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Construct redundancy within the Five-Factor Model as measured by the NEO PI-R: Implications for emotional intelligence and incremental coherence

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Abstract

Self-report measures of emotional intelligence (EI) have been criticized for not being associated with unique validity, independently of comprehensive measures of personality such as the NEO PI-R. In this investigation, the issue of unique validity was re-directed at personality as measured by the facets of the NEO PI-R. Specifically, based on three samples, the personality facet of Depression within the NEO PI-R was found to be so substantially predicted by ten other NEO PI-R facets as to suggest construct redundancy within the NEO PI-R (i.e., $R = .93$, $R = .99$, $R = .96$). Because mixed-models of EI tend to be associated with clearer construct boundaries than personality, it is suggested that EI may be associated with some scientific utility (i.e., 'incremental coherence'), even in the total absence of any empirically demonstrable unique validity.

Key words: personality, construct redundancy, reliability, emotional intelligence, multiple regression.

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The proposal of emotional intelligence (EI) as a construct in psychology has been met with a number of contentions that the scores derivable from the putative measures of EI are likely redundant with existing individual differences measures, namely personality and/or intellectual intelligence (Matthews, Zeidner, & Roberts, 2002). Mixed-model measures of EI, which are invariably in a self-report format, have been particularly criticized for sharing a substantial amount of variance with measures of personality (e.g., Davies, Stankov & Roberts, 1998), while ability-based measures have been suggested to be more closely related to intellectual intelligence (Matthews, Zeidner & Roberts, 2002). Consequently, for the purposes of establishing validity, investigators and commentators in the area have asserted that it is imperative that the putative measures of EI demonstrate themselves to be associated with an appreciable amount of variance that is independent of the existing well-established measures of individual differences. A number of validity type studies relevant to this issue have been published with mixed-results.

In one particular study (Schulte, Ree, & Carretta, 2004), scores from the Mayer-Salovey-Caruso-Emotional-Intelligence-Test (MSCEIT; Mayer, Salovey, & Caruso, 2002) were regressed onto total scores from the Wonderlic Personnel Test (WPT; Wonderlic, 1983), the NEO-Five Factor Inventory (NEO-FFI; Costa & McCrae, 1992a) and sex. The multiple regression yielded a multiple $R = .62$. Schulte et al. (2004) argued, however, that the multiple R would be expected to be attenuated due to measurement error in the EI and personality scores. This type of regression analysis is known as 'disattenuated regression' (see Bisbe, Coenders, Saris & Batista-Foguet, 2006, for an exposition on disattenutated regression). Therefore, Schulte et al. (2004) disattenuated the regression effects for imperfect reliability and reported a corrected multiple $R = .81$. Given the relatively large R value, Schulte et al. (2004) concluded that, "If EI can be largely predicted from other well-known constructs, its uniqueness and expected incremental utility for predicting human performance may be limited" (p. 1067).

Past studies that have investigated the unique construct validity associated with mixed-model measures of EI do not appear to have used disattenuated regression. However, the magnitude of the attenuated effects has been considered so large as to possibly suggest construct redundancy. For example, Gignac (2005) re-analyzed the Petrides and Furnham (2003) correlation matrix and reported a multiple R of .86 based on regressing Bar-On EQ-*i* (Bar-On Emotional Quotient Inventory; Bar-On, 1997) scores onto the five personality dimensions measured by the NEO PI-R. However, Gignac (2005) did not use disattenuated regression; consequently, the .86 estimated would have been expected to be downwardly biased, as the valid application of multiple regression assumes that the variables included in the model have been measured without error (Pedhazur, 1997).

Curiously, although a substantial amount of commentary on the construct of EI has been relevant to unique construct validity, very little research has examined the issue of construct redundancy within the NEO PI-R itself. Further, in those rare cases where the discriminant validity associated with the 30 facets of the NEO PI-R has been examined (e.g., Costa & McCrae, 1992b), the fact that the facet scores are known to be associated with imperfect levels of reliability (range in Cronbach's α from .65 to .80; Costa & McCrae, 1992a) has not been taken into consideration. Thus, the issue of whether at least one facet within the NEO PI-R can be demonstrated to be very substantially predicted by other facets within the NEO PI-R based on a disattenuated multiple regression analysis remains to be examined. If it were to be demonstrated that at least one facet of the NEO PI-R were largely redundant with other

facets within the NEO PI-R, the argument that measures of EI must demonstrate themselves not to be redundant with well-known measures of personality may be considered to be compromised.

