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More than meets the eye? Intuition and analysis revisited

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ABSTRACT

Research on individual differences in information processing is characterized by two incompatible theoretical perspectives. The unitary view postulates that analysis and intuition are the opposite poles of a single dimension, whereas the dual-process view proposes that they are independent constructs. We investigated this issue using two established measures of information-processing style, the Cognitive Style Index (CSI) and the Rational–Experiential Inventory (REI), each representative of one of the two conflicting views. We found that the REI's dimensionality was consistent with the dual-process view, reflected by two uncorrelated factors, although we failed to replicate the instrument developers' subsequent re-formulation into ability and engagement sub-scales. The structure of the CSI was more problematic, implying the existence of three factors, which is inconsistent with the unitary view advocated by its developers. Our studies suggest that the REI's original formulation is preferred, and that the unitary conception underpinning the CSI should be abandoned forthwith.

In recent years, there has been a resurgence of interest in the analysis of individual differences in information-processing (or cognitive) style, reflected in studies of alternatives to rational thinking (Dane & Pratt, 2007; Hodgkinson, Langan-Fox, & Sadler-Smith, 2008; Sinclair & Ashkanasy, 2005). Arguably, this renewed attention is in part due to interest in the self-report instruments used to assess information-processing style. In view of the difficulties in mapping non-rational processes, however, there seems to be little agreement among researchers as to how best to conceptualize and measure pertinent constructs. This lack of consensus has significant implications for the comparability of results across studies. Moreover, use of underspecified or miss-specified instruments, or theoretically incompatible scales, may lead to misconstrued conclusions and unjustified claims regarding practical implications. In the research reported in this article, therefore, we set out to examine these inconsistencies empirically through a comparative analysis of two established measures of cognitive style: the Cognitive Style Index (CSI: Allinson & Hayes, 1996) and the Rational–Experiential Inventory (REI: Epstein, Pacini, Denes-Raj, & Heier, 1996; Epstein, Pacini, & Norris, 1998; Pacini & Epstein, 1999).

Although information processing has been mapped in a number of ways, the principal focus for many researchers has been on the distinction between analytical and intuitive processes (Dane & Pratt, 2007). In short, there are opposing theoretical views on the relationship between rational and intuitive styles that make the selection of an appropriate measure difficult (see Hodgkinson & Healey, 2008). Two measures, the CSI and the REI, have been prominent in these debates, but are construed on incompatible theoretical foundations.

The CSI evaluates a *unidimensional* construct, where analysis and intuition are viewed as bipolar opposites of a single continuum (Allinson & Hayes, 1996). The REI, in contrast, is predicated upon a *dual-process* theory, which posits that rational (analytical) and experiential (intuitive) approaches are served by interacting, but independent systems (Epstein, 1990), a view supported by recent research that suggests that these systems derive from separate neural pathways (see Lieberman, 2007). Researchers who wish to investigate self-reported individual differences in analytical and intuitive processing are thus faced with a choice of two popular and seemingly equally well-validated instruments, based on incompatible underlying theories.

There are also significant unresolved issues related to the construct validity of each instrument. More specifically, questions remain regarding the underlying factor structures and scale intercorrelations within and across the two instruments.

In response to the above concerns, we designed two studies to compare the CSI and REI in terms of their theoretical underpinnings, to investigate their factor structures, and to evaluate their compatibility in terms of their declared theoretical foundations (unitary and dual-process, respectively). In Study 1, we explored

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the factor structure of each instrument at the item level. In Study 2, we investigated the factor structure of the combined scales (derived on the basis of Study 1 findings) at the scale level.

1. Theoretical background and empirical evidence for cognitive style measurement

1.1. Unitary conceptions and the Cognitive Style Index

Drawing upon early interpretations of cognitive style as a bipolar construct (see e.g., Kagan & Kogan, 1970), Allinson and Hayes (1996) argued that there is a single, super-ordinate dimension underpinning the facets of cognitive style identified by previous researchers. They labeled this bipolar scale "the intuition–analysis dimension," where intuition was defined as "immediate judgment based on feeling", analysis as "judgment based on mental reasoning" (p. 122). The scale they developed to measure this dimension was the 38-item Cognitive Style Index (CSI), which is conventionally scored using a trichotomous ('true,' 'uncertain,' 'false') response format. Twenty-one items assess analytical information processing (positively scored) while 17 evaluate intuitive processing (negatively scored). Item scores are summed to give a single index. The authors reported alphas ranging from .84 to .92 in their original studies. Alphas above .70 have also been reported in replication studies (e.g. Sadler-Smith, Spicer, & Tsang, 2000). Test–retest correlations range from .78 to .90 across 26 samples (Armstrong, Allinson, & Hayes, 2004).

