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Meta-analytic Investigations of the Relation Between Intuition and Analysis

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ABSTRACT

Over 50 years of research on cognitive style has converged on the importance of individual differences in use of intuition and analysis. This program of research is characterized, however, by two incompatible perspectives about the relation between intuition and analysis. The distinction concerns whether intuition and analysis are opposite poles of a single dimension or whether they are orthogonal constructs. Two studies report meta-analytic investigations of the relation between intuition and analysis. A meta-analysis of the existing research base ($k = 80$; $n = 27\,501$) showed that intuition and analysis are uncorrelated. A second meta-analysis of combinations of subscales from different cognitive style measures ($n = 511$) supported the results of the first meta-analysis. Confirmatory factor analysis also supported the existence of two uncorrelated constructs. Overall, the findings support the view that intuition and analysis are independent constructs, rather than opposite ends of a bipolar continuum. In addition, the findings suggest measures of analysis or rationality are not interchangeable. Copyright © 2015 John Wiley & Sons, Ltd.

KEY WORDS analysis; intuition; cognitive styles; decision-making styles

Although different terminologies have been used to describe individual differences in use of intuition and analysis, researchers generally agree on the characteristics that distinguish these cognitive styles. *Intuition* refers to reliance on immediate, unconscious judgment based on feelings, whereas *analysis* refers to reliance on deliberate, conscious judgment based on reason (Allinson & Hayes, 1996; Epstein, Pacini, Danes-Raj, & Heier, 1996). Intuition and analysis lie at the heart of theories of cognitive processing (e.g., Epstein et al., 1996; Gilovich, Griffin, & Kahneman, 2002; Stanovich & West, 2000), as well as theories of commonsense and judgment (Hammond, 1996; Heider, 1958; Reber, 1989).

There have been multiple attempts to assess individual differences in use of these cognitive styles (e.g., Allinson & Hayes, 1996; Cools & Van den Broeck, 2007; Epstein et al., 1996; Nygren, 2000; Scott & Bruce, 1995; Sjöberg, 2003). Because of the lack of a unifying conceptual framework, however, the different measures have been developed based on different assumptions about the nature of the relation between intuition and analysis (Hodgkinson, Sadler-Smith, Sinclair, & Ashkanasy, 2009).

Models of individual differences in cognition differ as to whether intuition and analysis are viewed as bipolar opposites or as two independent unipolar dimensions. The distinction concerns whether one can be as follows: (i) *either* intuitive *or* analytical or (ii) both intuitive and analytical in orientation. The first implies a negative relation between the constructs, whereas the second implies no relation between intuition and analysis. The goal of the present studies was to examine whether evidence favors one view versus the other. We should note that there is controversy in cognitive science over the possible existence of two distinct cognitive architectures, as opposed to one continuous, integrated structure of information processing (cf., Keren & Schul, 2009; Kruglanski & Gigerenzer, 2011). Our study is focused on individual differences in cognitive styles. As such, we do not claim to provide evidence for or against dual cognitive systems, which Kahneman (2011) described as “useful fictions” that help us explain human quirks in decision making.

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BACKGROUND

The notion of individual differences in cognitive style has its origins in research on perceptual psychology conducted in the 1950s (Holzman & Klein, 1954; Klein, 1951; Witkin, 1950; Witkin, Lewis, Hertzman, Machover, Meissner, & Wapner, 1954). The approach of these researchers was to isolate common patterns of adaptation to the external environment by examining, for example, a person’s ability to separate geometrical figures from their surrounding context (see Kozhevnikov, 2007, for a review). Although subsequent decades of cognitive style research have brought numerous types and styles of information processing, most of these can be categorized as either intuition based or analysis based (Kozhevnikov, Evans, & Kosslyn, 2014). Researchers have considerable options for assessing individual differences in intuition and analysis (e.g., Allinson & Hayes, 1996; Betsch, 2004; Cools & Van den Broeck, 2007; Epstein et al., 1996; Harren, 1978; Nygren, 2000; Scott & Bruce, 1995; Sjöberg, 2003; Vance, Groves, Paik & Kindler, 2007). There is, however, a lack of consensus about the theoretical relation between the constructs.

Bipolar approaches

One school of thought regarding the relation between intuition and analysis is that they represent the opposite ends of the same continuum (e.g., Allinson & Hayes, 1996; Kolb, 1984; Miller, 1987). These views are largely based on theories of lateralization of brain function (Hines, 1987). According to Allinson and Hayes (1996), intuition is characteristic of right-brain function, and analysis is characteristic of left-brain function. People are said to have stylistic orientations toward the use of one hemisphere versus the other.

Kolb's (1984) experiential learning theory presents a continuum anchored at one end by concrete experience (i.e., feeling) and at the other end by abstract conceptualization (i.e., thinking). According to Kolb, one could not engage in thinking and feeling at the same time. This is similar to the highly popular Myers–Briggs Type Indicator (Myers, 1962), which places thinking and feeling on a continuum of perception. Both approaches are consistent with the brain-lateralization view that analysis and intuition represent opposite ends of the same continuum.