The selection and justification of NEO PI-R predictors and criterion

The NEO PI-R (Costa & McCrae, 1992a) consists of five dimensions, each defined by six unique facets. Perhaps one of the most well-known and established psychological constructs within the NEO PI-R is 'Depression', which is one of the six facets that define the Neuroticism dimension. The construct of depression has a long history in psychology and it may be suggested that there is a substantial amount of scientific evidence supporting the plausibility of the construct (see Gotlib & Hammen, 2002). Consequently, in this investigation, the NEO PI-R Depression facet was chosen as the dependent variable to be regressed onto a selection of NEO PI-R facets, because there is a substantial amount of theoretical and empirical research to support depression as a genuine construct in psychology. Construct redundancy, in this context, would be indicated in the event that a regression equation was demonstrated to predict a very substantial percentage of the reliable variance in Depression facet scores (say, ≥80%).

The candidate predictors of the Depression facet were selected based on theoretical and empirical considerations. First, a self-evident theoretical case could be made for the remaining five Neuroticism facets, as the validity of the total Neuroticism score is predicated upon the empirical observation that the six facets are positively inter-correlated, which is in fact the case empirically (Costa & McCrae, 1992a).

Next, the dimension of Extraversion was considered, as Janowsky (2001) has delineated several empirical correlates between extraversion and depression, as well as theoretical implications for the effects. Specifically, the 'Positive Emotions' and 'Excitement Seeking' facets within the Extraversion dimension were considered particularly relevant to the prediction of scores on the Depression facet. The expected association between 'Positive Emotions' facet and Depression would appear to be self-evident, as Depression is in part defined as an absence of positive affect (Radloff, 1977).

Only the Feelings facet within the Openness to Experience dimension was expected to be associated with Depression. Theoretically, it was expected that those individuals who were more open to the experience of emotions would be more likely to experience depressive affect, all other things being equal. That is, individuals who self-reported themselves to be low on openness to feelings would likely not acknowledge (consciously or unconsciously) the experience of depression (or any other affect, for that matter).

Finally, the facets within the Conscientiousness dimension were considered, as the NEO PI-R dimensions of Conscientiousness and Neuroticism are well-known to be correlated negatively (e.g., Becker, 1999; DeYoung, Peterson & Higgins, 2002). Further, a negative association between Conscientiousness and depression, more specifically, has also been demonstrated empirically (Anderson & McLean, 1997). The Conscientiousness facets that were considered to be the most relevant to Depression were Competence and Self-Discipline. With respect to the Competence facet, it was theorized that those with higher depression scores may also be expected to suffer from lower levels of self-esteem, which was considered to affect self-report scores of Competence. With respect to the Self-Discipline facet, it

was theorized that those with higher depression scores may also be expected to suffer from lower levels of motivation and impulse control, which was considered to affect self-reported scores of Self-Discipline.

In summary, as critics of self-report measures of EI have asserted that EI measures must demonstrate unique construct validity, independently of personality, it was considered potentially interesting to test the hypothesis that a facet within the NEO PI-R (i.e. Depression) could be predicted nearly perfectly by a set of NEO PI-R facets.

Method

Samples

The analyses in this investigation were based on three sample correlation matrices. The first sample correlation matrix was obtained from the Costa & McCrae (1992a) publication manual, which has been reported to be based on an American representative sample of 500 male and 500 female adults. The second sample correlation matrix was based on a combination of university students and members of the broader Australian metropolitan population (n = 638, mean age = 26.1). Finally, the third sample consisted of 460 Canadian individuals (mean age = 33.7) with a twin (i.e., only one of the twin pairs was selected so as to not violate the independence of observations assumption; these data were derived from the University of British Columbia Twin Project; Jang, Steven, & Livesley, 2006)). Raw data were available for samples two and three; consequently, the correlation matrices and internal consistency reliabilities were estimated directly for the purposes of this investigation.