In an attempt to circumvent problems associated with trichotomized responses, Allinson and Hayes (1996) used item parceling. Parceling in this case involved summing the scores of items that were homogeneous with respect to selected statistical criteria (principally the inter-item correlations), which resulted in item parcels that were heterogeneous with respect to item content (i.e. the resulting parcels each comprised a mixture of intuitive and analytical items). As noted by Hodgkinson and Sadler-Smith (2003a, 2003b), this approach to parceling is seriously flawed since it is likely to have biased the outcome of factor analyses in favor of a single factor solution. Although Hodgkinson and Sadler-Smith (2003a) overcame this flaw in the original research by using domain homogeneous parcels (i.e. each parcel comprised only analytical or intuitive items), which yielded a series of two-factor solutions, item-parceling in general is far from ideal because it favors the emergence of second-order factor solutions at the expense of primaries (Kline, 1993). Hence, there is a possibility that the unifactorial and two-factor solutions obtained in previous studies may have been an artifact of item parceling and do not adequately reflect the true underlying structure of the CSI. Clearly, therefore, there is a need to re-examine the item-level factor structure of this instrument, incorporating a conventional response format that circumvents the need for such parceling.

1.2. Dual-process conceptions and the Rational–Experiential Inventory

Epstein et al. (1996) developed the REI on the assumption that two parallel cognitive systems co-exist: the rational system is conscious, deliberative, abstract, analytic, and affect free, while the experiential system is preconscious, automatic, concrete, holistic, and affect laden. This distinction forms the conceptual basis for Epstein's (1990) Cognitive-Experiential Self-Theory (CEST) upon which the REI is founded. The original version of the REI comprised two unipolar measures, each with a five-point Likert scale response format: 'Need for Cognition' (NFC), a 19-item scale adapted from Cacioppo and Petty (1982) that reflects "the extent to which individuals report that they enjoy and engage in, or dislike and avoid, cognitive activities" (Epstein et al., 1996, p. 394); and a 'Faith in Intuition' (FI) scale, developed specifically for the REI, consisting of 12 items designed to assess "confidence in one's feelings and immediate impressions as a basis for decisions and actions" (p. 394).

Subsequently, Pacini and Epstein (1999) reported the development of a 40-item version of the REI that draws an explicit distinction between 'engagement' and 'ability' for both dimensions. Rational ability (RA) refers to the capacity to think logically and analytically, whereas rational engagement (RE) refers to reliance on, and enjoyment of, thinking. Similarly, experiential ability (EA) refers to the capacity of an individual to draw upon intuition (for example, by trusting their initial feelings about people) while experiential engagement (EE) reflects the tendency of individuals to rely upon such experiences when facing important decisions. The two rationality and two experientiality sub-scales of the revised REI (long form) are balanced in terms of the number of items reflecting ability and engagement (10 items each) and the number of items positively and negatively worded. Rational and experiential scores are computed by summing scores for the ability and engagement sub-scales.

Using Principal Components Analysis, Pacini and Epstein (1999) found, consistent with CEST that two components accounted for 34% of the variance. All rationality items loaded on the first component, and experientiality items loaded on the second. A similar approach was adopted to examine the structure of the component scales themselves, but regrettably the procedure was modified in each case to force a two-factor solution, with the expectation that this would yield solutions that reflected the putative ability and engagement distinction posited in the revised version of the REI (Pacini & Epstein, 1999). Although two components emerged in respect of each scale, contrary to expectations, the experientiality (intuitive) items reflected positive and negative wording, rather than ability and engagement. Moreover, the engagement factor explained only "marginal" (but unspecified) variance (Pacini & Epstein, 1999, p. 975). Not unreasonably, the authors argued that the ability-engagement distinction is more discriminating for the rationality items, since people have objective information (such as college grades) regarding this aspect of ability, whereas they lack objective criteria for judging the accuracy of intuitive ability. They therefore maintained that the distinction between experiential ability and engagement should be retained for conceptual coherence.

