Personality and Individual Differences 216 (2024) 112399

Contents lists available at ScienceDirect

Personality and Individual Differences

journal homepage: www.elsevier.com/locate/paid

# Need for cognition predicts the accuracy of affective forecasts

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ARTICLE INFO

*Keywords:*
Affective forecasting
Need for cognition
Decision-making
Rational processing

ABSTRACT

Affective forecasting involves predicting our emotional response to a future event. Previous research has found that individuals tend to overestimate the intensity of their emotional reactions, a phenomenon referred to as impact bias. To explore individual differences in impact bias, this study draws on dual-process models that propose that cognition can be divided into analytical processing and an intuitive processing. The present study evaluates whether the magnitude of impact bias is moderated by an individual's need for cognition (NFC) as well as the situational demands under which the forecast is made. Results suggest that high NFC individuals make more accurate forecasts overall, but this depends on the situational demands present at the time of the forecast, with high NFC participants making more accurate forecasts when told to rely on their intuition, but less accurate forecasts when told to use visualization. The findings suggest that NFC may be an important determinant of affective forecasting accuracy, but the situational demands need to be considered in combination with individual differences.

## 1. Introduction

Affective forecasting involves an individual making a prediction about their future emotional state(s), usually in terms of how they will respond to particular events or experiences (Wilson & Gilbert, 2003). Research in the field of affective forecasting has consistently shown a tendency for individuals to overestimate the emotional impact of events, a phenomenon referred to as *impact bias* (Gilbert et al., 2002). Affective forecasts are susceptible to impact bias regardless of the valence of the event (Mathieu & Gosling, 2012). That is to say, individuals tend to overestimate how happy positive events will make them feel and how unhappy negative events will make them feel (Lam et al., 2005). The present study examines whether need for cognition (NFC) predicts the accuracy of affective forecasts and whether prompting rational processing can be used to increase the amount of information processed by an individual when performing an affective forecast, and thereby improve the accuracy of their forecast.

### 1.1. Rational processing

Cognitive processing can be considered in two ways: dispositional and situational. Individuals tend to show a consistent and reliable disposition towards rational processing (Epstein & Pacini, 2001). NFC is a measure of the extent to which individuals are inclined towards effortful processing and engaging with cognitive activities (Cacioppo & Petty, 1982). NFC has been linked to a range of cognitive abilities including problem-solving, intelligence, and biases in decision-making (Petty et al., 2009). Although affective forecasting accuracy has been linked to cognitive abilities such as working memory (Hoerger et al., 2010), as yet there has been no investigation as to whether cognitive dispositions such as NFC impact affective forecasting accuracy.

We hypothesize that NFC may be related to the accuracy of affective forecasts because it has been shown to predict less bias in decision-making in a range of domains (Blais et al., 2005; Carnevale et al., 2011; Kardash & Scholes, 1996). NFC tends to positively correlate with accuracy for a wide range of judgements and the effectiveness at which individuals process information and evidence (e.g. Cacioppo et al., 1996; Levin et al., 2000). For example, Carnevale et al. (2011) found that higher NFC individuals tended to be less susceptible to framing and sunk cost fallacies. Furthermore, NFC has been proposed to link to typical modes of information gathering and knowledge seeking, with high NFC people gathering more information before making a judgment (Kardash & Scholes, 1996). NFC has also been shown to buffer against any negative effects of emotion on biases in decision-making (Lin et al., 2006; Vafeiadis & Xiao, 2021). For example, Lin et al. (2006) found that NFC mediated the relationship between mood and risk taking, such that sadness did not increase risk taking in high NFC individuals. We therefore predict that NFC may similarly positively predict the accuracy of

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https://doi.org/10.1016/j.paid.2023.112399
Received 14 March 2023; Received in revised form 1 August 2023; Accepted 29 August 2023
Available online 12 September 2023

 

affective forecasts by making high NFC individuals less prone to biases such as the impact bias.