Independence approaches

An alternative to the bipolar models of intuition and analysis is the view that intuition and analysis are independent styles of processing information—they are orthogonal and serve different purposes (e.g., Epstein, 1994; Sloman, 1996; Stanovich & West, 2000). This dual-process framework suggests that intuition and analysis are both needed for processing information (Evans, 2008; Kuo, Sjostrom, Chen, Wang, & Huang, 2009). One of these frameworks, presented by Epstein and colleagues (Epstein, 1985; Epstein et al., 1996; Pacini & Epstein, 1999), is cognitive–experiential self-theory (CEST). According to CEST, people process information in two parallel interacting systems, rational versus experiential, which operate by different principles. The rational mode is deliberative and intentional and requires justification via logic and evidence. In contrast, the experiential system operates automatically and pre-consciously, at a level that is intuitive, automatic, and holistic. Although the experiential mode is the default, people are able to switch to a rational mode when they are motivated to do so. Very similar to the CEST model is the System 1 and System 2 model (Stanovich & West, 2000). This approach suggests that System 1 (intuitive) processing is automatic and must be consciously overridden by System 2 (rational). For some people, such as those of higher cognitive capacity, the dominance of the intuitive System 1 process will be minimized (Stanovich, 1999).

Evidence base

The Rational–Experiential Inventory (REI) was developed by Epstein and colleagues (Epstein et al., 1996; Pacini & Epstein, 1999) to measure self-reported individual differences in intuitive–experiential and analytical–rational thinking styles based on CEST (Epstein, 1994). The initial version of the REI scale (REI-31) was developed in 1996 with 31 items to represent two presumably independent constructs, need for cognition (Cacioppo & Petty, 1982) and faith in intuition (Epstein et al., 1996). In the same study, Epstein and colleagues also tested a shortened version with five items for each construct (REI-10). The scale was revised to 20 items (REI-20) by including two subscales, ability and engagement, under both rational and experiential thinking styles (Pacini & Epstein, 1999). In all versions, the correlation between rationality and experientiality was small and non-significant. Thus, Epstein and colleagues concluded that the scales supported the CEST assumption, that is, the two thinking styles were independent of one another (Epstein & Pacini, 1999). In addition, they also found that rationality and experientiality were differentially correlated with other constructs such as personality and relationship quality.

Allinson and Hayes (1996) developed the cognitive style index (CSI) to assess analysis and intuition as a unidimensional construct. Items assessing intuition are reverse scored such that the scale assesses preference for analysis. The authors reported alphas ranging from .84 to .92, and factor analysis supported unidimensionality. Hodgkinson and Sadler-Smith (2003) argued that the analytic approach used in the development of the CSI (i.e., item parceling) biased the outcome of factor analyses in favor of a single factor solution. Although Hodgkinson and Sadler-Smith were able to yield two-factor solutions in the CSI by using domain homogenous parcels, they still observed a substantial negative correlation between intuition and analysis (see also Hodgkinson et al., 2009).

Scott and Bruce (1995) developed the General Decision-making Style Inventory (GDMS) wherein intuition and analysis were conceptualized as independent decision-making styles. Nevertheless, the authors observed significant negative correlations between intuitive and analytical (i.e., rational) decision-making styles in three out of four samples and thus concluded that decision-making styles were not independent.

STUDY 1: META-ANALYSIS OF RESEARCH BASE

In order to shed light on the bipolar versus independence approaches to individual differences in intuitive and analytical cognitive styles, we conducted a meta-analysis of existing research that contained separate measures of the two constructs. We reasoned that a meta-analytic correlation that is significantly negative would provide some support for the bipolar model, whereas a lack of relation between the constructs would favor an independence model. In addition, we considered the relation of intuition and analysis with the five-factor model of personality (Digman, 1990). This is based on the idea that, if intuition and analysis are indeed independent constructs, they should have different relations with Big Five traits.[1]

[1]The only correlates with more than three samples were the Big Five personality traits (agreeableness, conscientiousness, extroversion, neuroticism, and openness to experience) and three decision-making styles (dependent, avoidance, and spontaneous decision-making styles). Because the decision-making styles are specifically associated with the GDMS, we did not include them in the meta-analysis.

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Search for primary data

A threefold approach was used to identify relevant studies containing useful information for the present meta-analysis. We first used Google Scholar to search for studies that cited the following scale development studies for measures of intuition and analysis listed in alphabetical order of the first authors: Betsch's (2004) preference for intuition and deliberation scale (PID), Cools and Van den Broeck's (2007) Cognitive Style Indicator, Epstein et al.'s (1996) Rational–Experiential Inventory (REI-31 and REI-10), Harren's (1978) Assessment of Career Decision-making Scale (ACDM), Nygren's (2000) Decision-making Style Inventory (DMI), Pacini and Epstein's (1999) Rational–Experiential Inventory (REI-20), Scott and Bruce's (1995) GDMS, and Vance et al.'s (2007) Linear–Nonlinear Thinking Style Profile. Each of these measures assesses intuition and analysis separately, which is necessary for assessing correlations between the constructs.