Closer scrutiny of Pacini and Epstein's (1999) analysis, however, reveals several unresolved methodological issues. Specifically, given the absence of a clear rationale concerning their choice of method of rotation to simple structure, and the lack of clearly stated statistical criteria for determining the number of components to be extracted, the possibility of alternative factor structures was not investigated. Hence, as with the Allinson and Hayes (1996) CSI, there is a pressing need to re-examine the dimensionality of the Pacini and Epstein (1999) REI. We set out to do this in our two studies. In Study 1, we investigated the commensurability of each instrument specific to their respective theoretical bases (unitary and dual-process). In Study 2, we examined the dimensionality of information-processing styles as captured jointly by the two instruments.

2. Study 1: Item level analysis of REI and CSI

Study 1 was designed to explore the factor structure of each instrument at the item level by means of extraction procedures comparable across instruments and commensurable with previous research.

2.1. Method

2.1.1. Participants

Participants comprised 408 undergraduate management students at a large Australian university, of whom 58.9% were female. Their ages ranged between 16 and 49 years ($M = 19.35$; SD = .19). Participation was voluntary.

2.1.2. Instruments and procedure

All participants completed the CSI (Allinson & Hayes, 1996) and the revised version of the REI (Pacini & Epstein, 1999), which were administered four weeks apart to minimize respondent fatigue. The response format of the CSI was adapted to a 5-point Likert scale in order to overcome the limitations of the original trichotomous ('true,' 'uncertain,' 'false') response format that, by definition, restricted item variances (Hodgkinson & Sadler-Smith, 2003a, 2003b), thereby necessitating item parceling (and thus precluded an item level exploration of the instrument's underlying factor structure).

Consistent with Pacini and Epstein (1999) and Hodgkinson and Sadler-Smith (2003a), we analyzed the REI and the CSI data using Principal Components Analysis (PCA).[1] Following Comrey (1978), we first verified that both datasets were suitable for exploratory factor analysis (REI, KMO = .9; REI, Bartlett's test of sphericity = 5530.76, $p < .001$; CSI, KMO = .8; CSI, Bartlett's test of sphericity = 4366.94, $p < .001$). We used Exploratory Factor Analysis (EFA) because we did not find *a priori* hypothetical structures within the extant literature that would warrant using Confirmatory Factor Analysis (see Hurley et al., 1997). With regard to the REI, such a structure was hard to justify because, as noted earlier, Epstein and his colleagues forced a fit in their original EFA; hence, in our view, the published exploratory analyses of the REI are indeterminate. With regard to the CSI, the situation was all the more problematic because all previous exploratory work used parceled items to overcome the problems with the test developers' choice of a trichotomous (true/uncertain/false) response format. Hence, there is no justifiable *a priori* structure for this instrument when scored using the five-point Likert scale adopted in our study. It was also important to use the same data reduction technique on the REI and CSI data sets gathered in the present study, so as to ensure comparable findings. In the light of all of these considerations, EFA was adopted as the method of choice for the analysis of both data sets.

2.2. Results

2.2.1. The Rational–Experiential Inventory

Based on Zwick and Velicer (1982), we used Cattell's scree test to identify the number of factors for extraction, and identified a three-component solution that accounted for 37.56% of the variance. Although we initially found eight Eigen values > 1 (6.44, 6.07, 2.25, 1.54, 1.53, 1.45, 1.19, 1.03), there was a clear inflexion after three. Oblimin rotation results indicated the three components were not significantly inter-correlated (consistent with previous research, see Epstein et al., 1996), so we adopted the Varimax procedure. All of the rationality items loaded significantly on the first principal component (Component 1 accounted for 16.09% of the total variance), thus reflecting the rationality construct as formulated by Epstein et al. (1996). The second and third principal components, which respectively accounted for 15.16% and 6.31% of the variance, captured the experientiality items. In keeping with the findings of Pacini and Epstein (1999), the positively worded experientiality items loaded on Component 2, while the negatively worded experientiality items loaded on Component 3. One negatively worded experientiality item (EE 35: "I generally don't depend on my feelings to help me make decisions") cross-loaded on Components 2 and 3. Three rationality items (RE 12, 26, and 28) cross-loaded on Component 1 and Component 3 but, in each case, the strongest loading in connection with these items was on Component 1 (rationality).

