The NEO PI-R in a North European Context

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The NEO PI-R in a North European Context

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Abstract

Based on a need to validate personality tests used in different cultures and in applied settings, results from four studies on three Norwegian translations of the NEO PI-R (Costa & McCrae, 1992) are reported. In the first study, 380 subjects with a mean age of 38 years completed the first translation. In the second study, 620 subjects with a mean age of 30 years completed the second translation. In the third study, 3447 subjects with a mean age of 31 years completed a third translation that was based on the two previous translations. The first three studies were generally based on data from research settings, while in the fourth study, 4,105 subjects with a mean age of 41 completed the third translation of NEO PI-R as part of selection and counseling processes. The original five-factor structure was well replicated across the four studies, albeit with minor exceptions for a few facet loadings. The total congruence coefficients obtained were .97 and .98 in all four studies. Gender differences indicate that females had higher scores than males on neuroticism, openness and agreeableness, which were comparable to the male scores on extraversion and lower scores on conscientiousness. Our findings show consistent support for the validity of the five-factor model as measured with the NEO PI-R.

Key Words: personality, five-factor model, factor analysis, gender differences

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Introduction

Personality tests are often used in applied settings, and represent valuable tools, for example, in selection processes. Such tests, however, are often developed in one culture and then translated and used in other cultures, which may cause uncertainty in regard to their validity in the new context. Thus, core aspects of validity need to be established whenever tests are used in a new cultural context. Indeed, results from local validation studies represent important information since the validity of tests directly influences the utility of selection procedures (e.g. Schmitt & Hunter, 1998). Moreover, information from studies on translated tests may serve a wider and cross-cultural purpose, in which construct validities can be compared across cultures and language families as a necessary background for a hypothesis about cross-cultural generalizability of personality theories. Hence, the availability of local validity data may serve several functions for test users and for future theoretical developments in the field.

Based on these lines of reasoning, we presently report on data describing the construct validity for three Norwegian translations of the NEO PI-R (Costa & McCrae, 1992), which is one of the world's most widely used personality tests. First, we introduce the five-factor model of personality, including a brief review of the theory; next, we describe the NEO PI-R, and lastly, we present results from four studies based on two preliminary Norwegian translations and a final translation, which is also the currently used translation. Our data have been collected in both research and applied settings, and provide an opportunity to compare construct validity across such settings, which is important when considering the use of a test for selection purposes. Our results are based on data for three available translations that have not been previously published, although a few summary findings based on accumulated Norwegian data for NEO PI-R have been published in Martinsen, Nordvik and Østbø (2005).

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The Five-Factor Model of Personality

The five-factor model of personality has been derived from factor analytic research based on the lexical hypothesis, which posits that personality can be studied using language markers. A number of early studies developed and elaborated on this hypothesis (Allport & Odbert, 1936; Cattell, 1944; Fiske, 1949; Norman, 1963; Thurstone, 1951; Tupes & Christal, 1961) and the five factor model has now become a standard in trait research (Digman, 1990; Goldberg, 1992). The five factors have been labeled as neuroticism (emotional stability reversed), openness to experience (intellect or culture), agreeableness, extraversion and conscientiousness (will). A large body of research supports the validity of the model, with some of this research briefly reviewed below.

The five factors are observable and have not only been identified in self-, peer- and spouse ratings (Costa & McCrae, 1992), but also in the way people present themselves on social networking sites such as Facebook (Back et. al, 2010). Observer ratings may have predictive validity in work settings (Mount, Barrick, & Strauss, 1994) and actually have higher validity than self ratings (Oh, Wang, & Mount, 2011).

The five traits are stable, and increasingly so, across the lifespan as regards rank order stability (Roberts & DelVecchio, 2000), while mean level changes in the five traits may be associated with a pattern of stability and change at different levels of age, particularly at the group level (Costa & McCrae, 2006; Roberts, Walton, & Viechtbauer, 2006a; Roberts, Walton, & Viechtbauer, 2006b).

Concerning the validity of the five-factor model across cultures, there is a distinction between *emic* and *etic* approaches to investigating this issue (Roland, 2002). Building on the lexical hypothesis, the *emic* approach seeks to analyze the constructs specific to each culture by gathering relevant markers from each culture's language. The *etic* approach seeks to cross-validate the language-based personality structure found in one culture across other cultures.

As for the *emic* approach, structures related to the five-factor model have often been identified across cultures, though culture-specific analyses have tended to extract more than five factors (DeRaad & Barelds, 2008; Roland, 2002; Saucier et al., 2005). DeRaad and Barelds (2008) reported that 12 out of 15 attempts to investigate personality based on personality markers from different languages identified the five-factor model or structures close to this. DeRaad et al. (2010) have demonstrated that three factors (extraversion, agreeableness and conscientiousness) are fully replicable across languages.

When investigating cultural variation in the *etic* perspective, there is evidence that the structure in the Anglo-American based NEO PI-R (Costa & McCrae, 1992) is generally replicable across cultures (cf. McCrae & Allik, 2002; McCrae, Terraciano, et. al, 2005a, b). It is also so that women tend to report higher levels of neuroticism, extraversion, agreeableness and conscientiousness than men, and that such differences are larger in wealthy and highly educated countries (Schmitt, Realo, Voracek, & Allik, 2008). Genetic influences are in the range of 40-50% (Bouchard & Loehlin, 2001), and it has been documented that there are also genetic influences on the stability of personality (DeFruyt, Bartels, Van Leuven, DeClercq, Decuyper, & Mervielde, 2006; Kandler, Bleidorn, Riebman, Spinath, Thiel, & Angleithner, 2010). Yamagata et al. (2006) found that both the five-factor model and its associated genetic components could be generalized across cultures in a multivariate behavioral genetic study.

Research on the predictive validity of the five-factor model is abundant, and the model is relevant, for example, for creativity (Feist, 1998), leadership (Judge et. al, 2002), academic performance, (Poropat, 2009) and job performance (Ones, Dilchert, Viswesvaran, & Judge, 2007; Tett, Jackson, & Rothstein, 1991). In the latter case, cumulative, predictive effect sizes for the five factors typically lie around .40. Beyond this, the five-factor model has been related to dimensional views of personality disorders (Markon et. al, 2005; Samuel & Widiger, 2008), health (Hampson, Goldberg, Vogt, & Dubanoski, 2007) and mortality among males (Taylor, Whiteman, Fowkes, Lee, Allerhand, & Deary, 2009).

Even though critical accounts of the five-factor model can be found (Benet-Martinez & Waller, 1997; Block, 1995), it can be concluded that a large number of studies shed light on the five-factor model and that most of these studies support the validity of the model. In addition, many of these validation studies have been conducted using the NEO PI or NEO PI-R.

NEO PI and NEO PI-R

Based on the hypothesis that five factors were adequate to represent the major dimensions of personality, Costa

and McCrae (1985) developed the NEO personality inventory (NEO PI). This inventory included 180 items for the five factors of neuroticism, extraversion, openness to experience, agreeableness and conscientiousness. Six facets were constructed for each of the first three factors, while the two remaining factors did not include facet scales. This version of the inventory was translated into a number of languages, including Norwegian by Lian, Vassend, & Andersen (1993).