Second, we conducted keyword searches on PsycINFO and Web of Science (see Table 1 for the search terms) and included articles that were not duplicated with those found through the first step. Third, manual searches of the 2000–2014 programs for the Society for Industrial and Organizational Psychology and Society for Judgment and Decision Making conferences were carried out.

Studies that contained enough information to extract either of the following were initially included: (i) a correlation between rationality and intuition or (ii) a correlation with Big Five personality traits. We identified 75 studies with 80 independent samples for inclusion into our meta-analysis. All included studies are indicated in the reference section. Among these studies, 80 independent correlations were extracted, and 18 variables were identified that met the inclusion criteria.

Coding of study characteristics

For each sample, the correlation between the following was coded: (i) intuition and analysis and/or (ii) intuition or analysis and one or more of the Big Five traits. In cases where facets of intuition or analysis were offered (e.g., both rational ability and rational engagement measures, which are facets of analysis, were listed for the same sample), composite formulas developed by Ghiselli et al. (1981) were used to estimate the correlation between a composite of the multiple facets and an outside variable (formula 13) and the correlation between two composites (formula 18).[2] We also coded the sample size and internal consistency values for each correlation. Finally, the scales used to measure intuition and analysis were coded as potential moderators.

The authors in this study each independently coded 10 articles that used one of the scales and then met to quantify levels of inter-coder agreement. The authors agreed 100% on all variables. After this point, the authors divided the remaining articles for coding.

Analyses

Hunter and Schmidt's (2004) meta-analysis methods were used. Correlations among all variables were corrected for unreliability using the artifact distribution method. Specifically, given that there were no previous meta-analyses on individual differences in these cognitive styles, the mean internal consistency reliability of all collected studies that used a certain scale was applied for correction. For example, the 36 studies that used the REI-20 scale had a mean reliability of .86 for the rational thinking style and .87 for the experiential thinking style, which were then used for the unreliability correction. For reliabilities of the Big Five traits, generalizable alpha reliabilities from previous research (Viswesveran & Ones, 2000) were used for the corrections.

The ACDM, GDMS, and REI-20 scales together comprised 67 of 80 samples; the remaining scales (Linear–Nonlinear Thinking Style Profile, REI-31, REI-10, DMI, and PID) were used less frequently and thus could not be used as moderators. Meta-analyses were carried out within each moderator category. To determine whether correlations differed significantly across scales, formulas 4, 9, and 14 from Raju and Brand (2003)[3] were used to test the significance of the difference between the corrected meta-analytic correlations.

Results and discussion

Table 2 lists results for the relation between intuition and analysis. The average corrected intuition–analysis correlation was −.04, and the 95% confidence interval (CI) was slightly below 0. The corrected correlation, however, is near zero, and the 80% credibility interval clearly includes zero, suggesting that the practical significance of a −.04 correlation is negligible.

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[2]According to Ghiselli et al. (1981, pp. 164), to calculate the correlation between the component variable c and an outside variable o, r_{co}, let k represent the number of facets within one composite variable c, $\overline{r}_{ii'}$ represent the average of the coefficients of correlation among the component variables, and $\overline{r}_{oi}$ represent the average of the coefficients of correlation between the component variable c and an outside variable o; then we have $r_{co} = \frac{\overline{r}_{oi}}{\sqrt{1/k+\left(\frac{k-1}{k}\right)\overline{r}_{ii'}}}$ (formula 13).To calculate the correlation between two composites c_x and c_y, $r_{c_x c_y}$, let $\overline{r}_{xx'}$ represent the average of the intercorrelations among the k components of composite x, $\overline{r}_{yy'}$ represent the average of the intercorrelations among the m components of composite y, and $\overline{r}_{x_k y_m}$ represent the average of the coefficients of the correlation among the k components of composite x and among the m components of composite y, that is, the average of the cross-correlations; then we have $r_{c_x c_y} = \frac{\overline{r}_{x_k y_m}}{\sqrt{1/k+\left(\frac{k-1}{k}\right)\overline{r}_{xx'}}\sqrt{1/m+\left(\frac{m-1}{m}\right)\overline{r}_{yy'}}}$ (formula 18, pp. 175).