Measure

The NEO PI-R consists of five dimensions, Neuroticism, Extraversion, Agreeableness, Openness to Experience, and Conscientiousness (Costa & McCrae, 1992a). Each dimension is composed of six unique facets which are measured by eight self-report items on a 5-point Likert scale (thus, a total of 240 items). Evidence for reliability and validity of the scores derived from the NEO PI-R has been extensively documented (see Costa & McCrae, 1992a). The facets particularly relevant to this investigation included Depression (dependent variable) and Anxiety, Angry Hostility, Self-Consciousness, Impulsiveness, Vulnerability, Excitement-Seeking, Positive-Emotions, Feelings, Competence, and Self-Discipline (independent variables).

Data analytic strategy

In order to estimate the percentage of variance in the Depression facet accounted for by the 10 hypothesized facet predictors, two stages of multiple regression analyses were performed. In the first stage, the observed (i.e., non-disattenuated) correlation matrices (samples 1-3) were subjected to ordinary least squares multiple regression (method: enter), where the Depression facet was regressed onto the following 10 facets: Anxiety, Angry Hostility, Self-

Consciousness, Impulsiveness, Vulnerability, Excitement Seeking, Positive Emotions, Feelings, Competence, and Self-Discipline. The primary purpose of the multiple regressions was to estimate the percentage of common variance that could be accounted for in Depression by the 10 facets (represented by R and R^2). However, the standardized beta weights (β) were also reported to determine which predictors were found to be associated with statistically significant weights within the regression equation. Statistical significance of R, R^2 and the beta weights was determined by 95% confidence intervals as estimated by 5000 bootstrapped samples via Amos 7.0. In the case of the NEO PI-R correlation matrix (sample 1), raw data bootstrapping was not a possibility, as only the correlation matrix was available rather than the raw data. Consequently, the Monte Carlo utility within Amos 7.0 was used to generate corresponding raw data (i.e., raw data with the same inter-variable correlations, means, and standard deviations) from which 5000 bootstrapped 95% confidence interval estimates could be derived.

With respect to the second multiple regression analysis, the bi-variate correlations within the observed correlation matrices (samples 1-3) were disattenuated for imperfect reliability based on the corresponding Cronbach's alpha (α) estimates and the well established disattenuation for imperfect reliability procedure (Nunnally & Bernstein, 1994). Schmidt and Hunter (1996) suggested (scenario 19) that Cronbach's α may be considered an adequate estimate of reliability in construct redundancy research scenarios, although the presence of transient error may cause an underestimation in the disattenuated correlations. As emotionally relevant personality facets are known to be affected to some degree by transient error (Schmidt, Huy, & Remus, 2003), the multiple regression results presented in this investigation should be regarded as lower-bound estimates of construct redundancy between Depression and the predictor facets.

Based on these disattenuated correlation matrices, the multiple regressions were re-performed to yield R, R^2 and β estimates which were not attenuated due to the imperfectly measured facet level scores. In effect, this analysis corresponded to 'disattenuated regression' (Bisbe, Coenders, Saris, Batista-Fouget, 2006). Across all three samples of data, the statistical significance of the R, R^2, and standardized beta weights were determined via 5000 bootstrapped samples as derived from the Monte Carlo utility within Amos 7.0. Such a procedure was considered particularly appropriate, given the lack of a well-established sampling theory to help determine the statistical significance of effects disattenuated for imperfect reliability (Raju & Brand, 2003).

Results

The attenuated and disattenuated Pearson correlation coefficients between the 11 selected NEO PI-R facets are reported for samples 2 and 3 in Tables 1 and 2, respectively (the correlation matrix associated with sample 1 can be viewed on the last page of Costa & McCrae, 1992a). The corresponding reliability coefficient estimates are reported on the main diagonal of the respective Tables. As can be seen in the first column of Tables 1 and 2, the correlation coefficients between the Depression facet and the selected predictor facets were very large in some instances. For example, the sample 2 attenuated correlation coefficient between Anxiety (N1) and Depression (N3) was estimated at .71 and the corresponding disattenuated correlation coefficient was estimated at .85 (see Table 1).