In a study on their Norwegian translation by Lian and colleagues (1993), some of the factor loadings deviated from the ones in the original structure (Costa & McCrae, 1985), and six out of 18 facets had their primary loadings on factors other than on the one in which they were theoretically expected to load. The differences were explained by referring to different sample characteristics and cultural differences (Lian et al., 1993). Later, Vassend and Skrondal (1997) sought to validate the Norwegian translation through both an exploratory and confirmatory factor analysis. While an exploratory factor analysis provided an acceptable fit to the posited five-factor model, it turned out to be harder to find an acceptable fit through the use of a confirmatory factor analysis. Therefore, some uncertainty regarding the Norwegian NEO PI's validity remained.

Costa and McCrae (1992) later revised the NEO PI to also include facet scales for the last two factors in their model and the NEO PI-R (revised) included 240 items that operationalized five factors and six facets below each factor. Each facet scale included eight items, and the facet labels are listed below in Table 1. The psychometric qualities of the NEO PI-R are commonly reported to be adequate for a comprehensive measure of personality (e.g. Botwin, 1995). In cross-cultural research, some minor deviations from the proposed five-factor model have been reported, although the overall fit has typically been good (McCrae & Allik, 2002). Two facets, N5: Impulsiveness and E3: Assertiveness, have tended to have loadings on factors other than those posited, and there are typically several other cross-loadings for the facets. The five factors themselves have generally been correlated, which may reflect two higher order factors (Digman, 1997).

Based on this, we may expect to identify a five-factor structure in Norwegian data, while it seems reasonable that the facets N5 and E3 in particular may deviate from the expected pattern of facet loadings. Based on the above mentioned studies on gender differences we also expect females to have higher scores on neuroticism, extraversion, agreeableness, and conscientiousness (Schmitt et al. , 2008).

Confirmatory Analysis for Complex Data on Personality

It has recurrently been an aim in this research area to compare factor structures based on data from, e.g. national samples, with an *a priori* defined theoretical structure. In this regard, it seems initially natural to consider confirmatory factor analysis through structural equation modeling (e.g. Bollen, 1989; Vassend & Skrondal, 1997). Although such methods have become a precise and accepted standard for model testing in many areas of psychology, such methods have been shown to be less adequate for complex datasets with personality variables. The reason for this is that the number of cross-loadings tends to be high in such data, and unless such cross-loadings are specified in the model, they cause bad model fit and rejection of otherwise theoretically relevant models. Church and Burke (1994, p. 110) noted that "even trivial sources of covariation may need to be included in one's model to achieve good fit." Aluja, Garcia, Garcia and Seisdedos (2005) replicated McCrae, Zonderman, Costa, Bond and Paunonen's (1996) findings, and found that for CFA to provide meaningful results, a model had to be specified in which all statistically significant loadings were set free to be estimated to obtain an acceptable fit. McCrae et al. (1996) argued that cross-loadings may actually be theoretically meaningful, so the ideal of simple structure may hence not be applicable with complex personality data; sometimes, items and facets are chosen by test constructors that lie between factors.

Table 1. NEO PI-R factors and facets

Neuroticism	Extraversion	Openness	Agreeableness	Conscientiousness
1. Anxiety (n1)	Warmth (e1)	Fantasy (o1)	Trust (a1)	Competence (c1)
2. Angry Hostility (n2)	Gregariousness (e2)	Aesthetics (o3)	Straightforwardness (a2)	Order (c2)
3. Depression (n3)	Assertiveness (e3)	Feelings (o3)	Altruism (a3)	Dutifulness (c3)
4. Self-Consciousness(n4)	Activity (e4)	Actions (o4)	Compliance (a4)	Achievement striving (c4)
5. Impulsiveness (n5)	Excitement Seeking (e5)	Ideas (o5)	Modesty (a5)	Self-Discipline (c5)
6. Vulnerability (n6)	Positive emotions (e6)	Values (o6)	Tender-mindedness (a6)	Deliberation (c6)

McCrae et al. (1996) argued that when the ideal of a simple structure is not theoretically relevant, orthogonal rotation towards an *a priori* specified structure is suitable. In such analyses, model fit is based on the degree of congruence between the factor structure at hand and the specified structure. Thus, an orthogonal Procrustes rotation is widely used in this research area (Aluja et al., 2005; McCrae & Allik, 2002; Terraciano, 2003), and can be regarded as a different type of confirmatory analysis than model testing in a structural equation modeling perspective. In orthogonal Procrustes rotation, Tukey's coefficient of congruence is typically used to evaluate model fit, with lower limits for acceptable factor replicability suggested to be in the area between .85 to .90 (Mulaik, 1972; Rolland, 2002). We used orthogonal Procrustes rotations in all of our analyses below.

To sum up, and based on the above theory, empirical findings and methodological considerations, the purpose of this article is to present Norwegian data for the NEO PI-R. Data are provided for three Norwegian translations through four studies. Our main focus is to investigate the extent to which we can replicate the original five-factor structure through different translations and through both research settings and applied settings. We also analyze gender differences based on expectations that females should have higher scores on all factors except openness. We report means, standard deviations, reliabilities, factor congruencies.

Study 1

Method

Participants

Three hundred and eighty subjects participated in this study. Their mean age was 38.04 years, and the standard deviation was 13.18 years. The range in age was from 18 to 82 years, and there were 219 females and 154 males. There were a few responses missing on the age variable, and the sample was heterogeneous with regard to occupational and educational backgrounds.

Instrument

The NEO PI-R (Costa & McCrae, 1982) was used, which measures five factors and six facets on each of the five factors. The factor and facet labels are listed in Table 1. There are 240 items in the inventory with eight items measuring each of 30 facets.

Translation Process

This translation was done by the first author and followed a standard translation – back translation procedure conducted by independent translators. The translation was approved (McCrae, 1999) after some adjustments, and was subsequently used to collect data.

Procedure

A data collection procedure was used in which students at the school of psychology at the University of Bergen were invited to ask friends and relatives of their families to complete the inventory. A sample of 70 managers who participated in various forms of training programs was also included.

Results

Upon inspection, the data for the factors and facets in this translation of the NEO PI-R were generally within the range of the normal distribution based on a rule of thumb that skewness and kurtosis values should be between -1 and 1.

As for the Cronbach's alpha reliabilities, the coefficients for the factors and facets should be relatively equal across cultures if the item contents within factors and facets in a translation reflect similar item contents across the two cultures. In this respect, it can be observed that the pattern of reliabilities in Table 2 corresponds well with the original American data.

The data from the present sample were further analyzed using principal component analysis that revealed six components with eigenvalues above 1 (the first 11 eigenvalues were: 6.23, 4.89, 3.23, 2.25, 1.73, 1.04, .84, .80, .75, .68, .64), while the scree plot suggested that five factors should be extracted. Parallel analysis (Horn, 1965; Zwick & Velicer, 1986) clearly advised to extract five components based on 200 extractions and the 95th percentile of eigenvalues using the Monte Carlo PCA program (Watkins, 2000).