[3]According to Raju and Brand (2003), let u represent the ratio of unattenuated, restricted standard deviation to the unattenuated, unrestricted standard deviation on x. Because there is no range restriction in this study, $u = 1$; r_{xy} represents the restricted and attenuated correlation between the predictor (x) and criterion (y) in a sample; r_{xx} and r_{yy} represent the predictor and criterion reliabilities, respectively, in the sample; $\hat{\rho}_{xy}$ is an estimate of an unrestricted and unattenuated population correlation (ρ_{xy}) between the predictor and the criterion; $\hat{V}\left(\hat{\rho}_{xy}\right)$ is an asymptotic sampling variance of $\hat{\rho}_{xy}$.In this study, assuming that both criterion and predictor reliabilities are fixed, then $\hat{V}\left(\hat{\rho}_{xy}\right) = \frac{k^2 r_{xx}^2 r_{yy}^2 \left(1-r_{xy}^2\right)^2}{(n-1)\hat{W}^3}$ (formula 9), where $\hat{W} = r_{xx} r_{yy} - r_{xy}^2 + k^2 r_{xy}^2$ (formula 4) and $k = 1/u$.A z-test is then used to assess whether two observed correlations, corrected for unreliability, are significantly different from each other (assuming that the two observed corrected correlations are normally distributed and are derived from two independent samples): $z = \frac{\hat{\rho}_1 - \hat{\rho}_2}{\sqrt{\hat{V}\ (\hat{\rho}_1) + \hat{V}\ (\hat{\rho}_2)}}$ (formula 14).

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Table 1. Definitions for, and measures of, each search terms meta-analyzed

Search terms	Definition	Measures included in the meta-analysis
	Constructs defined as rationality	
Rational decision-making style	The decision-making style characterized by a thorough search for and logical evaluation of alternatives	General Decision-making Inventory (Scott & Bruce, 1995) Decision-making Style Inventory (Nygren, 2000) Assessment of Career Decision-Making scale (Harren, 1978)
Preference for deliberation	The decision-making style describing a tendency to make slower, elaborated, and cognition-based decisions	Preference for Intuition and Deliberation (Betsch, 2004)
Analytical thinking style	The thinking style describing individual's tendency to process information with a rational system, which operates at a conscious level and is intentional, analytical, and relatively affect free	Rational–Experiential Inventory (REI-31 and REI-10, Epstein et al., 1999; REI-20, Pacini & Epstein, 1999)
Linear thinking style	The thinking style characterized by relying on an analytical method to understand the whole by breaking it into parts and assuming that relationships between variables are unidimensional and linear	Linear/nonlinear thinking style profile (Vance et al., 2007)
	Constructs defined as intuition	
Intuitive decision-making style	The decision-making style characterized by a reliance on hunches and feelings	Same as rational decision-making style
Preference for intuition	The decision-making style characterized by a tendency to base most of the decisions on affect, resulting in fast, spontaneous decisions	Same as preference for deliberation
Experiential thinking style	The thinking describing individual's tendency to process information with an experiential system, which is automatic, preconscious, holistic, associationistic, and associated with affect	Same as rational thinking style
Nonlinear thinking style	The thinking style characterized by relying on a holistic method to link parts together and assuming that relationships between variables are nonlinear and multidimensional	Same as linear thinking style

Table 2. Meta-analysis results for the relationship between rationality and intuition

Variable	N	k	r_m	SD_r	r_α	$SD_{r\alpha}$	% var.	CV_{10}	CV_{90}	CI_L	CI_U
Overall analysis											
Rationality–intuition	27 501	80	−.04	.20	−.04	.23	7.52	−.34	.26	−.06	−.03
Moderator analysis											
Scales as moderator											
ACDM	2 851	11	−.28	.28	−.49	.38	5.28	−.98	−.00	−.54	−.44
GDMS	6 055	20	−.03	.24	−.03	.30	5.86	−.42	.35	−.07	.00
REI-20	14 795	36	.01	.08	.01	.08	34.45	−.09	.11	−.01	.03
Settings as moderator											
Field	14 167	31	.01	.08	.01	.08	33.41	−.09	.11	−.01	.03
Lab	628	5	.02	.14	.03	.12	43.13	−.12	.18	−.06	.12
Sample as moderator											
Student	2 996	12	.03	.11	.04	.11	31.61	−.11	.18	−.01	.08
Non-student	1 682	6	.04	.08	.05	.05	63.50	−.02	.12	−.01	.11

Note: ACDM, Assessment of Career Decision Making Scale; GDMS, General Decision-making Style Inventory; REI, Rational–Experiential Inventory; r_m, mean sample size-weighted correlation; SD_r, sample size-weighted observed standard deviation of correlations; r_α, mean sample size-weighted correlation corrected for unreliability using alphas; $SD_{r\alpha}$, corrected standard deviation of corrected correlations; % var., percentage of variance attributable to statistical artifacts; CV_{10} and CV_{90}, 10% and 90% credibility values, respectively; CI_L and CI_U, lower and upper bounds, respectively, of the 95% confidence interval around the corrected mean correlation; z, the z-statistic calculated using formula 14 (and using formula 9 to calculate sampling variance) from Raju and Brand (2003) for assessing the significance of the difference between the corrected correlations within each moderator category (zs ≥ ±1.96 suggest a significant difference).

