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Psychometric analysis of the Korean version of the Disgust Scale—Revised

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Abstract

Objective: Disgust is a basic emotion associated with feelings of revulsion and withdrawal behaviors from dangerous situations. The aim of this study was to examine the psychometric properties of the Disgust Scale—Revised (DS-R), a tool designed to measure individuals' responses to various disgust-provoking situations, among Korean populations.

Methods: A sample of 1117 healthy volunteers completed self-report questionnaires containing the 27-item DS-R. A subsample (n = 231) completed the Temperament and Character Inventory (TCI), Eysenck Personality Questionnaire (EPQ), and State-Trait Anxiety Inventory (STAI). Principal component analysis using a varimax rotation was conducted. Construct validity was assessed using Pearson correlation analysis for the TCI, EPQ, and STAI. To examine differences in responses on the DS-R among populations, patients with obsessive-compulsive disorder were compared with healthy subjects who were matched with respect to age and sex.

Results: The Cronbach α estimates for total items and the 3 original subscales of the DS-R, including: core disgust, animal reminder disgust, and contamination-based disgust, were 0.86, 0.77, 0.80, and 0.55, respectively. Principal component analysis identified 5 factors, which accounted for 48% of the total variance of the scale. The 5 newly developed dimensions were labeled as core disgust-touch, core disgust-dirt, contamination-based disgust, animal reminder disgust, and social intolerance disgust. The Cronbach α coefficients were 0.79, 0.64, 0.46, 0.77, and 0.34, respectively, for these subscales. The DS-R was correlated positively with harm avoidance from the TCI, neuroticism from the EPQ, and the anxiety scores of STAI. Furthermore, the contamination-based disgust scores for patients with obsessive-compulsive disorder were higher than those of normal controls.

Conclusion: The DS-R may be a reliable, valid, and acceptable tool to measure disgust sensitivity among Korean populations. The psychometric properties of the Korean version of the DS-R and the original DS-R are discussed.

1. Introduction

Disgust is a basic emotion involving feelings of revulsion associated with distaste. Disgust is experienced in response to a wide range of aversive stimuli, including human waste products, body envelope violations, death and dead bodies, sex involving culturally deviant sexual behavior, violations of culturally expected hygiene practices, and noninfectious stimuli that resemble contaminants [1,2]. Disgust plays an important role in protecting individuals from potentially harmful sources, such as poisonous foods and contaminants, and disgust plays a role in interpersonal intimacy and moral decisions [3]. For these reasons, disgust reactions can function as a "behavioral immune system," and disgust can result in behavioral avoidance and rejections of disgusting objects or situations [4]. Evidence suggests that disgust sensitivity may be associated with increased vulnerability to various psychiatric disorders and psychopathology [5]. In particular, disgust sensitivity may be involved in the development and maintenance of anxiety disorders, such as specific phobia [6] and obsessive-compulsive disorder (OCD) [7].

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Trait disgust sensitivity can be characterized as stable individual differences in response to various stimuli eliciting disgust, the intensity of the individual's response to disgusting stimuli, and the secondary reactions to the experience of disgust. One tool used to measure individual differences in trait disgust sensitivity is the Disgust Scale (DS) [1]. The DS was developed as a self-report instrument to assess individual differences of overall disgust sensitivity and specific sensitivity to a variety of potential disgust elicitors. The original scale is composed of 32 items. The measure consists of disgust-eliciting stimuli across 8 domains of disgust, including food, animals, body waste products, sex, body envelope violations, death, hygiene, and magical thinking. Although early reports using this scale describe good internal consistency and evidence of construct validity, the original subscales did not have sufficiently high reliability to be considered distinct individual difference measures. Therefore, a new refined and revised version, the Disgust Scale—Revised (DS-R) [8], was developed.