Based on this, a subsequent principal component analysis with a promax rotation was used to analyze the data. The five components explained 61.1% of the total variance, and the pattern of loadings was generally in correspondence with the theoretically expected pattern exhibited in Table 1. To further investigate the factor structure, we used principal component analysis with orthogonal Procrustes rotation. The solution from this analysis is shown in Table 2.

As can be seen in Table 2, there is a high congruence between the original American pattern of loadings and the observed pattern of loadings. As could

be expected, there are two main exceptions: the facet Impulsiveness (N5) has a higher positive loading on the extraversion component than on the posited component of neuroticism, and the facet assertiveness (E3) has a stronger absolute loading on the component of neuroticism than on the posited component of extraversion.

Beyond the two deviations from the expected pattern of loadings in the present study, which is not at all uncommon in research on the NEO PI-R (McCrae & Allik, 2002), there is obviously a high level of correspondence between the factor loadings for the present Norwegian translations and the original American NEO PI-R (cf. Costa & McCrae, 1992). The coefficients of congruence for the facets were between .87 and 1.00; for the factors, these coefficients were between .96 and .98, while the total congruence was .97. Taken together, this implies a more than acceptable fit with the posited model.

Study 2

Method

Participants

In this study, the NEO PI-R was completed by 620 subjects. Of these, 369 were males, 251 were females, the average age was 30.3 years, and the standard deviation 9.48. They completed the inventory as part of various research projects initiated by the second and third authors.

Translation Procedure

This second Norwegian translation was done by the third author and followed a standard translation – back translation procedure conducted by independent translators. The translation was approved (McCrae, 1998) after adjustments, and was subsequently used to collect data.

Results

By inspection, the data were normally distributed according to the same rule of thumb as in Study 1. The means, standard deviations, and reliabilities for this translation are given in Table 3.

When using a principal component analysis, there were six factors with eigenvalues above 1, and the scree plot also suggested to extract six factors. The 10 first eigenvalues were: 5.88, 4.30, 3.46, 2.25, 1.67,1.23, .94,.85,.79,.75. Parallel analysis (Horn, 1965; Zwick & Velicer, 1986) again advised to extract five components based on 200 extractions and the 95th percentile of eigenvalues using the Monte Carlo PCA program (Watkins, 2000). Five factors explained 58.52% of the variance.

When confirmatory analysis was done using principal component analysis with orthogonal Procrustes rotation, the expected pattern of loadings emerged quite clearly. Table 3 shows that the factor loadings and the congruence between the present data and the theoretically and empirically derived target data is high in relation to both facets and factors.

Table 2. Descriptive statistics, Cronbach's alpha reliability coefficients, factor loadings and coefficients of factor congruence based on a principal component analysis with an orthogonal Procrustes rotation. Loadings above .30 are written in bold face.

Variable	Mean	Std Dev	Alpha	N	E	O	A	C	Congruence
N1	15.11	5.92	.84	**.86**	-.15	-.01	.05	.01	.97
N2	11.59	4.74	.73	**.75**	-.04	-.05	**-.34**	-.04	.97
N3	13.80	5.44	.79	**.82**	-.13	.03	.11	-.23	.99
N4	13.88	4.73	.67	**.63**	-.28	-.18	.17	-.20	.96
N5	18.22	4.74	.71	**.37**	**.51**	.11	-.25	**-.40**	.96
N6	10.46	4.40	.75	**.79**	-.12	-.10	.09	-.26	.98
E1	22.28	4.14	.72	-.07	**.77**	.11	**.32**	.13	.98
E2	19.71	5.17	.77	-.10	**.73**	.00	.12	.04	.98
E3	17.09	5.36	.80	**-.41**	**.36**	.23	**-.34**	**.30**	.99
E4	20.65	4.15	.62	-.23	**.65**	.17	-.16	**.36**	.92
E5	17.17	5.23	.67	-.01	**.48**	.18	-.24	**-.31**	.90
E6	21.69	5.50	.81	-.01	**.78**	**.33**	-.14	.02	.94
O1	18.79	5.42	.80	.19	.28	**.58**	-.16	-.21	.98
O2	19.89	5.54	.76	.12	.04	**.70**	.19	.09	1.00
O3	21.42	4.61	.75	**.32**	**.49**	**.51**	.01	.11	.99
O4	18.21	4.51	.64	-.21	**.34**	**.57**	.01	-.04	.99
O5	18.5	5.97	.84	-.04	-.04	**.81**	-.14	.05	.98
O6	22.43	3.51	.56	-.21	.13	**.70**	-.03	-.06	.98
A1	21.69	4.44	.78	**-.30**	**.33**	.09	**.61**	.04	.98
A2	21.38	4.78	.69	-.03	-.23	-.03	**.73**	.18	.99
A3	22.94	3.88	.69	-.02	**.41**	.08	**.63**	.17	.96
A4	17.85	4.09	.61	-.14	-.15	-.10	**.72**	-.05	.98
A5	18.41	4.26	.68	.16	-.15	-.22	**.67**	-.04	1.00
A6	20.20	3.88	.58	**.37**	.24	.16	**.49**	-.05	.87
C1	21.30	3.61	.62	**-.46**	.15	.15	.01	**.60**	1.00
C2	17.87	4.29	.61	.13	-.06	-.19	-.05	**.71**	.96
C3	21.75	4.23	.67	-.14	-.05	-.04	**.39**	**.64**	.99
C4	19.08	4.11	.61	-.03	.21	.12	-.13	**.73**	1.00
C5	19.73	5.11	.80	**-.34**	.08	-.07	.04	**.76**	.99
C6	16.05	4.65	.73	.01	**-.34**	-.20	.20	**.57**	.91
Congruence				.96	.97	.97	.97	.98	.97
N	83.19	22.53	.92						
E	118.58	20.58	.89						
O	119.16	20.43	.90						
A	122.43	16.97	.86						
C	115.72	18.91	.89						

Table 3. Descriptive statistics, Cronbach's alpha reliability coefficients, factor loadings and coefficients of factor congruence based on principal component analysis with orthogonal Procrustes rotation. Loadings above .30 are written in bold face.