Moderator analyses

Because the large 80% credibility interval indicates that the population of correlations has considerable variability, it is likely that one or more important moderators are present. We examined whether the intuition–analysis relation varied with the use of different scales. Table 2 shows the corrected correlations between intuition and analysis when using different scales (GDMS, ACDM, and REI-20). Specifically, whereas REI-20 had positive corrected correlation of .01, both GDMS and ACDM had negative corrected

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Table 3. Meta-analysis results for the relations between rationality/intuition and Big Five traits

Variable	N	k	r_m	SD_r	r_α	$SD_{r\alpha}$	% var.	CV_{10}	CV_{90}	CI_L	CI_U
Conscientiousness											
Rationality	3332	10	0.22	0.20	0.28	0.24	6.85	−0.03	0.59	0.24	0.32
Intuition	3332	10	0.03	0.14	0.04	0.17	14.71	−0.18	0.25	−0.01	0.08
Openness to experience											
Rationality	3332	10	0.26	0.21	0.35	0.27	5.94	0.00	0.69	0.30	0.39
Intuition	3332	10	0.18	0.04	0.23	—	—	—	—	0.19	0.28
Extraversion											
Rationality	3566	10	0.08	0.10	0.10	0.11	27.66	−0.04	0.24	0.06	0.14
Intuition	3568	10	0.17	0.06	0.21	0.05	63.05	0.15	0.28	0.17	0.25
Agreeableness											
Rationality	3566	10	0.10	0.14	0.13	0.17	14.60	−0.08	0.35	0.09	0.18
Intuition	3373	10	0.09	0.1	0.13	0.11	29.10	−0.01	0.26	0.08	0.17
Neuroticism											
Rationality	3566	10	−0.02	0.23	−0.02	0.28	5.38	−0.38	0.34	−0.07	0.02
Intuition	3566	10	−0.01	0.10	−0.01	0.10	30.17	−0.14	0.12	−0.05	0.03

Note: r_m, mean sample size-weighted correlation; SD_r, sample size-weighted observed standard deviation of correlations; r_α, mean sample size-weighted correlation corrected for unreliability using alphas; $SD_{r\alpha}$, corrected standard deviation of corrected correlations; % var., percentage of variance attributable to statistical artifacts; CV_{10} and CV_{90}, 10% and 90% credibility values, respectively; CI_L and CI_U = lower and upper bounds, respectively, of the 95% confidence interval around the corrected mean correlation.
Dashes represent instances in which corrected standard deviation of corrected correlation ($SD_{r\alpha}$) was negative, and thus information of $SD_{r\alpha}$, percentage of variance attributable to statistical artifacts (% var.), and credibility intervals was unavailable.

correlations (for GDMS, $r_\alpha = -.03$; for ACDM, $r_\alpha = -.49$). Using REI-20 as the criterion of comparison, GDMS had a corrected correlation that significantly differed from that found with the REI-20 ($z = -2.25$, $p < .05$), and the corrected correlation for the GDMS was also significantly different from that found with the ACDM ($z = -13.81$, $p < .01$). Thus, we were able to conclude that the use of different scales was a significant moderator for the rationality–intuition correlation, particularly with respect to the ACDM.[4]

Relations with Big Five traits

Table 3 shows meta-analytic results for the correlations between intuition and analysis, and the Big Five personality traits. We also conducted z-tests for significant difference in correlational coefficients based on Raju and Brand (2003), as shown in Table 4. According to these results, analysis tended to have stronger relations with conscientiousness and openness to experience than did intuition. Whereas intuition tended to have a stronger relation with extraversion, intuition and analysis had equivalent mean-corrected correlations with agreeableness and neuroticism.

Overall, the meta-analysis suggested a near-zero correlation between intuition and analysis, which is consistent with the independence models (e.g., Epstein, 1994; Sloman, 1996; Stanovich & West, 2000). Recall that these models are based on the view that intuition and analysis are independent, unidimensional styles of information processing that serve different purposes. There were two possible limitations on making this inference, however, from our meta-analysis. First, our moderator analysis identified scale type as a moderator of the relation between intuition and analysis. One scale, the ACDM, showed a sizable correlation between the two constructs. Second, most of the scale correlations between intuition and analysis were based on subdimensions of the same measure (i.e., the same scale measures both intuition and analysis). It is possible that, during the scale development phase, items that cross-loaded on intuition and analysis were discarded.

Although not a panacea for these limitations, we conducted a second meta-analysis that was designed by intercorrelating intuition and analysis measured by *different* scales. For instance, intuition as measured by the REI was correlated with analysis as measured by the PID. This analysis allowed us to examine cross-scale correlations of intuition and analysis and thus provided an alternative assessment of construct relations. Because the ACDM is the only one of the measures that focuses specifically on the career domain, we did not include it in the second study. We discuss this later in the Conclusions.

STUDY 2: CROSS-SCALE META-ANALYSIS

Participants, measures, and procedure

We conducted a meta-analysis of data collected specifically for this study—on four different cognitive style measures (i.e., REI-31, GDMS, DMI, and PID). The intuition and analysis subscales from different measures were randomly combined, resulting in 12 pairs of intuition–analysis scale combinations. To examine the scale-level relation between intuition and analysis, we used two different methods for data analysis. First, we used meta-analysis to summarize the 12 pairs of correlational results collected from our sample. Second, we conducted a hierarchical confirmatory factor analysis (CFA) to examine whether the intuition (or analysis) constructs

[4]The corrected correlation for identifiable studies conducted in field settings (.01) and the corrected correlation for identifiable studies conducted in lab settings (.03) were not significantly different ($z = -0.37$, n.s.).