In conclusion, having submitted all forty REI items to a PCA, but unlike previous researchers without *a priori* forcing a two-factor solution, we found three factors (principal components): one rationality factor and two experientiality factors. Hence, and in contrast with Pacini and Epstein (1999), our results suggest that a three-factor, rather than four-factor, solution is the preferred basis for interpreting the REI. Our findings are consistent with the original formulation (Epstein et al., 1996), but cast doubt on the construct validity of the subsequent reformulation (Pacini & Epstein, 1999) of this instrument. Our analysis, which unlike Pacini and Epstein (1999) did not force a two-factor solution on the rationality items, failed to find any evidence for the distinction between ability and engagement. Our findings in respect of experientiality (intuition) do, however, seem to mirror those of Pacini and Epstein (1999): items separated according to the polarity of wording (positive and negative) rather than on the basis of an ability-engagement distinction. The negatively worded factor accounted for a much smaller amount of variance (6.31%), arguably reflecting a method factor rather than a true substantive factor, an issue which we investigated further in Study 2.

2.2.2. The Cognitive Style Index

We again used exploratory PCA, but this time found ten Eigen values > 1 (6.53, 2.75, 1.98, 1.59, 1.47, 1.34, 1.25, 1.15, 1.13, 1.07), with a clear inflexion after three. As such, based on Cattell's scree test, we identified three components that accounted for 29.63% of the variance. These were rotated to simple structure using Oblimin rotation, consistent with previous findings that CSI factors are correlated (Hodgkinson & Sadler-Smith, 2003a).

This time, nineteen of the 21 analysis items loaded on Component 1 (items 6 and 14 being the exceptions); five of these cross-loaded on Component 2 (Items 4, 9, 11, 21, and 23). Two of the cross-loading items (Items 4 and 21) had a higher loading on Component 2 than on Component 1. The intuition items generally loaded on Components 2 and 3, but three of them (Items 2, 17 and 18) failed to load at the salient level of .32 (Hair, Black, Babin, Anderson, & Tatham, 2005). None of the intuition items exhibited cross-loadings above the .32 threshold.

Component 1 was concerned with deliberative rational analysis (for example: "I take my time and thoroughly consider all the relevant factors"). We labeled this unipolar component 'systematic processing'. Component 2 was bipolar, as evidenced by the mixture of positive and negative loadings, reflecting cautiousness (e.g., "My philosophy is that it is better to be safe than risk being sorry") and spontaneity (e.g., "I work best with people who are spontaneous"). We labeled this component 'spontaneous–cautious'. Like Component 1, Component 3, which we labeled 'heuristic processing', reflecting intuitive judgments (e.g., "I make many of my decisions on the basis of intuition"), was unipolar.

In conclusion, the item-level factor structure of the CSI stands in marked contrast to the findings of researchers who have investigated the structure of this instrument using item-parceling procedures. Responses to the CSI do not appear to be composed of a single bipolar analysis/intuition factor (cf. Allinson & Hayes, 1996; Sadler-Smith et al., 2000); but nor do they comprise two unipolar factors, separately reflecting the analysis and intuition constructs (cf. Hodgkinson & Sadler-Smith, 2003a). Rather, two unipolar dimensions, respectively reflecting 'heuristic processing' and 'systematic processing' emerged, together with a bipolar

[1] The rotated components loadings associated with these analyses are available from the authors upon request.

dimension that spanned the analysis and intuition domains, which we labeled 'spontaneous–cautious'.