Table 1:
Attenuated (below diagonal) and disattenuated correlation matrix (diagonal) with Cronbach's α estimates on diagonal (Sample 2)

	N3	N1	N2	N4	N5	N6	E5	E6	O3	C1	C5
N3	**.85**	.85	.69	.89	.58	.90	-.08	-.37	.24	-.64	-.60
N1	.71	**.82**	.64	.89	.49	.81	-.20	-.28	.29	-.39	-.35
N2	.56	.51	**.78**	.60	.53	.66	.01	-.28	.17	-.41	-.42
N4	.70	.69	.45	**.73**	.58	.85	-.11	-.35	.21	-.54	-.50
N5	.45	.38	.40	.42	**.72**	.71	.33	.19	.38	-.52	-.66
N6	.74	.66	.52	.65	.54	**.80**	-.05	-.24	.18	-.75	-.65
E5	-.06	-.16	.02	-.09	.24	-.04	**.72**	.60	.23	-.03	-.09
E6	-.30	-.22	-.22	-.26	.14	-.19	.45	**.77**	.43	.27	.10
O3	.19	.23	.13	.16	.28	.14	.17	.33	**.76**	.10	-.09
C1	-.49	-.29	-.30	-.38	-.37	-.56	-.02	.20	.07	**.69**	.91
C5	-.50	-.29	-.34	-.39	-.51	-.53	-.07	.08	-.07	.69	**.83**

Note. N=638; see *Note* Table 3 for facet full names.

Table 2:
Attenuated (below diagonal) and disattenuated correlation matrix (diagonal) with Cronbach's α estimates on diagonal (Sample 3)

	N3	N1	N2	N4	N5	N6	E5	E6	O3	C1	C5
N3	**.83**	.83	.63	.85	.48	.84	.17	-.43	.25	-.66	-.55
N1	.67	**.79**	.66	.76	.46	.76	.08	-.18	.39	-.39	-.35
N2	.51	.52	**.79**	.57	.49	.56	.22	-.37	.22	-.45	-.36
N4	.66	.58	.43	**.73**	.45	.78	.04	-.40	.15	-.59	-.52
N5	.36	.34	.36	.32	**.69**	.49	.39	.10	.33	-.58	-.59
N6	.68	.60	.44	.59	.36	**.79**	.08	-.41	.05	-.80	-.71
E5	.13	.06	.16	.03	.27	.06	**.68**	.24	.15	-.22	-.23
E6	-.34	-.14	-.29	-.30	.07	-.32	.17	**.76**	.48	.33	.27
O3	.19	.29	.16	.11	.23	.04	.10	.35	**.69**	.09	.01
C1	-.50	-.29	-.33	-.42	-.40	-.59	-.15	.24	.06	**.69**	.80
C5	-.45	-.28	-.29	-.40	-.44	-.57	-.17	.21	.01	.60	**.81**

Note. N=460; see *Note* Table 3 for facet full names.

As can be seen in Table 3, the multiple regression results based on the attenuated correlation matrices yielded multiple R^2 values of .61, .71, and .67 across the three respective samples, which suggested that a substantial amount of the Depression facet variance could be predicted by the 10-facet predictor multiple regression equation. An examination of the standardized beta weights revealed effects that were congruent theoretically (i.e., in terms of direction). Further, a large percentage of the beta weights were statistically significant across all three samples. A notable exception was the N5 (Impulsiveness) facet which was not a statistically significant contributor to the regression equation across all three samples. Over-

all, however, there was an appreciable amount of consistency in the multiple regression solutions across samples.

As can be seen in Table 4, the multiple regression results based on the disattenuated correlation matrices yielded multiple R^2 values of .86, .97, and .93 across the three respective samples, which suggested that nearly all of the true score Depression facet variance could be predicted by the 10-facet predictor multiple regression equation. An examination of the standard beta weights revealed effects that were, again, congruent theoretically. Further, nearly all of the beta weights were statistically significant across all three samples.[4] The exceptions were N5 (Impulsiveness) and E5 (Excitement-Seeking). Thus, as was the case for the attenuated multiple regression analyses, there was an appreciable amount of consistency in the multiple regression solutions across all three samples.