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Table 4. Side-by-side comparison of the relationships that rationality and intuition have with a common set of correlates[a]

Variable	Correlation with rationality	Correlation with intuition	Magnitude difference[b,c,d]	Direction
Agreeableness	0.13	0.13	0.00	Same
Conscientiousness	0.28	0.04	0.24**	Same
Extraversion	0.10	0.21	−0.11**	Same
Neuroticism	−0.02	−0.01	0.01	Same
Openness to experience	0.35	0.23	0.12**	Same

Note:
[a]Numbers reflect correlation corrected using alpha coefficients for both rationality and intuition (r_α).
[b]Absolute values of r_αs are used to calculate the magnitude difference. That is, the directions are not considered when calculating magnitude difference.
[c]Positive numbers mean the magnitude of correlation with rationality was stronger than that with intuition.
[d]z-test for significant difference in correlational coefficients based on Raju and Brand (2003).
*$p < .05$;**$p < .01$.

measured by different scales tap into the same overarching latent construct.

Participants were recruited using Amazon's Mechanical Turk (Buhrmester et al., 2011). Five hundred and eleven participants were randomly assigned to provide responses to different intuitive and analytical subscale pairings. For example, 43 participants completed the rational subscale of Epstein et al.'s (1996) REI-31 scale and the intuitive subscale of Scott and Bruce's (1995) scale. Participants were given one of 12 possible such pairings.

Results and discussion

Meta-analysis

Descriptive statistics, including sample sizes, means, standard deviations, alpha reliabilities, and intuition–analysis correlation for each combination of scales, are listed in Table 5.

A meta-analysis was conducted with the 12 intuition–analysis pairs and a total sample size of 511. Because participants were randomly assigned to different pairs and there was no overlapping of participants across scale pairs, 12 different scale pairs were regarded as 12 independent studies in the meta-analysis. The mean sample size-weighted correlation corrected for unreliability using alpha was near 0 with substantial variability, $r_\alpha = .03$, 80% credibility value = [−0.04, 0.11], 95% CI = [−0.07, 0.14]. These results suggested that there was practically no significant correlation between intuition and analysis across cognitive style subscales.

Construct-level confirmatory factor analysis

These data provided the opportunity to examine the relation between intuition and analysis at the latent (construct) level. The meta-analysis method can show that analysis and intuition, whether measured by the same or different scales, are not significantly correlated. This method cannot rule out, however, the possibility that such insignificance is (at least partly) due to the lack of construct validity for either analysis or intuition measures. In other words, the meta-analysis method only provides corrections for unreliability *within* one particular measure (e.g., analysis as measured by REI), but it cannot correct for the measurement deficiency *across* different measures (e.g., when the analysis scores as measured by REI, GDMS, DMI, and PID are combined).

To address this, we conduct a hierarchical CFA to calculate the intercorrelation between analysis and intuition while simultaneously considering the construct validity of analysis and intuition as measured by different scales. The hierarchical CFA can provide useful information about the following: (i) whether different scales of analysis and intuition provide

Table 5. Descriptive statistics and correlation coefficients for all scale combinations and meta-analysis results in Study 2

		N	$M_{\text{rationality}}$	$SD_{\text{rationality}}$	$M_{\text{intuition}}$	$SD_{\text{intuition}}$	$\alpha_{\text{rationality}}$	$\alpha_{\text{intuition}}$	$r_{\text{R–I}}$
Pair #1	PID deliberation–REI experiential	37	3.60	0.56	3.74	0.51	0.74	0.83	0.17
Pair #2	GDMS intuitive–PID deliberation	32	3.55	0.78	3.78	0.41	0.91	0.71	−0.24
Pair #3	PID deliberation–DMI intuition	43	3.95	0.83	3.82	0.50	0.76	0.94	−0.00
Pair #4	PID intuition–REI rational	37	3.49	0.63	3.30	0.36	0.82	0.55	0.07
Pair #5	REI rational–GDMS intuitive	43	3.52	0.60	3.40	0.38	0.64	0.72	−0.15
Pair #6	DMI intuition–REI rational	46	4.02	0.71	3.20	0.35	0.92	0.63	−0.09
Pair #7	GDMS rational–PID intuition	45	3.25	0.54	4.19	0.72	0.87	0.72	0.02
Pair #8	REI experiential–GDMS rational	48	3.75	0.61	4.15	0.62	0.87	0.80	0.13
Pair #9	GDMS rational–DMI intuition	53	3.80	0.76	4.25	0.63	0.89	0.93	−0.01
Pair #10	PID intuition–DMI analysis	41	3.31	0.58	4.79	0.59	0.83	0.92	0.09
Pair #11	DMI analysis–REI experiential	39	3.62	0.70	4.90	0.73	0.93	0.90	0.43**
Pair #12	GDMS intuitive–DMI analysis	47	3.56	0.71	4.72	0.67	0.78	0.91	−0.15

