index, $\beta = .28$, $SE = .18$, $t(69) = 1.89$, $p = .06$. Also, comparison of the predicted means at 1 SD above the centered PNS mean showed that high-PNS participants rated the quantitative value index more positively in the unclear contingency condition than in the clear contingency condition, $\beta = .34$, $SE = .32$, $t(69) = 2.06$, $p = .04$. No other pairwise comparisons reached significance ($p > .22$). In contrast, submitting ratings of the qualitative value index to the same regression analysis revealed no significant effects (all $ps > .60$).

We observed the same basic pattern in Study 2. The full mixed-model ANOVA revealed the predicted three-way interaction, $F(1, 61) = 4.21$, $p = .04$, and post hoc analyses showed that high-PNS participants in the unclear contingency condition rated the quantitative value index more positively than both low-PNS participants in the unclear contingency condition and high-PNS participants in the clear contingency condition (both $ps < .05$; for all other pairwise, $p > .19$). As in Study 1, submitting qualitative value index ratings to the same regression analysis returned no effects ($ps > .33$).

This pattern was again replicated in Study 3. The full mixed-model ANOVA revealed the predicted three-way interaction, $F(1, 58) = 5.50$, $p = .02$, and post hoc analyses showed that high-PNS participants in the unclear contingency condition rated the quantitative value index more positively compared to both low-PNS participants in the unclear contingency condition and high-PNS participants in the comparison conditions (all $ps < .05$; for all other pairwise, $p > .19$). Again, regressing qualitative value index ratings onto the same factors returned no effects ($ps > .43$).

Taken together, these results show that the pattern of difference scores reported across the three studies is not due to decreased liking for the qualitative value index. Rather, this pattern is clearly due to high-PNS participants liking and identifying more

with the quantitative value index, but not the qualitative index, after exposure to unclear performance contingencies in another domain.

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