Variable	Mean	Std Dev	Alpha	N	E	O	A	C	Congruence
N1	13.00	5.48	.82	**.83**	-.20	-.01	.10	-.05	.96
N2	11.95	4.40	.69	**.74**	.04	.03	**-.36**	-.02	.97
N3	12.42	5.73	.83	**.82**	-.23	.00	.15	-.19	.96
N4	13.33	4.62	.72	**.66**	**-.33**	-.12	.11	-.15	.97
N5	18.26	3.95	.60	**.33**	**.43**	.08	-.25	**-.35**	.96
N6	9.44	4.12	.76	**.75**	-.22	-.08	.10	-.27	.98
E1	21.99	3.84	.70	-.07	**.71**	.17	**.37**	.11	1.00
E2	20.46	4.85	.77	-.17	**.71**	-.03	.05	-.05	.99
E3	17.21	4.77	.76	**-.35**	**.43**	.16	**-.34**	**.30**	.99
E4	19.02	4.23	.66	-.01	**.61**	.10	-.20	**.39**	.99
E5	18.12	4.99	.70	-.21	**.46**	.02	**-.34**	-.17	.91
E6	22.58	4.99	.80	-.17	**.75**	.21	.00	.06	.98
O1	19.14	4.94	.79	.16	.19	**.66**	-.06	-.23	.98
O2	17.79	6.18	.81	.28	.08	**.69**	.14	.04	.97
O3	20.92	4.42	.76	**.35**	**.43**	**.58**	.11	.03	.98
O4	17.14	4.24	.64	-.15	**.35**	**.52**	-.06	-.16	.95
O5	19.67	5.49	.82	-.06	-.11	**.77**	-.02	.15	.98
O6	22.11	3.57	.57	-.12	.10	**.64**	.12	-.12	.94
A1	20.96	3.88	.72	-.27	**.32**	.22	**.49**	.01	.98
A2	19.82	4.39	.66	.06	-.11	-.09	**.67**	.09	.97
A3	22.89	3.35	.63	-.10	**.40**	.09	**.65**	.18	.96
A4	16.83	3.91	.56	-.08	-.13	-.18	**.72**	-.04	.96
A5	18.29	4.68	.76	**.30**	-.09	-.11	**.64**	.01	.97
A6	21.61	3.82	.64	.23	.19	**.31**	**.56**	.04	.92
C1	21.42	3.27	.54	**-.43**	.04	.18	.02	**.63**	.98
C2	18.11	4.45	.70	.00	-.08	-.19	.05	**.72**	.98
C3	22.56	4.09	.65	-.10	-.03	-.14	**.30**	**.68**	.97
C4	18.92	4.13	.70	-.09	.22	.10	-.19	**.79**	1.00
C5	19.03	4.89	.80	-.22	.09	-.02	-.07	**.79**	.97
C6	17.07	4.47	.73	-.14	**-.38**	-.13	**.30**	**.50**	.97
Congruence				.97	.97	.97	.97	.98	.97

N	78.40	21.16	.92
E	119.38	18.78	.89
O	116.76	19.91	.90
A	120.41	15.76	.86
C	117.12	18.39	.90

Table 4. Descriptive statistics and Cronbach's alpha reliabilities.

	Total			Males		Females	
Var.	**Mean**	**Std Dev**	**Alpha**	**Mean**	**Std Dev**	**Mean**	**Std Dev**
N1	14.46	6.39	.87	12.47	5.99	16.43	6.17
N2	11.93	4.95	.77	10.80	4.96	13.08	4.68
N3	14.31	6.43	.86	12.72	6.17	15.90	6.33
N4	14.43	5.05	.74	13.57	4.95	15.31	5.03
N5	17.64	4.48	.68	16.87	4.39	18.40	4.42
N6	10.84	4.92	.81	9.46	4.65	12.25	4.80
E1	22.40	4.16	.75	21.65	4.31	23.09	3.90
E2	20.69	5.02	.78	20.15	5.01	21.18	5.00
E3	16.30	5.11	.80	17.24	5.01	15.36	5.04
E4	19.39	4.42	.68	19.46	4.36	19.29	4.48
E5	17.97	5.18	.71	18.98	4.65	17.06	5.48
E6	22.19	5.17	.81	21.82	5.27	22.50	5.06
O1	18.62	5.18	.80	18.24	5.18	19.06	5.13
O2	19.07	6.00	.82	17.62	6.21	20.41	5.46
O3	21.73	4.35	.76	20.38	4.34	23.02	3.95
O4	17.65	4.19	.63	17.37	4.22	17.93	4.13
O5	19.26	5.54	.82	19.92	5.63	18.64	5.38
O6	22.35	3.69	.63	22.21	3.77	22.48	3.62
A1	21.47	4.60	.81	21.30	4.64	21.56	4.57
A2	20.27	4.51	.69	19.56	4.53	20.91	4.39
A3	23.62	3.49	.69	23.08	3.60	24.11	3.31
A4	16.94	4.21	.64	16.61	4.12	17.20	4.27
A5	18.93	4.35	.70	18.10	4.38	19.70	4.19
A6	21.28	3.71	.59	20.25	3.82	22.26	3.32
C1	21.03	3.93	.70	21.51	4.00	20.50	3.83
C2	17.33	4.42	.68	17.27	4.50	17.39	4.38
C3	22.54	4.02	.62	22.75	4.14	22.31	3.86
C4	19.30	4.57	.75	19.63	4.71	18.93	4.42
C5	18.50	4.97	.78	18.80	5.03	18.15	4.90
C6	16.37	4.58	.73	16.52	4.69	16.17	4.48
N	83.61	25.54	.94	75.91	24.66	91.34	24.09
E	118.96	20.31	.90	119.30	20.17	118.49	20.52
O	118.71	19.68	.90	115.75	20.03	121.59	18.89
A	122.51	15.89	.86	118.93	16.36	125.71	14.72
C	115.12	19.64	.91	116.48	20.49	113.54	18.68

Table 5. Factor loadings and coefficients of factor congruence based on principal component analysis with orthogonal Procrustes rotation. Loadings above .30 are written in bold face.

	N	E	O	A	C	Congruence
N1	**.84**	-.17	-.07	.05	-.12	.97
N2	**.76**	-.07	-.03	**-.36**	-.10	.98
N3	**.81**	-.26	-.07	.07	-.23	.97
N4	**.70**	-.29	-.11	.07	-.19	.99
N5	**.42**	**.45**	.09	-.23	**-.38**	.98
N6	**.77**	-.23	-.12	.05	**-.32**	.99
E1	-.14	**.71**	.17	**.37**	.19	1.00
E2	-.27	**.72**	.01	.13	.03	.99
E3	**-.39**	**.41**	.19	**-.38**	.29	.99
E4	-.16	**.54**	.13	-.19	**.41**	.96
E5	-.13	**.51**	.11	**-.34**	-.19	.96
E6	-.23	**.75**	.22	.02	.13	.97
O1	.20	.22	**.61**	-.13	-.22	.99
O2	.22	.06	**.72**	.16	.08	.99
O3	.39	**.44**	**.57**	.11	.11	.99
O4	-.24	**.34**	**.49**	-.04	-.12	.96
O5	-.14	-.08	**.79**	-.08	.16	1.00
O6	-.21	.16	**.62**	.17	-.09	.91
A1	**-.40**	**.32**	**.15**	**.53**	.14	.98
A2	-.05	-.12	-.06	**.71**	.15	.99
A3	-.03	**.45**	.14	**.61**	.20	.96
A4	-.15	-.17	-.15	**.72**	-.03	.97
A5	.20	-.15	-.16	**.60**	-.05	1.00
A6	**.35**	.28	.28	**.48**	-.09	.85
C1	**-.46**	.24	.18	.01	**.62**	.99
C2	.06	-.05	-.20	-.01	**.73**	.98
C3	-.17	.02	-.08	.28	**.70**	.99
C4	-.18	.26	.13	-.08	**.76**	.99
C5	**-.32**	.08	-.06	.06	**.76**	.99
C6	-.13	**-.35**	-.08	.26	**.58**	.98
Congruence	.97	.98	.97	.98	.99	.98

Table 6. Descriptive statistics and Cronbach's alpha reliabilities.