Table 3:
Standardized beta weights, 95% confidence intervals, and tolerance levels associated with the multiple regression: Attenuated correlation matrix

	Sample 1				Sample 2				Sample 3			
	β	95%CI		Tolerance	β	95%CI		Tolerance	β	95%CI		Tolerance
N1	.26*	.21	.31	.52	.26*	.19	.32	.39	.30*	.22	.38	.45
N2	.15*	.10	.20	.65	.11*	.05	.16	.63	.05	-.02	.12	.61
N4	.22*	.17	.27	.60	.20*	.14	.27	.43	.22*	.14	.29	.53
N5	.03	-.02	.08	.65	-.02	-.08	.04	.52	-.01	-.07	.06	.64
N6	.14*	.08	.20	.42	.25*	.18	.32	.34	.19*	.10	.28	.38
E5	.02	-.03	.06	.79	.04	-.01	.09	.73	.08*	.03	.14	.87
E6	-.07*	-.12	-.03	.67	-.14*	-.19	-.08	.60	-.18*	-.24	-.11	.64
O3	.10*	.05	.15	.72	.09*	.04	.14	.76	.13*	.07	.19	.73
C1	-.15*	-.20	-.09	.51	-.06	-.12	.01	.44	-.13*	-.20	-.06	.52
C5	-.07*	-.12	-.02	.54	-.13*	-.20	-.07	.44	-.03	-.10	.05	.52
R	.78*	.76*	.81*		.84*	.82	.87		.82*	.79	.85	
R^2	.61*	.58*	.65*		.71*	.67	.75		.67*	.62	.72	

Note. * p<.05; N1=Anxiety, N2=Angry Hostility, N4=Self-Consciousness, N5=Impulsiveness, N6=Vulnerability, E5=Excitement-Seeking, E6=Positive Emotions, O3=Openness to Feelings, C1=Competence, and C5=Self-Discipline.

[4] Deegan (1978) demonstrated that the observation of standardized beta weights greater than |1.0| is perfectly possible in multiple regression, particularly when multicolinearity is suspected, which is precisely what this study is investigating.'

Table 4:
Standardized beta weights, 95% confidence intervals, and tolerance levels associated with the multiple regression: Unattenuated correlation matrix

	Sample 1				Sample 2				Sample 3			
	β	95%CI		Toler-ance	*β*	95%CI		Toler-ance	*β*	95%CI		Toler-ance
N1	.29*	.24	.34	.26	-.05	-.09	-.01	.10	.57*	.50	.65	.12
N2	.11*	.08	.15	.43	-.09*	-.11	-.06	.35	-.19*	-.24	-.14	.35
N4	.35*	.31	.39	.33	.01	-.04	.05	.11	.21*	.16	.26	.28
N5	.01	-.03	.05	.37	-.76*	-.82	-.70	.09	-.05*	-.09	-.01	.37
N6	-.13*	-.19	-.06	.14	1.76*	1.66	1.86	.03	-.11*	-.20	-.02	.08
E5	.02	-.02	.05	.48	.40*	.36	.44	.29	.16*	.13	.20	.73
E6	-.16*	-.20	-.13	.38	-.39*	-.43	-.36	.26	-.40*	-.45	-.35	.35
O3	.27*	.23	.31	.38	.02	-.01	.04	.48	.26*	.22	.30	.47
C1	-.52*	-.59	-.44	.11	1.68*	1.54	1.82	.02	-.42*	-.49	-.36	.15
C5	.16*	.10	.22	.16	-1.45*	-1.45	-1.57	.03	.07*	.02	.11	.28
R	.93*	.92	.94		.99*	.98	.99		.96*	.96	.97	
R^2	.86*	.84	.87		.97*	.96	.97		.93*	.91	.94	

Note. * p<.05; see *Note* Table 3 for facet full names.

Discussion

Based on a theoretically derived multiple regression model, the reliable variance associated with the Depression facet of the NEO PI-R was found to be very substantially predicted by ten NEO PI-R facet predictors across three samples (R^2 = .86, R = .97, R = .93). These results suggest that there may be construct redundancy within the NEO PI-R.

Although several researchers have contended that mixed-model measures of EI must demonstrate incremental predictive validity beyond measures of the Five Factor Model (FFM), it would appear to be anomalous that the same criterion for validity is very rarely asserted (if ever) for the facets of comprehensive inventories of personality such as the NEO PI-R, for example. In those rare instances where NEO PI-R facet level discriminant validity has been investigated specifically, the authors failed to disattenuate the facet level intercorrelations for imperfect reliability (e.g., McCrae & Costa, 1992b). Consequently, the inter-facet correlations would have been attenuated, which may be expected to have reduced the amount of observed redundancy within the reported results.