In addition to dispositional preferences, individuals utilise different processing types according to situational demands. The context in which an affective forecast is made has been shown to affect its accuracy (e.g. Devine, 1989; Gunnell & Ceci, 2010; Krauss et al., 2004). Specifically, several biases are less pronounced when participants are encouraged to be more rational when making their forecasts (Evans & Curtis-Holmes, 2005; Shiloh et al., 2002).

However, the expectation that rational processing may produce more accurate forecasts may not apply to affective forecasting as these judgements are about emotional states. The apparent reduction in cognitive biases typically found when using rational processing may not apply to affective forecasts due to their emotional content. While, rational processing appears less prone to cognitive biases in judgements that involve predictions about probabilities or the likelihood of external events (Evans, 2008), affective forecasting is somewhat different in that it requires a prediction about internal emotional states (Wilson & Gilbert, 2003). According to dual-process theories, individuals have two distinct processing systems: intuitive (System 1 or Type 1) and rational/analytical processing (System 2 or Type 2; Evans & Stanovich, 2013). The rational Type 2 processing is "emotionless", while intuitive Type 1 processing is intimately associated with affect or emotion (Epstein et al., 1996). Therefore, for a participant to accurately predict their internal *emotional* state, it is reasonable to expect that they must recall how experiences have impacted their affect in the past. To do this effectively an individual would need to effectively engage both Type 1 and Type 2 processing to draw on both their emotions and their experiences.

Based on the current evidence it would appear both rational processing and intuitive processing have some qualities that may benefit the accuracy of affective forecasts, as such, it is likely that processing forecasts in a way that integrates both intuitive and rational information may be superior to either processing alone. One such technique that may integrate the intuitive and rational processing is visualization. Epstein and Pacini (2001) argue that the intuitive thinking encodes data in images and narratives and that visualization is particularly effective at engaging the intuitive processing because it shares the medium of images. Mental imagery is a key component of our ability to predict the future and consider a range of potential futures (Moulton & Kosslyn, 2009). Visualization allows for more concrete and detailed representation of possible outcomes, with the events and objects being imagined typically accurate representations of reality (Rouw et al., 1997). Furthermore, visually constructing future mental scenes allows individuals to link potential future outcomes with their past experiences and behave in a way that is more rational (Gershman & Bhui, 2020). Indeed, as Moulton and Kosslyn (2009) argue, visualization "transforms past experience into explicit, specific predictions" (p. 1274). Visualization is also thought to be a key way in which people integrate conscious predictions with emotional information (Wicken et al., 2021). If visualization can integrate information in the manner proposed, then it is likely to attenuate impact bias compared to either system alone.

Importantly, it is plausible that cognitive dispositions such as NFC interact with the situational processing demands to determine the accuracy of affective forecasts. For instance, it may be beneficial if an individual is encouraged to process an affective forecast in the manner in which they prefer, whereas, misalignment between one's trait and state processing might lead to ineffective forecasts and higher impact bias. Recent evidence across a wide range of domains has shown the importance of simultaneously considering both situational and person variables in order to understand the effect of such contingencies on behavior and performance (Birney & Beckmann, 2022; Fleeson, 2007; Kuper et al., 2022; Minbashian et al., 2018). Our study adopts this approach by simultaneously modelling how individual differences in NFC interact with experimental manipulations of processing to impact the accuracy of affective forecasts.

## 2. Method

### 2.1. Participants

Participants were recruited from a pool of undergraduate psychology students at an Australian university, who participated in exchange for course credit. The sample size was determined by the maximum number of students who could be recruited in one semester. 138 participants commenced the study, with 107 completing both study sessions. 5 participants were subsequently excluded from the analysis because they did not correctly enter all data. The final sample ($N = 102$; 74.51 % female, $M_{Age} = 20.16$, $SD = 5.60$) completed the study in either the intuitive condition ($n = 34$), the rational condition ($n = 34$), or the visualization condition ($n = 34$).

### 2.2. Procedure

Ethical clearance was obtained from an Australian university and all participants provided informed consent. All data was collected online using Qualtrics. Data was recorded at two time points. In the first session, participants completed the NFC measure, stated a goal for their upcoming psychology essay and then made a prediction about their expected happiness on the day they receive feedback should they meet, exceeded or fail to meet their stated goal. Later in the semester, on the day on which participants received their essay feedback, participants reported their actual happiness and indicated their performance in the essay.