	Total			Males		Females	
Var	**Mean**	**Std Dev**	**Alpha**	**Mean**	**Std Dev**	**Mean**	**Std Dev**
N1	9.65	4.83	.82	8.94	4.44	10.71	5.17
N2	8.25	4.01	.73	7.97	3.89	8.68	4.16
N3	9.39	4.70	.78	9.00	4.36	9.96	5.11
N4	10.20	4.28	.71	9.92	4.18	10.61	4.40
N5	14.82	4.24	.67	14.31	4.10	15.58	4.33
N6	6.64	3.62	.79	6.26	3.38	7.22	3.87
E1	24.42	3.56	.74	23.85	3.55	25.27	3.41
E2	22.58	4.12	.72	22.11	4.07	23.29	4.10
E3	19.40	4.15	.74	19.83	4.01	18.76	4.28
E4	22.13	3.70	.64	21.84	3.60	22.57	3.81
E5	17.78	4.56	.65	18.57	4.17	16.59	4.86
E6	24.31	4.35	.78	23.73	4.18	25.18	4.45
O1	15.77	4.74	.76	15.50	4.72	16.17	4.73
O2	18.15	5.67	.82	17.00	5.56	19.86	5.40
O3	20.84	3.94	.71	19.95	3.84	22.16	3.72
O4	19.42	3.80	.60	19.06	3.80	19.96	3.74
O5	20.03	5.02	.81	20.23	5.01	19.72	5.03
O6	22.74	3.21	.55	22.38	3.23	23.28	3.11
A1	23.22	3.80	.79	22.80	3.76	23.84	3.78
A2	21.27	4.22	.68	20.73	4.29	22.08	3.98
A3	25.10	3.31	.70	24.58	3.33	25.87	3.12
A4	18.22	3.79	.60	17.79	3.74	18.87	3.76
A5	19.12	4.06	.69	18.80	4.02	19.61	4.06
A6	20.00	3.31	.52	19.48	3.30	20.78	3.17
C1	24.44	3.16	.69	24.47	3.11	24.39	3.24
C2	19.57	3.70	.63	19.45	3.65	19.75	3.76
C3	25.95	3.28	.62	26.05	3.30	25.80	3.24
C4	23.28	3.73	.74	23.40	3.70	23.10	3.77
C5	23.37	4.06	.75	23.2	3.96	23.59	4.19
C6	18.50	4.24	.72	18.66	4.12	18.27	4.41
N	58.95	19.97	.92	56.40	18.74	62.74	21.10
E	130.64	16.87	.89	129.93	16.39	131.68	17.53
O	116.96	17.32	.88	114.14	17.28	121.15	16.52
A	126.96	15.05	.86	124.20	15.09	131.06	14.03
C	135.13	16.62	.90	135.27	16.50	134.92	16.79

Table 7. Factor loadings and coefficients of factor congruence based on principal component analysis with orthogonal Procrustes rotation. Loadings above .30 are written in bold face.

	N	E	O	A	C	Congruence
N1	**.83**	-.19	-.02	.05	-.11	.97
N2	**.71**	-.07	-.05	**-.37**	-.16	.98
N3	**.78**	-.24	-.01	.03	-.27	.98
N4	**.70**	-.28	-.11	.02	-.23	.99
N5	**.45**	**.40**	.03	-.22	**-.43**	.99
N6	**.72**	-.26	-.13	.01	**-.36**	.99
E1	-.20	**.67**	.15	.35	.28	.98
E2	-.24	**.69**	.00	.12	.13	.97
E3	**-.40**	**.38**	.20	**-.37**	.29	.99
E4	-.25	**.54**	.13	-.09	**.35**	.89
E5	-.10	**.45**	.08	**-.40**	-.05	.98
E6	-.20	**.73**	.21	.09	.18	.97
O1	.26	.13	**.61**	-.14	-.24	.99
O2	.17	.06	**.73**	.19	.11	1.00
O3	**.40**	**.48**	**.50**	.11	.08	.99
O4	**-.33**	.29	**.49**	-.03	-.08	.96
O5	-.07	-.13	**.80**	-.08	.19	.98
O6	-.25	.17	**.55**	.21	-.09	.87
A1	-.29	**.33**	.13	**.56**	.04	.98
A2	-.06	-.13	-.08	**.74**	.09	.97
A3	-.07	**.43**	.11	**.60**	**.31**	.97
A4	-.16	-.12	-.05	**.74**	.04	1.00
A5	.04	-.14	-.11	**.65**	-.10	.97
A6	.27	**.30**	.20	**.52**	.06	.92
C1	**-.41**	.23	.18	.02	**.64**	1.00
C2	-.01	.00	-.12	.08	**.76**	.99
C3	-.21	.10	-.07	.26	**.69**	.98
C4	-.26	**.34**	.11	-.08	**.70**	.97
C5	**-.39**	.18	.01	.08	**.69**	.99
C6	-.11	**-.34**	-.11	.25	**.65**	.98
Congruence	.96	.97	.98	.97	.98	.97

Study 3

Method

Participants

There were 3,447 participating subjects, including 1,744 males and 1,834 females; a few were missing gender identification. The mean age was 31.4 years and the standard deviation was 11.4. The data were gathered through a number of research projects with a range of samples, as well as from clinical settings.

Translation

The better items from each of the two previous translations were included in the third and final translation, with the items chosen based on linguistic- and five-factor model theoretical considerations. This last translation was done by the second author in consultation with the other two authors. Based on this, we arrived at the final Norwegian translation of the NEO PI-R.

Results

Upon inspection, data for the 30 facets and the five factors were within the normal distribution using the same rule of thumb as in Studies 1 and 2. The descriptives are shown in Table 4, and the reliabilities are clearly acceptable. With regard to gender differences, it can be noted that females have higher scores on the factors of neuroticism, openness and agreeableness, but lower scores on conscientiousness and extraversion. All gender differences were significant at values lower than the .01 criterion except for extraversion, which was not significant.

When factor analyzing the data, we found six factors with eigenvalues above one, although the scree plot recommended extracting five factors. The parallel test again advised to extract five factors using a web utility (Patil, Surendra, Sanjay, & Donavan, 2007), and we based this analyses on 200 extractions and the 95th percentile of eigenvalues. Eigenvalues for the 10 first factors were: 7.40, 4.22, 3.13, 2.05, 1.58, 1.03, .85, .73, .69, .66. Five factors explained 61.3% of the variance. Using principal component analysis with orthogonal Procrustes rotation, the pattern of factor loadings again proved to be in close correspondence with the target values. This factor solution is exhibited in Table 5.

The data were split on gender and factor analyzed separately with orthogonal Procrustes rotation, with the pattern of factor loadings being virtually identical to the solution in Table 5 for both genders.

A few other analyses were also done although not specified in the introduction. In these analyses the correlations between the five factors and age were N: -.09, E: -.20, O: -.12, A: .22 and C: .15. Because of the sample size these correlations were highly significant. Additionally, because there were a few cross-loadings, we finally compared factor scores for the five factors based on a principal component analysis and the sum scores of six facets for each factor, which are typically generated in practical use of the NEO PI-R. The correlations between the two sets of scores (factor scores and sum scores) were: N = .98, E = .88, O = .98, A = .87, C = .98.