The importance of establishing incremental predictive validity in the assessment of the validity of the scores derived from a putative measure of EI should not be considered completely undermined in this investigation. Certainly, it should play a role in the evaluation of a construct. However, it may be argued that incremental predictive validity, a purely statistical criterion, should not be the sole basis upon which to evaluate the plausibility or utility of a construct such as EI. A supplementary consideration may be referred to as 'incremental coherence', which is observed when a newly introduced construct has more clearly specified construct boundaries than the construct with which it is putatively redundant. In the context of mixed-models of EI versus the FFM of personality, EI may be suggested to be associated

with incremental coherence, as the models of EI are substantially narrower and comprehensible than the FFM of personality. That is, an item that may be indicative of EI must be relevant to emotions and relevant to some sort of skill or competency in the experience or application of emotions. In contrast, personality has been reported to encompass individual differences in "emotional, interpersonal, experiential, attitudinal, and motivational styles" (McCrae & John, 1992, p.175), which suggests effectively all individual differences except intellectual intelligence. Given such a level of expansiveness, it is perhaps not a coincidence that the FFM of personality has been consistently disconfirmed via confirmatory factor analysis (Gignac, Bates, & Jang, 2007).

In contrast, models of EI have been confirmed via confirmatory factor analysis (see Gignac, Palmer, & Stough, 2007, and references therein). Furthermore, despite EI's relative scientific nascence, the area has been associated with some interesting and useful theoretical contributions. For example, Zeidner, Matthews, Roberts, and MacCann (2003) posited the 'Multi-Level Investment Model' to help explain the development of EI in childhood. Similar theoretical contributions to the area of personality are relatively sparse, particularly considering the number of years personality has been an active area of research in psychology.

The question of why Structural Equation Modeling (SEM) was not used in this investigation may be understandably posed, particularly considering that SEM is known to partition true score variance from error variance, which results in disattenuated effect sizes (Fan, 2003). There were two primary reasons why SEM was not used in this investigation. First, the item level data were not available for the NEO PI-R normative sample data (i.e., sample 1). Secondly, it was considered beneficial to use a relatively straightforward method (disattenuated multiple regression) that might be expected to be used by other researchers on either their own data or previously published correlation matrices.

It should be noted that the accuracy of the disattenuated regression results reported in this investigation is predicated, in part, on the accuracy of the Cronbach's α estimates. If the reliability estimates were biased in any systematic way, it is likely that they were upwardly biased, rather than downwardly biased (see Gignac, Bates, & Jang, 2007), which would have had the effect of underestimating the degree of communality and/or redundancy observed in the results. Thus, the conclusions made in this investigation would likely have remained the same, even if arguably more accurate methods of estimating reliability were used.

The results reported in this investigation should not be viewed as a criticism of the NEO PI-R, in particular, as the findings may very well be observed based on other comprehensive inventories of personality. Future empirical research on other inventories may support such a suggestion. It should also be acknowledged that the personality facets of the NEO PI-R predicted depression scores as measured by the NEO PI-R. It is possible that a more comprehensive measure of depression would exhibit a more substantial amount of unique reliable variance than the relatively brief Depression facet within the NEO PI-R. It will be noted, however, that several of the predictor facets analysed in this investigation appeared to suffer from construct redundancy, as they were associated with very low levels of tolerance (<.10; see Table 4). The depression facet was chosen because it is arguably one of the best established constructs in psychology.

In conclusion, the possible empirical demonstration of construct redundancy between EI and the Five Factor Model as measured by the NEO PI-R should not be viewed as necessarily detrimental to the plausibility of EI as a useful construct, as the reliable variance of at least one facet within the NEO PI-R (i.e., Depression) can be nearly entirely accounted for

by a multiple regression model based on 10 NEO PI-R facet predictors. Consequently, it is suggested that researchers consider engaging in personality research that has a much narrower focus than the FFM/Big Five and its corresponding inventories, which may be expected to result in an accelerated level of progress and interest in individual differences psychology. Perhaps the emergence of EI in individual differences psychology may be viewed as consistent with such a phenomenon.

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