### 2.3. Materials

#### 2.3.1. Need for cognition (NFC; Pacini & Epstein, 1999)

The 20 items assessing NFC from the rational-experiential inventory were administered. Items measured engagement and ability at rational processing (e.g. I try to avoid situations that require thinking in depth about something). Responses to all items are on a 5-item Likert-like scale ranging from "*Definitely NOT true of myself*" to "*Definitely true of myself*". The scale has high reported internal reliability, alpha = 0.87. Participants' NFC scores were calculated by summing items and then Z-score transformed prior to analysis.

#### 2.3.2. Affective forecast

Participants in all conditions made their affective forecast for three possible outcomes: (1) surpassing their goal, (2) meeting their goal and (3) falling below their goal. When asked to forecast surpassing their goal, participants were given the example of achieving 10 marks above their goal and when forecasting falling below their goal they were given the example of 10 marks below their goal. Participants were randomly allocated to one of the following conditions:

*2.3.2.1. Intuitive condition.* Participants in the intuitive condition spent 2 min viewing emotional faces and describing the effect of each on their emotional state. Similar tasks have been used in previous research to induce intuitive processing (Gyurak et al., 2011). After the task, participants were asked:

> "*What do you expect your general level of happiness will be the day you receive your mark in the following situations? Try to go with your natural, intuitive response. We are interested in your gut-level reactions to this prediction.*"

*2.3.2.2. Rational condition.* Participants were asked to spend 2 min solving several mathematical questions as this has been shown to induce rational processing (Krauss et al., 2004). The participants were asked to complete a pros-and-cons list of pursuing and achieving their goal. The pros-and-cons list was used to induce participants to consider rationally the costs and benefits of their goal and it was expected it would force them to place the affective benefits of achieving their goal in a wider context. After completing the task participants were asked:

> "*What do you expect your general level of happiness will be the day you receive your mark in the following situations? Try to be as rational and analytic as possible and ensure you consider all of the associated costs and benefits of achieving your goal.*"

*2.3.2.3. Visualization condition.* Participants were asked to spend 2 min practicing visualization. The task was designed so participants could practice using visualization to think about the relationship between emotions and events as well as place participants in a relaxed mindset so they were prepared to use their imagination when completing the prediction.

After the practice task, participants were given similar instructions to carry out the visualization task for the day they receive their essay feedback:

> "*Now we would like you to make a number of predictions about your general level of happiness in a number of scenarios. To assist you in doing this accurately use visualization to combine your rational and intuitive judgements. Visualise yourself on the day that you receive your essay feedback, what events do you experience, how do the events of the day affect your mood and for how long? Uses the boxes below to record the events and emotions you experience.*"

After this participants received the following instructions to make their predictions:

> "*What do you expect your general level of happiness will be the day you receive your mark in the following situations? Use visualization to combine your rational and intuitive judgements and assist you in making an accurate prediction.*"

### 2.3.3. Experienced happiness

In the second session, participants reported their experienced happiness using the following single-item measure, "*How happy would you say you are today?*" Participants responded on a 7-point Likert scale ranging from "*Very Unhappy*" to "*Very Happy*". This item was a similar item to that used by other affective forecasting studies (e.g. Ayton et al., 2007; Lam et al., 2005; Wilson et al., 2000). Single-item measures of happiness have been shown to have good psychometric properties (Andrews & Robinson, 1991; Fordyce, 1988) and correlate well with more extensive measures of happiness (Gilbert et al., 1998).

### 2.3.4. Bias

As we were interested in assessing the absolute accuracy of participants' forecasts, we utilised the following method to calculate a bias score:

$$Bias = (p - a)^2$$

where $p$ is a particular participant's predicted happiness and $a$ is their actual reported happiness.

## 3. Results

To select the appropriate prediction for each participant, participants were first classified based on the outcome of their essay result into one of the following groups: achievers who score within ±5 marks of their goal (n = 27), underachievers who scored at more than 5 marks below their goal (n = 71) and overachievers who scored more than 5 marks above their goal (n = 4). Table 1 presents summary statistics of experimental variables broken down by outcome group.