The DS-R has a factor structure consisting of 3 subscales, including core disgust, animal reminder disgust, and contamination-based disgust. Core disgust is based on the sense of offensiveness and the threat of disease. This domain includes items, such as rotting foods, small animals, and body waste products [2,8]. Animal reminder disgust reflects the aversion to stimuli related to reminders of that humans have animal origins. This domain includes items related to death and body envelope violations [2,8]. Contamination disgust is related to the perceived threat of interpersonal transmission of bodily fluids or microbes [2,8]. The rating scale for the revised version has been changed from a rating of either true or false on the first part of the measure and a 3-point rating system on the second part of the measure to the new 5-point Likert scale ranging from 0 to 4. The DS-R contains 27 items, including 25 disgust elicitor items and 2 "catch" questions for identifying whether subjects take the task seriously.

Disgust sensitivity has been shown to be positively correlated with trait anxiety [9,10]. In addition, sex differences in disgust sensitivity have been reported. Moreover, disgust sensitivity has been implicated in various neuropsychiatric disorders, such as OCD [7,11,12] and specific phobias [6,13,14]. Specifically, disgust sensitivity may be associated with the washing and fear of contamination symptoms observed among individuals with OCD [11,15].

The purpose of this study was to investigate the factor structure and psychometric properties of the DS-R scale and to develop the Korean version of this measure. If the Korean version of the DS-R is a good tool for measuring disgust sensitivity, higher scores on the DS-R will be related to higher scores in anxiety-related traits, such as harm avoidance and neuroticism. In addition, sex differences in disgust sensitivity and differences in disgust sensitivity between healthy subjects and patients with OCD are anticipated.

2. Methods

2.1. Subjects

One thousand one hundred ninety-two Korean volunteers (538 males, 654 females) were recruited through advertisements. A subset of participants was excluded from analysis because of missing information. In addition, only participants with appropriate responses to the 2 catch questions were included. Finally, a total of 1117 participants with complete data (498 males, 619 females) were included in the data analysis. The mean age of the final sample was 24.2 years (SD, 5.3) for the males and 22.6 years (SD, 4.8) for the females. All participants were ethnically Korean.

Subjects with any current neurologic disorders or Axis I psychiatric disorders according to the self-administered questionnaires were excluded. This study was performed under the ethical guidelines established by the Institutional Review Board at Severance Hospital, and written informed consent was obtained from all participants.

A subset of participants (n = 130) was reassessed 4 weeks after the initial assessment to establish test-retest reliability. A subset of the participants (n = 231) also completed additional scales, including the Temperament and Character Inventory (TCI) [16,17], the Eysenck Personality Questionnaire (EPQ) [18,19], and the State-Trait Anxiety Inventory (STAI) [20,21] to examine convergent validity. To examine differences in DS-R scores among populations, a total of 66 patients with OCD were recruited from the outpatient OCD clinic at the Severance Hospital, Yonsei University Health System. For patients with OCD, the patient version of the Structured Clinical Interview for the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* [22], was administered by a trained psychiatrist to assess for Axis I disorders and to confirm a diagnosis of OCD. Some in the OCD group also met criteria for major depression (n = 8), social phobia (n = 1), somatoform disorder (n = 1), and alcohol abuse (n = 1). The participants with OCD (age, 24.7 ± 7.4 years; male/female, 42/24) were compared with 66 healthy subjects (age, 24.7 ± 4.1 years; male/female, 42/24) individually matched by age and sex.

2.2. Measures

2.2.1. Korean draft version of the DS-R scale

After obtaining permission to create a Korean version of the DS-R scale from Haidt, the original author of the scale, a Korean physician, who spoke both English and Korean, made the initial translation of the DS-R scale from English into Korean. A second Korean psychiatrist reviewed this preliminary translation. The translated questionnaire was given to 10 individuals with varying sociodemographic characteristics, and these individuals reported on the clarity of the items. Next, another blinded bilingual speaker made a back translation from the Korean version into English. The English back translation of the items was compared with the original and reviewed by a

group of psychiatrists. In the case of disagreement between the back-translated items and the originals, the first translator offered a second Korean translation. The second translation was judged satisfactory. The final Korean draft version was further revised by a Korean language expert to take the cultural differences of the meanings of the items into account.