Note: N, the sample size from valid responses; $M_{\text{rationality}}$, mean of rationality; $SD_{\text{rationality}}$, standard deviation of rationality; $M_{\text{intuition}}$, mean of intuition; $SD_{\text{intuition}}$, standard deviation of intuition; $\alpha_{\text{rationality}}$, alpha reliability of rationality scale; $\alpha_{\text{intuition}}$, alpha reliability of intuition scale; $r_{\text{R–I}}$, correlation between rationality and intuition; DMI, Decision-making Inventory (Nygren, 2000); GDMS, General Decision-making Scale (Scott & Bruce, 1995); PID, Preference for Intuition and Deliberation (Betsch, 2004); REI: Rational–Experiential Inventory (Epstein et al., 1996).
*$p < .05$;**$p < .01$.

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equivalent reflection of the intended underlying constructs and (ii) whether there is still no correlation between analysis and intuition even after considering the measurement deficiency across different scales.

Using a hierarchical CFA approach, the 48 analysis-focused items were set to load onto four first-order factors representing the analytical portions of their respective scales. Likewise, the 41 intuition-focused items were set to load onto four first-order factors representing the intuition portions of their respective scales. Based on the assumption that scale responses are the result of underlying psychological constructs, two second-order factors were generated to represent the underlying intuition and analysis factors, with the four first-order (i.e., scale) factors loading on each of the respective second-order factors.

The hierarchical CFA model (visually shown in Figure 1) was estimated using MPLUS 7.11 (Muthén & Muthén, 2013). To accommodate the planned missing data (i.e., participants were not asked to complete all scales used in this analysis), a full-information maximum-likelihood estimation procedure was used (Enders & Bandalos, 2001). Two models were estimated: (1) an uncorrelated-factors model in which the second-order factors are presumed to be unrelated and (2) a correlated-factors model in which the second-order factors were allowed to correlate. The difference between the models is shown as a dashed line in Figure 1.

Because the models were very similar in terms of fit, only the uncorrelated-factors model fit statistics are reported in the following. The indicator of absolute model data fit was significant, $\chi^2 = 3799.0$, $df = 1,859$, $p < .001$. The root mean square error of approximation (RMSEA) relative fit index was within acceptable bounds ($RMSEA = 0.045$, 90% CI = [0.043, 0.047]), whereas the comparative fit index (CFI) relative fit index indicated imperfect fit ($CFI = 0.66$). The presence of imperfect relative fit was not surprising given the presence of two non-significant hierarchical factor loadings, as described in the following.

All but one of the observed variables (scale items) significantly loaded onto their respective first-order scale factors; M standardized $\lambda = 0.79$, $SD = 0.25$. Of more substantive interest is the loading of each first-order factor onto its respective second-order factor. The right-hand portion of Figure 1 shows that there was variability in how well each first-order scale factor was represented by its posited underlying second-order factor. The intuition scale-level factors all significantly loaded onto the second-order intuition factor (loadings ≥ 0.68), indicating that they formed a cohesive second-order factor. This was not the case, however, with the analysis scales. Two of the scale-level analysis factors (DMI rationality and PID rationality) did not significantly load onto the second-order analysis factor. It seemed that the item content or item responses were different enough from scale to scale to prevent a cohesive factor from forming. In short, the four analytical scales examined here do not appear to be interchangeable with one another.

Another substantive question addressed by this CFA is to what degree intuition and analysis were related at the construct level, that is, whether the two second-order factors were correlated with one another. The second-order intuition and analysis factors were negatively correlated, but not at a significant level, $\Phi = -0.18$, $p = .30$. Allowing intuition and analysis to correlate did not significantly improve model data fit, $\Delta\chi^2 = 1.11$, $df = 1$, $p = .30$, and therefore, the uncorrelated-factors model is the more appropriate model. This analysis suggests that no meaningful correlation between intuition and analysis exists at the construct level.

Hierarchical CFA with second-order analysis and intuition factors (left portion of figure) modeled from first-order scale-level factors (right portion of figure) [a, b]