Study 4

Above all, the studies supported the construct validity of the NEO PI-R as an operationalization of the five-factor model through target-rotated factor analyses. Nevertheless, it was still unknown as to whether the construct validity was acceptable when the inventory was used in applied settings. Consequently, another study was conducted to investigate the factor structure of the NEO PI-R when used in selection and counseling settings.

Method

Participants

A total of 4,105 subjects participated in this study. Of these, 2,453 were males and 1,652 were females, and they either participated in selection or counseling settings. The subjects were from a wide range of professions, but an inspection of the data indicated that a larger number of leaders were among the participants. Of these, 1,711 protocols were identifiably from settings in which the selection of leaders or specialists was the issue.

The mean age was 40.26 years, and the standard deviation was 9.57 years. All of the uses were commercial (paid use of NEO PI-R), and the data were primarily gathered through a web service system available to registered users of the instrument.

Results

Upon inspection, all variables were within acceptable limits for skewness, while some of the facets tended to have exaggerated values for kurtosis based on the rule of thumb used in the previous studies. The means and

standard deviations for males, females and the total are reported in Table 6 along with reliabilities. Compared with the data from the previous study, the present total means are lower on neuroticism and higher on extraversion, agreeableness and conscientiousness. It is also clear that females have higher scores than males on all factors except for conscientiousness, while the latter difference was not significant.

When using principal component analysis, both the eigenvalue greater than 1 criterion and the scree plot advised the extraction of five factors. There were two screes, one after three factors and one after five. Parallel analysis based on 200 extractions and the 95th percentile of eigenvalues using a web utility (Patil, Surendra, Sanjay, & Donavan, 2007) clearly suggested to extract five factors. The 10 first eigenvalues were: 7.93, 3.60, 3.12, 1.81, 1.59, .92, .88, .77, .71, .65. Five factors explained 60.16% of the total variance.

The results from principal component analysis with orthogonal Procrustes rotation are shown in Table 7. It is clear that the factor solution from this sample also has an excellent fit to the theoretically and empirically defined target solution.

The data were again split on gender and factor analyzed separately with orthogonal Procrustes rotation, and the pattern of factor loadings was virtually identical to the solution in Table 10 for both genders.

Again, factor scores for the five factors were compared with the sum scores of the NEO PI-R. The correlations between the two sets of scores were: N = .97, E = .87, O = .98, A = .88, C = .98.

Discussion

The present study sought to shed some light on the psychometric qualities associated with various Norwegian translations of the NEO PI-R. We also wanted to investigate the construct validity of the instrument when used in applied settings and we wanted to investigate gender differences. Based on theory and previous empirical results, we expected to find close similarities between the Norwegian translations and the original American target data, and we summarize our findings below.

Our reliabilities were close to the values found in the American normative sample (Costa & McCrae, 1992). This means that throughout the four samples and three translations, these values were very similar to the original ones, which is a finding that may support the similarity of the contents across our translations compared with the original American version.

Beyond this, the results from our several factor analyses exhibited a more than acceptable fit to the theoretically- and empirically derived targets for comparison values using an orthogonal Procrustes rotation. This method of confirmatory analysis has been proposed as an alternative to confirmatory factor analyses that use structural equation modeling methods by McCrae et al. (1996). Subsequent to this proposition, this method has been used extensively in research on the cross-cultural validity of the NEO PI-R (McCrae & Allik, 2002; Terraciano, 2003). We found that the overall congruence coefficients for all four of our factor solutions were .97 or .98, which is well beyond any threshold for factor replicability (Mulaik, 1972; Rolland, 2002). There was virtually no variation in these coefficients, thereby indicating that the effects of translations or samples were close to non-existent. The pattern of factor loadings showed minor deviations in particular for N5: Impulsiveness and E3: Assertiveness, although this could have been expected based on findings from the other language versions of NEO PI-R (cf. McCrae & Allik, 2002). Because of such small deviations from a simple five-factor structure, comparisons of factor scores and sum scores for the five factors were carried out in Studies 3 and 4. These correlations were close to 1 for N, O, and C, and close to .90 for E and A in both studies. The correlations between factor scores and sum scores for the variables can be interpreted as highly acceptable test-retest variables (e.g. Anastasi, 1997) or as indicators of congruence. Beyond this, the factor solutions for males and females were similar in both Studies 3 and 4.

With concern to gender differences, women were expected to have higher means on neuroticism, extraversion, agreeableness and conscientiousness than men, and that these differences should be salient especially in a wealthy and highly educated country like Norway (Schmitt, et al., 2008). We found that females had higher scores than males on neuroticism, openness and agreeableness, while the scores were unexpectedly lower on conscientiousness. These results were obtained in Studies 3 and 4 and were slightly different from what could be expected, but again we do not know about the generalizability of our samples so the results should be interpreted with care. Nevertheless, our findings were in correspondence with the findings in a previous study by Costa, Terracciano, & McCrae (2001).

Otherwise, the factor means were quite comparable across the first three Norwegian samples, although we did not use tests of significance again because of unknown sample characteristics. The data from these samples also mirrored three translations. Interestingly, when comparing the means from the American normative sample (Costa & McCrae, 1992), it seems that the Norwegian participants across the three

samples deviated differently from their American counterparts on neuroticism, while they had higher scores on extraversion and openness and lower scores on agreeableness and conscientiousness. Although we did not have representative Norwegian samples, the consistency of our findings across samples and translations (the three first studies) invites an interpretation of cultural differences in the mean values, albeit that the interpretations of such findings are far from straightforward (cf. McCrae et al., 2005a; McCrae & Allik, 2002). Nevertheless, it adds to our interpretation that the present findings partly replicate previous findings by Lian, Vassend and Andersen (1993) using the NEO PI. Finally, it should be underlined that it can be important to report means for large samples with unknown generalizability characteristics in case future research will give an opportunity to compare such samples with representative samples.

The means for NEO PI-R used in applied settings seemed to deviate from the means in the other three samples. The scores on neuroticism were lower, whereas the scores on extraversion and conscientiousness were higher than in the other three samples. Still, such deviations can be explained by the fact that the sample in Study 4 comprised not only a large number of leaders, but also a military sample. Judge et al. (2002) have shown that leaders as a group may have higher values on extraversion, openness and conscientiousness than other groups, but lower values on neuroticism. Military officers have lower values on neuroticism and higher values on extraversion and conscientiousness. Hence, given the leader and military bias in the present sample, as well as the aforementioned findings from research on leadership, it could have been expected that the sample means would have been higher on extraversion and conscientiousness and lower on neuroticism. Secondly, since the data from our Study 4 were gathered in either selection or counseling settings, the data may additionally have been biased because of social desirability influences. Completing the NEO PI-R in a selection setting has been found to increase the mean scores on E and C in particular, and lower the scores on N, while the factor structure and predictive validity were relatively unaffected compared with a research setting (Martinsen et al., 2009). Thus, the differences between the mean values in Study 4 and the other studies may be attributable to both sample characteristics and the sample testing conditions. If the main cause of such differences may be social desirability influences, a consequence of this could be that NEO PI-R may need norms from real selection conditions to maximize its utility. Alternatively, since the construct validity from the present Study 4 was acceptable, with the same being the case along with practically unchanged criterion validity across conditions in a former study (Martinsen et al., 2009), it may be necessary to base selection decisions on the rank ordering of selection candidates instead of using norms and cutoff criteria for selection.