2.3. Discussion

This initial investigation of the REI and the CSI has raised questions about their theoretical underpinnings as well as their factor structures. Consistent with a dual-process formulation, the REI analysis confirmed the independence of rationality and experientiality, but failed to identify any ability-engagement distinction for the rationality and experientiality scales (cf. Pacini & Epstein, 1999). The experientiality scale did separate into two sub-components but, contrary to expectations, these comprised positively- and negatively-worded items. Our analysis of the CSI yielded findings contrary to the unitary theory underpinning the instrument's development. As such, these findings are problematic. In this case, PCA revealed two unipolar dimensions, respectively reflecting 'systematic processing' and 'heuristic processing', together with a bipolar 'spontaneous–cautious' dimension, rather than a single, bipolar analysis–intuition dimension (cf. Allinson & Hayes, 1996).

3. Study 2: Scale level analysis of REI and CSI

In the light of Study 1, which yielded findings at the item-level incompatible with the theoretical foundations of the CSI and the ability/engagement re-formulation of the REI, it was important to investigate the factor structures and scale inter-correlations of these instruments concurrently at the scale level. Accordingly, in Study 2 we used psychometrically refined scales derived from Study 1 in an investigation of the overall factor structure of the combined instruments. Given the need for conceptual clarity, we felt it important to use refined versions of the scales to avoid the confounding effects of measurement error in the subsequent correlational analyses.

3.1. Method

3.1.1. Participants

Participants in Study 2 comprised 300 undergraduate management students drawn from the same Australian university as in Study 1. Their ages ranged between 17 and 46 years ($M = 19.55$; $SD = .22$), of whom 53.3% were female. Participation in this research was again voluntary.

3.1.2. Instruments and procedure

As in Study 1, all participants completed the revised REI (Pacini & Epstein, 1999) and the CSI (Allinson & Hayes, 1996). The instruments and procedure in this study were identical to those employed in Study 1, except that we refined the scales by deleting items that had exhibited factor loadings of less than .32 (Hair et al., 2005), and calculated Cronbach reliability coefficients for each of the factor-based scales thus obtained. Hence, six separate scale scores were computed: (1) CSI systematic processing (Analysis, $\alpha = .84$); (2) CSI heuristic processing (Intuition 1, $\alpha = .73$); (3) CSI spontaneous–cautious (Intuition 2, $\alpha = .74$); (4) REI rationality (Rational, $\alpha = .86$); (5) REI experientiality positively-worded (Experiential 1, $\alpha = .86$); and (6) REI experientiality negatively-worded (Experiential 2, $\alpha = .81$).

To examine the relationships between the factors that emerged from Study 1, all six sets of scale scores were entered jointly into a PCA, thus enabling us to explore the compatibility of the REI and CSI. Similar to Study 1, we used EFA to determine the relationship of both instruments without forcing them *a priori* into difficult to justify hypothetical structures.

3.2. Results

Descriptive statistics are shown in Table 1. We examined the correlation matrix in the table to discern whether the two factors derived for the REI experientiality items represent a single substantive factor together with a method factor. If this were the case, since the factor consisting of negatively-worded items (Experiential 2) was reverse scored, we would expect to find that this factor would be significantly positively correlated with the factor comprising positively-worded items (Experiential 1). Moreover, this factor should behave in an identical fashion in terms of its relationships to the other scales. Inspection of Table 1 reveals that this is the case, thus adding weight to the conjecture that the second experientiality factor is indeed a method factor.

As in Study 1, the various tests to ascertain the factorability of the input correlation matrix were satisfactory (KMO = .6; Bartlett test of sphericity = 473.02, $p < .001$). Accordingly, all six scales were entered into the PCA. The scree plot was inconclusive, however, so we adopted Eigen value > 1 as the criterion for the number of factors to be extracted. There were three factors with Eigen values greater than unity accounting for 78.44% of the variance. We expected the factors to correlate, and hence used Oblimin rotation. The pattern matrix, highlighting rotated component loadings $\geqslant .32$, is reproduced in Table 2.

The REI rationality scale (Rational) loaded on Component 3, while the two REI experientiality scales (Experiential 1 and Experiential 2) loaded on Component 2. This is in line both with the findings of Study 1 and those reported by Epstein et al. (1996). Once again the CSI revealed a more complex picture: all three scales loaded on Component 1. Furthermore, while the heuristic processing (Intuition 1) and systematic processing (Analysis) loadings were high, the loading for Intuition 2 was marginal (.34) at the scale level. Nevertheless, spontaneous–cautious exhibited a higher loading on Component 3 (−.49) along with REI rationality (.97). To examine the relationship between rationality and experientiality/intuition more closely, the two experientiality scales were subsequently combined into a single scale. A supplemental analysis confirmed that the correlation between the two REI overarching dimensions (rational and experiential/intuitive) was close to zero ($r = -.05$), thus attesting to their independence.