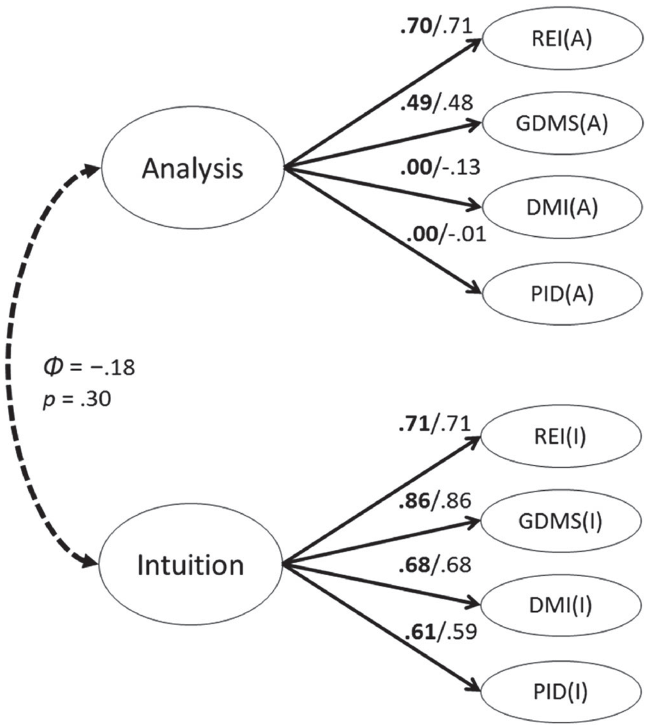

Figure 1. Hierarchical confirmatory factor analysis (CFA) with second-order analysis and intuition factors (left portion of figure) modeled from first-order scale-level factors (right portion of figure) Note: a. Standardized factor loadings when estimated with uncorrelated (bold values)/correlated second-order factors. Observed variables omitted for simplicity; b. REI = Rational-Experiential Inventory; GDMS = General Decision-making Style; DMI = Decision-making Style Inventory; PID = Preference for Intuition and Deliberation; (A) = analysis-focused subscale (I) = intuition-focused subscale

CONCLUSIONS

The purpose of this set of studies was to determine the nature of the relation between intuitive and analytical cognitive styles. Two contrasting perspectives were proposed: (i) intuition and analysis are significantly negatively correlated (bipolar model) and (ii) intuition and analysis are uncorrelated (independence model). The meta-analyses reported here showed no evidence for an intuition and analysis correlation, suggesting that the independence model may be more appropriate. This conclusion was supported by the CFA in Study 2. This supports a dual-process model of rationality and intuition (Evans, 2008), suggesting that analysis and intuition are not opposite ends of the same continuum.

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Moderator analysis showed that the scale chosen for use appears to influence the correlation between the constructs. Specifically, studies using the ACDM tend to find strong negative correlations between intuition and analysis. We believe that it is possible that intuition and analysis, as measured by this career-specific measure, may have high shared variance due to this shared career context. For instance, Bentler (1969) showed that nonrandom error, such as acquiescence, may create erroneous intercorrelations. It is possible that a general tendency for people to agree or disagree with career-related decision items caused this measure to show a relation between intuition and analysis that is not evident using non-domain-specific measures.

We also examined the relation of intuition and analysis with personality constructs in the five-factor model. These analyses showed that intuition and analysis have different relations with different Big Five constructs. For the Big Five personality traits, intuition tended to have a stronger relation with extraversion, whereas analysis tended to have a stronger relation with conscientiousness and openness to experience. These results provide additional support for the independence view of the cognitive styles, as the two styles appear to have different nomological networks.

The results of the CFA in Study 2 suggested that no meaningful correlation between intuition and analysis exists at the construct level. It also showed that, whereas intuition appears to be measured with some consistency across scales, there seems to be greater disparity in the different measures of analysis. The lack of a unified analytical factor suggests that the various scales may be measuring different constructs. There was no way in the current study to directly test which scale was the most accurate in measuring analysis. To address this, future research will need to compare the nomological networks and predictive validity of the different analytical scales. Hodgkinson and Sadler-Smith (2003) have called for revalidating scales to measure these cognitive styles. In the absence of such efforts, future researchers and practitioners should consider carefully the content of analysis scales when selecting which measure to use, as it could affect conclusions drawn from study results. Specifically, we suggest that researchers choose the analysis scale that matches with the predicted behaviors or preferences. The REI, for example, assesses analysis as one's need for cognition, whereas the GDMS assesses analysis more in terms of preferred style of approaching decisions.

Our meta-analysis did not include attitudinal or behavioral outcomes related to analysis and intuition. This is partly due to the interdisciplinary nature of the studies that we included. The involvement of multiple fields made it hard to identify or integrate for a universal attitudinal or behavioral outcomes. For example, although much research has linked analysis and intuition with decision quality in certain tasks, we were not able to integrate decision quality from multiple tasks in various fields as one universal behavioral correlate. Future research may need to explore how analysis and intuition contribute to certain attitudinal and behavioral outcomes that are important to their specific concerns. For instance, research is needed to link analysis and intuition with coping styles (Epstein & Meier, 1989), naturalistic decision making (Klein, 2008; Salas et al., 2009), leadership (Armstrong et al., 2012), consumer choice (Ares et al., 2014), and education (Sadler-Smith, 2011).

In summary, the results converge on the proposition that analysis and intuition are orthogonal constructs. This is consistent with previous research supporting a dual-process model (Evans, 2008; Hodgkinson et al., 2009). Researchers should rely on measures that were developed based on this independence perspective. Assessing intuition as the opposite of analysis is likely to lead to erroneous conclusions regarding the nature of cognitive style and its relation with general information processing.

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