**Table 1**
Summary statistics for study variables. Standard deviations are presented in parentheses.

| | Underachievers | Achievers | Overachievers |
|---|---|---|---|
| N | 71 | 27 | 4 |
| Predicted happiness | 2.61 (1.24) | 5.63 (0.93) | 6.75 (0.50) |
| Experienced happiness | 4.38 (1.62) | 5.11 (1.25) | 6 (0.82) |
| NFC | 67.9 (10.8) | 70.0 (10.1) | 77.8 (9.43) |
| Bias | 7.38 (8.61) | 1.78 (3.46) | 1.25 (1.89) |

### 3.1. Impact bias

Overall, affective forecast showed significant bias in that the bias scores were significantly greater than zero; $t(101) = 7.29$, $p < .001$. A one-way (outcome groups: achievers vs underachievers vs overachievers) between-subjects analysis of variance (ANOVA) indicated that bias differed by outcome condition $F(2, 99) = 6.24$, $p = .003$. Pairwise comparisons with Tukey correction indicated that this effect was driven by greater bias in the underachievers compared to the achievers; $t = 3.32$, $p = .004$. No other pairwise comparisons were significant (all $p > .05$).

### 3.2. Processing style effects

Results were analysed using a regression model with the bias score as the criterion variable. Dummy coded experimental group (intuitive vs. rational and intuitive vs. visualization) and the scaled NFC score were entered as predictors along with their relevant interactions. The results indicated that NFC was a significant negative predictor of bias; $b = -3.02$, $p = .014$, such that those participants with higher NFC made more accurate affective forecasts. Neither the intuitive vs rational ($b = 0.31$, $p = .743$) nor the intuitive vs visualization ($b = -3.9$, $p = .677$) were significant. For completeness, the model was re-run using the rational condition as the control group and the rational vs visualization comparison was also not significant ($b = 1.39$, $p = .457$). The group (intuitive vs. visualization) X NFC interaction was significant ($b = 4.96$, $p = .006$). As depicted in Fig. 1, participants low in NFC made significantly more accurate forecasts in the visualization group than the intuitive group, whereas, high-NFC participants showed the reverse effect, making more accurate predictions in the intuitive condition than the visualization group. The other group (intuitive vs rational) X NFC interaction was not significant ($b = 2.69$, $p = .178$). Bivariate correlations are presented in Table 2.

## 4. Discussion

The results indicate that participants overestimated the impact of their essay mark on their happiness. Importantly the current results also suggest that individuals high in NFC are less susceptible to impact bias overall, although these differences depended on the situational demands occurring at the time of the forecast. Specifically, the accuracy of affective forecasts appears to be impaired in high NFC individuals when they utilise visualization, whereas participants low in NFC seem to benefit from visualization at least compared to when they use their intuition alone.

### 4.1. Impact bias

Impact bias was particularly pronounced in the underachiever group (who failed to reach their goal), suggesting that negative events may be particularly susceptible to impact bias. This is in line with the findings of Mathieu and Gosling (2012) who, in the 16 findings they reviewed in their meta-analysis, found that there was significant asymmetry in impact bias, with the effect more pronounced when forecasting negative events. One viable explanation for the asymmetry between the accuracy