2.2.2. Temperament and Character Inventory—Revised—Short Version

To assess the convergent and discriminant validity of the DS-R, temperament was measured using the Temperament and Character Inventory—Revised—Short Version scale (TCI-RS) with 140 items [16]. The TCI, originally developed by Cloninger, was designed to assess personality across 4 dimensions of temperament (novelty seeking, harm avoidance, reward dependence, and persistence) and 3 dimensions of character (self-directedness, cooperativeness, and self-transcendence). Each item is rated on a 5-point scale, ranging from 0 to 4. The scores of each facet were obtained by the sum of each of the corresponding items after inversion for reverse items, and the scores of the 7 main dimensions were calculated as the sum of the correspondent facets. The Korean version of TCI-RS has been standardized and validated for Korean populations, and this measure has been shown to have acceptable reliability and validity [16]. In the present study, harm avoidance and novelty seeking scale scores were used.

2.2.3. Eysenck Personality Questionnaire

The EPQ was also administered to evaluate convergent and discriminant validity. The Korean version of the EPQ consists of 81 true-false items, which assess the personality traits of psychoticism, extraversion, neuroticism, addiction, criminality, and lie [18]. The EPQ had acceptable reliability ranging from 0.67 to 0.84 among Korean populations. In the present study, the neuroticism and lie scale scores were used.

2.2.4. State-Trait Anxiety Inventory

To measure individual anxiety levels, the STAI, including 20 items of state anxiety and 20 items of trait anxiety, were applied to a 4-point, Likert-type scale [20,21]. High scores on the STAI indicate a tendency to have more state or trait anxiety

2.3. Statistical analysis

To examine the factor structure of the Korean version of the DS-R, principal components analysis was used. The principal analysis was conducted using a varimax rotation, and factors with eigenvalues greater than 1.0 were identified. Scree plots were used to determine the number of factors. Items were retained if they had loadings equal to or greater than 0.40 on that factor. The internal consistency reliability for each subscale was examined using a Cronbach α coefficient. The test-retest reliability was evaluated using a Spearman correlation.

The convergent and discriminant validity was assessed by examining the interscale correlations. The Pearson correlation coefficient for total and subscale scores of the Korean version of the DS-R and the subscales of the TCI, EPQ, and STAI were calculated. In addition, to examine group differences on the DS-R, independent t tests were used to examine differences between sexes and between healthy subjects and patients with OCD.

The significance of the correlations was accepted when $P < .05$.

3. Results

3.1. Feasibility

There were no problems in the use of the Korean version of the DS-R from the participants. It took only approximately 10 to 15 minutes to complete it.

3.2. Factor structure

The Kaiser-Meyer-Olkin measure of sampling adequacy and the Bartlett Test of Sphericity were conducted on the data before factor extraction to ensure that the characteristics of the data set were suitable for the factor analysis to be conducted. The Kaiser-Meyer-Olkin analysis yielded an index of 0.86 in concert with a highly significant Bartlett Test of Sphericity ($\chi^2 = 1446.4$, $df = 190$, $P < .001$). The principal components analysis using the varimax rotation identified 5 factors with eigenvalues greater than 1.0. These factors cumulatively accounted for 48% of the total variance of the measure.

The first factor consisted of 9 items, which contained 5 items of core disgust, 2 items of animal reminder disgust, and 2 items of contamination-based disgust subscales of the original DS-R, and this first factor accounted for 25.0% of the variance (Table 1). This first factor was labeled as core disgust-touch. The second factor contained 6 items from the original animal reminder disgust subscale and accounted for about 7.5% of the variance. As such, this new factor was labeled with the same name, animal reminder disgust. A third factor contained 5 items from the core disgust subscale of the original DS-R and accounted for about 5.6% of the variance. This factor was labeled as core disgust-dirt. The fourth factor contained 3 items from the contamination-based disgust subscale of the original DS-R and accounted for 5.0% of the variance. This factor was labeled as contamination-based disgust. The last factor consisted of 2 items and was labeled as social intolerance disgust, and it accounted for 4.5% of the variance.