Table 1
Study 2: Scale means, standard deviations, reliabilities, and scale correlations ($N = 300$).

Scale	Mean (SD)	Reliabilities and inter-correlations					
		1	2	3	4	5	6
1. CSI Analysis (systematic processing)	3.49 (.51)	**.86**	−.64**	−.30**	.17**	−.21**	−.28**
2. CSI Intuition 1 (heuristic processing)	3.03 (.47)		**.68**	.46**	−.00	.25**	.25**
3. CSI Intuition 2 (spontaneous–cautious)	3.15 (.57)			**.67**	−.29**	.38**	.27**
4. REI Rational (rationality)	3.56 (.54)				**.86**	−.05	.01
5. REI Experiential 1 (experientiality positive)	3.59 (.57)					**.84**	.60**
6. REI Experiential 2 (experientiality negative)	3.27 (.60)						**.79**

** Correlation is significant at the .01 level (2-tailed).

Table 2
Study 2: Pattern matrix (rotated components) for the combined scale level Principal Components Analysis ($N = 300$).

Scale	Component		
	1	2	3
1. CSI Analysis (systematic processing)	−**.89**	.05	.04
2. CSI Intuition 1 (heuristic processing)	**.94**	.00	.09
3. CSI Intuition 2 (spontaneous–cautious)	**.34**	.30	−**.49**
4. REI Rational (rationality)	.09	.09	**.97**
5. REI Experiential 1 (experientiality positive)	−.06	**.91**	−.05
6. REI Experiential 2 (experientiality negative)	.01	**.88**	.10
Eigen value	2.49	1.18	1.04
Percent of variance	41.49	19.69	17.26

Note: Rotation method: direct Oblimin. Loadings $\geqslant$ .32 in **bold** typeface. REI Experiential 1 and Experiential 2 (method) factors analyzed separately.

3.3. Discussion

The results of Study 2 are in line with Study 1, suggesting that the revised REI should be scored using the original and simpler formulation, avoiding any ability-engagement distinction. The CSI, on the other hand, requires some revision, in order to attain acceptable levels of internal consistency across the three components we identified. Furthermore, to overcome the difficulties with the trichotomous response format, the CSI response format should be changed to a Likert-scale format, obviating the need for item parceling.

4. General discussion

Our analyses have highlighted differences in the two instruments investigated, but also raise questions about the measurement of cognitive style in general. There are four issues here: (1) dimensionality; (2) internal structure of the dimensions; (3) polarity of the identified factors; and (4) compatibility of constructs that the scales purport to measure.

Although the developers of the CSI and the REI claim both instruments assess similar aspects of human information processing, they are predicated upon incompatible theoretical foundations, unitary in the case of the CSI and dual-process in the case of the REI. Our findings offer support for a two-dimensional interpretation, although the relationship of the CSI to these two dimensions is less clear. In accordance with CEST, we found the REI rationality and experientiality scales to be independent, while the analytical and intuitive factors of the CSI appear to overlap and interrelate.

Theoretically, our findings clearly point to two substantive dimensions: intuition/experientiality and analysis/rationality. Psychometrically, they suggest that the REI has several advantages over the CSI. The REI is founded upon a more convincing theoretical basis (dual-process theory), and the items of the two main scales (rationality and experientiality) seem to reflect accurately the overall construct definition as intended by Pacini and Epstein (1999). Only the CSI analysis scale appears to capture the rational analysis construct as initially conceptualized by Allinson and Hayes (1996), while intuition shows a much greater dispersion and a concomitant lack of coherence in terms of the domain it purports to represent. Accordingly, we suggest that in future cognitive style researchers would be well-advised to consider the REI to be a measure of two orthogonal constructs of information processing, and to abandon forthwith the unitary conception underpinning the CSI.

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