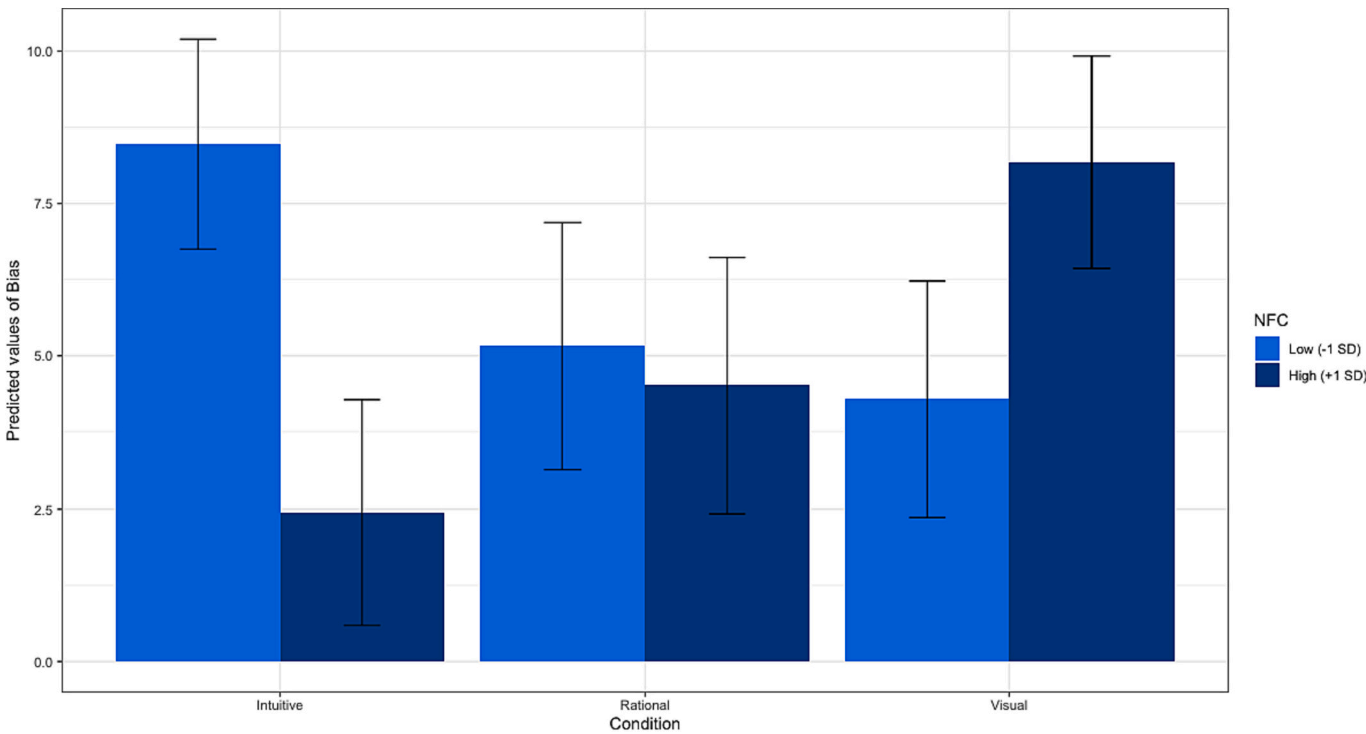


**Fig. 1.** Predicted bias as a function of experimental condition and NFC. Values for high and low NFC correspond to +1/−1SD of the mean. Error bars represent ±1 standard error of the mean.

**Table 2**
Bivariate correlations between key study variables.

| Variable | 1 | 2 | 3 | 4 | 5 | 5 |
|---|---|---|---|---|---|---|
| 1. NFC | | | | | | |
| 2. Essay Goal | 0.146 | | | | | |
| 3. Essay Mark | 0.428*** | 0.207* | | | | |
| 4. Essay Goal − Essay Mark | −0.32** | 0.381*** | −0.826*** | | | |
| 5. Affective Forecast | 0.127 | −0.094 | 0.361*** | −0.395*** | | |
| 6. Happiness | 0.107 | 0.004 | 0.253* | −0.237* | 0.229* | |
| 7. Bias | −0.073 | 0.041 | −0.137 | 0.153 | −0.462*** | 0.345*** |

* $p < .05$.
** $p < .01$.
*** $p < .001$.

of forecasting emotional reactions to positive and negative events is that individuals neglect to consider their coping abilities when forecasting negative events. Individuals may tend to overestimate the affective consequences of negative events more sharply than positive events because they lack awareness of their coping abilities and fail to factor the coping abilities into their forecasts.