Despite the rapid growth of research on the five-factor model, we should mention that many still advance the idea that a different number of latent factors is more adequate as a taxonomy for human personality, e.g because constructs describing positive and negative valence are not well described by the big five (Benet-Martinez & Waller, 1997). Still, Piedmont (1998) summarizes several arguments and issues that need to be addressed before it can be concluded that more than five factors are necessary to adequately describe personality. Based on this, the research up to now suggest that the five-factor structure is an acceptable way to conceptualize the structure of personality, and that the more popular research instrument in this area demonstrates adequate qualities in our Norwegian translations. Based on the present study, it seems well supported that the five-factor model, as measured by NEO PI-R, can be imported to Norwegian culture, and that the American five-factor structure is well replicated in the present translation. This represents cross-cultural similarity in the *etic* perspective (Rolland, 2002). A different question concerns whether there are culture-specific personality traits in Norway beyond the traits that have been identified in America. A study of this would represent the *emic* perspective and cannot be answered properly by using the NEO PI-R or other popular instruments that have been constructed in America, or which to a large extent are based on previous American research. Further research on traits based on lexical analyses of the Norwegian language, both the official languages and important dialects, may be interesting issues for future research.

References

Allport, G. W., & Odbert, H. S. (1936). Trait names: A psycho-lexical study.

Psychological Monographs, 47 (1, whole no. 211)

Aluja, A., Garcıa, O., Garcıa, L. F., & Seisdedos, N. (2005). Invariance of the ‘‘NEO-

PI-R'' factor structure across exploratory and confirmatory factor analyses. Personality and Individual Differences, 38, 1879–1889

Anastasi, A. (1997). Psychological testing. 7th edition. Upper Saddle River, NJ:

Prentice Hall

Back, M. D., Stopfer, J. M., Vazire, S., Gaddis, S., Schmuckle, S. C., Egloff, B., &

Gosling, S. D. (2010). Facebook profiles reflect actual personality, not self-idealization. Psychological Science OnlineFirst, published January 29th.

Bass, B. M. (1990). Bass and Stogdill's handbook of leadership: Theory, research

and managerial applications. New York: Free Press

Benet-Martinez, V., & Waller, N. G. (1997). Further evidence for the cross-cultural

generality of the big seven factor model: indigenous and imported Spanish

personality constructs. Journal of Personality, 65, 567-598

Block, J. (1995). A contrarian view of the five-factor approach to personality

description. Psychological Bulletin, 117,187-215.

Bollen, K. A. (1989). Structural Equations with Latent Variables. Wiley Series in

Probability and Mathematical Statistics. New York: Wiley

Botwin, M. (1995). Review of the NEO PI-R. In J. Conoley & J. Impara (Eds.),

Mental Measurement yearbook. 12th edition (pp. 862-863). Lincoln: University of Nebraska Press

Bouchard, T. J., Jr., & Loehlin, J. C. (2001). Genes, personality and evolution.

Behavior Genetics, 31, 243–273.

Cattell, R. B. (1944). Interpretation of the twelve primary personality factors.

Character and Personality, 13, 55-91

Church, A. T. Burke, P. J. (1994). Exploratory and confirmatory tests of the Big Five

and Tellegen's three- and four-dimensional models. Journal of Personality and Social Psychology, 66, 93-114.

Costa, P. T., & McCrae, R. R. (1985). The NEO personality inventory. Manual.

Odessa, Fl.: Psychological Assessment Resources

Costa, P. T., & McCrae, R. R. (1992). Revised NEO personality Inventory:

Professional manual. Odessa, Fl.: Psychological Assessment Resources

Costa, P. & McCrae, (2006). Age changes in personality and their origins: Comments

on Roberts, Walton, and Viechtbauer (2006). Psychological Bulletin, 132, 26-28.

Costa P.T. Jr., Terracciano A., & McCrae R. R. (2001). Gender differences in

personality traits across cultures: Robust and surprising findings. Journal of Personality and Social Psychology, 81, 322-331

DeFruyt, F., Bartels, M., Van Leuven, K. G., DeClercq, B., Decuyper, M., &

Mervielde, I. (2006). Five types of personality continuity in childhood and adolescence. Journal of Personality and Social Psychology, 91, 538-552

De Raad, B., & Barelds, D. P. H. (2008). A new taxonomy of Dutch personality traits

based on a comprehensive and unrestricted list of descriptors. Journal of Personality and Social Psychology, 94, 347–364.

DeRaad, B., Barelds, D., Levert, E. Ostendorf, F., Mlacic, B., Di Blas, L.,

Hrebickova, M., Szirmak, Z., Szarota, P., Perugini, M., Church. T., & Katigbak, M. S. (2010). Only three factors of personality description are fully replicable across languages: A comparison of 14 trait taxonomies. Journal of Personality and Social Psychology, 98, 160–173

Digman, J. M. (1990). Personality structure: Emergence of the five-factor model. Annual Review of Psychology, 41(1), 417–440.

Digman, J. M. (1997). Higher-order factors of the Big Five. Journal of Personality

and Social Psychology, 73, 1246-1256.

Feist, G. J. (1998). A meta-analysis of personality in scientific and artistic creativity.

Personality and Social Psychology Review, 2, 290-309.

Feist, G. J. (1999). The influence of Personality on artistic creativity. In R. J.

Sternberg (Ed.), Handbook of creativity (pp. 273-296). NY: Cambridge University Press

Fiske, D. W. (1949). Consistency of the factorial structure of personality ratings from

different sources. Journal of Abnormal and Social Psychology, 44, 329-344

Goldberg, L. R. (1992).The development of markers for the big-five factor structure.

Psychological Assessment, 4, 26-42.

Horn, J. L. (1965), "A Rationale and Test for the Number of Factors in Factor

Analysis," Psychometrika, 30, 179-85.

Judge, T. A., Bono, J. E., Ilies, R., & Gerhardt, M. W. (2002). Personality and

leadership: A qualitative and quantitative review. Journal of Applied Psychology, 87, 765-780.

Hampson, S. E., Goldberg, L. R., Vogt, T. M., Dubanoski, J. P. (2007). Mechanisms

by which childhood personality traits influence adult health status: Educational attainment and healthy behaviors. Health Psychology, 26, 121-125.

Kandler, C., Bleidorn, W., Riebman, R., Spinath, F. M., Thiel, W., & Angleithner, A.

(2010). Sources of cumulative continuity in personality: A longitudinal multiple-rater twin study. Journal of Personality and Social Psychology, 98, 995-1008.

Lian, L., Vassend, O., and Andersen, H. T. (1993). Norske versjoner av NEO-

personality inventory, symptom checklist 90 revised og Giessen subjective complaints list. Del III (Norwegian versions of the NEO-personality inventory, symptom checklist 90 revised, and Giessen subjective complaints list. Part III). Tidsskrift for Norsk Psykologforening, 30, 117-126

Markon, K. E., Krueger, R. F., & Watson, D. (2005). Delineating the structure of

normal and abnormal personality: An integrative hierarchical approach. Journal of Personality and Social Psychology, 88, 139–157.

Martinsen, Ø. L., Lang-Ree, O. C., Almås Sørensen, L. J., & Arnulf, J. K. (2009,

july). Validity of a normative measure of the five factor model under two different testing conditions in a realistic setting. Paper presented at the European Conference for Psychology, Oslo

Martinsen, Ø. L., Nordvik, H., & Østbø, L. (2005). Norske versjoner av NEO PI-R og

NEO FFI (Norwegian versions of teh NEO PI-R and the NEO FFI). Tidsskrift for Norsk Psykologforening, 42, 421-423

McCrae, R. R. (1999). Personal communication. June 1999.

McCrae, R. R., Allik, J. (Eds.) (2002). The five-factor model of personality across

cultures. New York: Kluwer academic

McCrae, R. R., Terraciano, A., & 79 members of the Personality Profiles of Cultures

project (2005a). Personality profiles of cultures: Aggregate personality traits. Journal of Personality and Social Psychology, 89, 407-425.

McCrae, R. R., Terraciano, A., & 79 members of the Personality Profiles of Cultures

project (2005b). Universal features of personality traits from the observer's perspective: Data from 50 cultures. Journal of Personality and Social Psychology, 89, 547-561.

McCrae, R. R., Zonderman, A. B., Costa, P. T., Bond, M. H., Paunonen, S. V. (1996).

Evaluating replicability of factors in the Revised NEO Personality Inventory: Confirmatory factor analysis versus Procrustes rotation. Journal of Personality and Social Psychology, 70, 552-566.

Mount, M. K., Barrick, M. R., & Perkins Strauss, J. (1994). Validity of observer

ratings of the big five personality factors. Journal of Applied Psychology, 79, 272-280.

Mulaik, S. A. (1972). The foundations of factor analysis. New York: McGraw Hill

Norman, W. T. (1963). Toward an adequate taxonomy of personality attributes:

Replicated factor structure in peer nomination personality ratings. Journal of Abnormal and Social Psychology, 66, 574-583

Oh, I. S., Wang, G. & Mount, M. K. (2011). Validity of Observer Ratings of the Five-

Factor Model of Personality Traits: A Meta-Analysis. Journal of Applied Psychology, 96, 762–773

Ones, D. S., Dilchert, S., Viswesvaran, C., & Judge, T. (2007). In support of

personality assessment in organizational settings. Personnel Psychology, 60, 995–1027

Patil, Vivek H., Surendra N. Singh, Sanjay Mishra,and D. Todd Donavan (2007),

"Parallel Analysis Engine to Aid Determining Number of Factors to Retain [Computer software]. Available from http://ires.ku.edu/~smishra/parallelengine.htm; Utility developed as part of Patil, Vivek H., Surendra

N. Singh, Sanjay Mishra, and Todd Donovan (2008), "Efficient Theory Development and Factor Retention Criteria: A Case for Abandoning the 'Eigenvalue Greater Than One' Criterion," Journal of Business Research, 61, 162-170.

Piedmont, R. L. (1998). The revised NEO personality inventory. Clinical and

research applications. New York: Plenum

Poropat, A. E. (2009). A meta-analysis of the five-factor model of personality and

academic performance. Psychological Bullletin, 135, 322-338

Roberts, B. W., & DelVecchio, W. F. (2000). The rank-order consistency of

personality from childhood to old age: A quantitative review of longitudinal studies. Psychological Bulletin, 126, 3–25.

Roberts, B.W.,Walton, K., & Viechtbauer,W. (2006a). Patterns of mean-Level change

in personality traits across the life course: A metaanalysis of longitudinal studies. Psychological Bulletin, 132, 1–25.

Roberts, B.W.,Walton, K., & Viechtbauer,W. (2006b). Personality traits chance in

adulthood: A reply to Costa & McCrae (2006). Psychological Bulletin, 132, 29–32.

Roland, J. P. (2002). The cross-cultural generalizability of the five-factor model of

personality. In R. R. McCrae & J. Allik (Eds.), The five-factor model of personality across cultures (pp. 7-28). New York: Kluwer academic

Samuel, D. B., & Widiger, T. A. (2008). A meta-analytic review of the relationship

between the five-factor modell and DSM-IV-TR personality disorders: A facet level analysis. Clinical Psychology Review, 28, 1326-1342.

Saucier, G., Georgiades, S., Tsaousis, I., & Goldberg, L. R. (2005). The factor

structure of Greek personality adjectives. Journal of Personality and Social Psychology, 88, 856–875.

Frank L. Schmidt, F. L. & Hunter, J. E. (1998). The Validity and Utility of Selection

Methods in Personnel Psychology: Practical and Theoretical Implications of 85 Years of Research Findings. Psychological Bulletin, 124, 262-274

Schmitt, D. P., Realo, A., Voracek, M., & Allik, J. (2008). Why can't a man be more

like a woman? Sex differences in Big Five personality traits across 55 cultures. Journal of Personality and Social Psychology, 94, 168–182

Taylor, M. D., Whiteman, M. C., Fowkes, G. R., Lee, A. J., Allerhand, M., & Deary,

I. J. (2009). Five Factor Model personality traits and all cause mortality in the Edinburgh Artery Study cohort. Psychosomatic Medicine, 71, 631-641.

Terraciano, A. (2003). The Italian version of the NEO PI-R: Conceptual and empirical

support for the use of targeted rotation. Personality and Individual Differences, 35, 1859-1872.

Tett, R. P., Jackson, D. N., & Rothstein, M. (1991). Personality measures as

predictors of job performance: A meta-analytic review. Personnel Psychology, 44, 703-742

Thurstone, L. L. (1951). The dimensions of temperament. Psychometrica, 16, 11-20

Tupes, E. C., & Christal, R. E. (1961). Recurrent personality factors based on trait

ratings (USAF ASD Technical Report No. 61-97). Lackland Air Force Base, TX: U. S. Air Force

Vassend, O., & Skrondal, A. (1997). Validation of the NEO Personality Inventory and

the five-factor model. Can findings from exploratory and confirmatory factor analysis be reconciled. European Journal of Personality, 11, 147-166.

Watkins, M. W. (2000). Monte Carlo PCA for parallel analysis [computer software].

State College, PA: Ed & Psych Associates.

Yamagata, S., Suzuki, A., Ando, J., Ono, Y., Kijima, N., Yoshimura, K., Ostendorf,

F., Angleitner, A. Riemann, R., Spinath, F. M., Livesley, W. J. & Jang, K. L. (2006). Is the genetic structure of human personality universal? A cross-cultural twin study from North America, Europe, and Asia. Journal of Personality and Social Psychology, 90, 987–998.

Zwick, W. R. & Velicer, W. F. (1986). Comparison of five rules for determining the

number of components to retain. Psychological Bulletin, 99, 432–442.

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