### 4.2. Need for cognition

High-NFC participants performed more accurate forecasts, averaged across conditions. This suggests that a rational processing disposition might assist in deeper and more conscious consideration of affective forecasts and in turn more accurate forecasts. Interestingly, the results suggest that visualization significantly impaired the forecasting ability of high-NFC participants compared to the intuitive condition and that high-NFC participants in the rational condition fell in between the other two conditions. This perhaps suggests that rather than integrate information from the rational and intuitive systems the visualization task disrupted the processing abilities of highly rational participants. According to dual processing theories, the rational processing system encodes information in abstract symbols, words and numbers and makes decisions through logic and evidence (Epstein & Pacini, 2001). Visualization may have disrupted this process of logic, as rational participants may have been unfamiliar with relying on associative connections and affective responses, thereby reducing the accuracy of rational thinkers. As visualization is an internal state it is difficult to ascertain whether visualization does combine rational and intuitive processing as proposed.

On the other hand, visualization improved the forecasting accuracy of low-NFC participants, at least compared to when they were encouraged to rely on their intuition alone. This may indicate that intuitive thinkers benefit from processing emotional information more deeply using visualization. This is in keeping with previous literature that has found visualization to be beneficial to goal setting. Visualization has often been used as a tool to aid in goal pursuit and individuals will pursue a goal more readily if it is easily visualized (e.g. Cheema & Bagchi, 2011). The present research does raise an important concern in that, as a tool for forecasting, visualization may not be universally beneficial (at least if the goal is to accurately assess the benefit of potential goals). It is therefore important individual differences be considered when designing tools for affective forecasting.

Although low NFC was associated with poorer forecasting overall, the benefit of high NFC was restricted to the intuitive processing group. It is therefore likely that any deficiencies that low-NFC participants have performing affective forecasts can be overcome by encouraging deeper processing either through rational processing or by using visualization. Given, however, that visualization had a contrasting effect on high and low-NFC participants it is important to consider the interactive effects of task and person qualities when designing methods for improving forecasting.

### 4.3. Limitations

The current study utilised specific methods designed to induce emotional (viewing emotional faces) and rationale processing (making a pros-and-cons list). While these induction methods were selected to prompt a specific type of processing when making an affective forecast, we cannot rule out that the findings are dependent on the specific induction method. Future research should explore the generalizability of these findings by utilising a range of a variety of methods to encourage different types of information processing when individuals are engaging in affective forecasting. It is also worth noting that, like many samples used in the study of decision-making, our sample is relatively young compared to the general population. Given that executive functions and associated brain regions develop into early adulthood (Ferguson et al., 2021; Neubeck et al., 2022), the current findings need further work to ensure they generalize across the lifespan.

While the current study suggests that encouraging intuitive processing increases bias in low NFC individuals, we cannot determine exactly what it was about encouraging intuitive processing that caused the effect. Given there is much debate over the meaning of the term intuition in the research literature (Epstein, 2010), participants are likely to have a diverse understanding of what it is to make decisions based on intuitions. For example, encouraging people to rely on their intuitions might lead them to rely more heavily on their emotions when making their forecast, and the type of emotions they experience may then influence the accuracy of their affective forecasts (Polyportis et al., 2020). In addition, there are reliable individual differences in the use of rational processing which may mean participants may differ in their ability to apply the processing strategies being prompted by our experimental interventions (Stanovich et al., 2011).

## 5. Conclusion

The present study has expanded on affective forecasting research by examining the relationship between NFC and impact bias, and whether this relationship depended on the situational demands occurring at the time of the forecast. The present findings suggest that individuals high in NFC may be more accurate at performing affective forecasts when asked to rely on their intuitions, however, the pattern is reversed with participants high in NFC making less accurate predictions when asked to use visualization. These results suggest that the effects of individual differences in NFC on forecasting accuracy are dependent on both individual differences and the situational demands when a forecast is elicited.

## CRediT authorship contribution statement

**Kit Double**: Conceptualization, Methodology, Data curation, Analysis, Writing - Original draft preparation. **Michael Cavanagh**: Writing - Reviewing and editing.

## Declaration of competing interest

None.

## Data availability

Data will be made available on request.

## Acknowledgments

The authors did not receive any funding for this research.

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