3.3. Reliability

To assess the internal consistency reliability, the Cronbach α coefficient for all 25 items was 0.86. For the 3 subscales of original DS-R, the Cronbach α coefficients were 0.77 for core disgust, 0.80 for animal reminder disgust,

Table 1
Rotated factor matrix of the Korean version of the DS-R scale for healthy volunteers (n = 1117)

Korean items	Original items	Component and factor loadings				
		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Core-T-20	Core-20 put ketchup on vanilla ice cream	0.63				
Core-T-23	Conta-23 chocolate shaped like dog□doo	0.63				
Core-T-25	Core-25 drink a glass of milk when you smell that it is spoiled	0.62				
Core-T-26	Conta-26 inflate a new unlubricated condom, using your mouth	0.59				
Core-T-22	Core-22 friend changes underwear only once a week	0.55				
Core-T-17	Core-17 smell urine in a tunnel	0.51				
Core-T-27	Core-27 step on an earthworm	0.50				
Core-T-24	AR-24 touch the ashes	0.50	0.43			
Core-T-19	AR-19 pick up dead body with bare hands	0.42				
AR-07	AR-07 touch a dead body		0.80			
AR-21	AR-21 see a man with his intestines exposed		0.71			
AR-02	AR-02 see a human hand preserved in a jar		0.66			
AR-14	AR-14 sleep in a hotel room where a man had died of a heart attack		0.62			
AR-10	AR-10 watch a person with a glass eye take the eye out of the socket		0.53			
AR-05	AR-05 walking through a graveyard		0.52			
Core-D-06	Core-06 cockroach in someone else's house			0.65		
Core-D-03	Core-03 clear a throat full of mucous			0.61		
Core-D-15	Core-15 see maggots on a piece of meat			0.52		
Core-D-08	Core-08 see someone vomit			0.45		
Core-D-11	Core-11 see a rat in a park			0.42		
Conta-09	Conta-09 the cook had a cold				0.70	
Conta-04	Conta-04 my body touch the toilet seat				0.62	
Conta-18	Conta-18 drank from the glass that an acquaintance had been drinking from	0.45			0.50	
SI-13	Core-13 soup stirred by a used but thoroughly washed flyswatter					0.72
SI-01	Core-01 eating monkey meat					0.55

Varimax rotation with Kaiser Normalization.
Core-T indicates core disgust-touch; AR, animal reminder disgust; Core-D, core disgust-dirt; Conta, contamination-based disgust; SI, social intolerance disgust. The numbers are the original DS-R items numbers.

and 0.55 for contamination-based disgust. For the 5 newly extracted factors of Korean version of the DS-R, the Cronbach α coefficients were 0.79, 0.77, 0.64, 0.46, and 0.34 for core disgust-touch, animal reminder disgust, core disgust-dirt, contamination-based disgust, and social intolerance disgust, respectively.

The test-retest reliability as assessed with a Spearman correlation coefficient was 0.85 ($P < .001$).

3.4. Validity

As shown in Table 2, the total score of the DS-R was significantly positively correlated with the harm avoidance scale of the TCI, the neuroticism scale of the EPQ, and both the state and trait anxiety subscales of the STAI. The original 3 subscales (core disgust, animal reminder disgust, and contamination-based disgust) of DS-R showed significant

Table 2
Pearson correlation coefficients for the Korean version of the DS-R scores and the subscales of the TCI, EPQ, and STAI (n = 231)

	TCI		EPQ		STAI	
	Harm avoidance	Novelty seeking	Neuroticism	Lie	State anxiety	Trait anxiety
Core disgust	0.24**	0.02	0.19*	0.04	0.19**	0.16*
Animal reminder disgust	0.23**	0.004	0.15*	−0.04	0.15*	0.13#
Contamination-based disgust	0.13*	−0.08	0.12#	0.08	0.15*	0.13#
K-DS-R-core-touch	0.25**	−0.02	0.17*	0.13	0.13#	0.12#
K-DS-R-animal reminder	0.24**	0.05	0.17*	−0.08	0.21**	0.18**
K-DS-R-core-dirt	0.23**	0.07	0.19**	−0.09	0.17*	0.14*
K-DS-R-contamination	0.00	−0.03	0.05	−0.005	0.10	0.08
K-DS-R-social intolerance	0.01	−0.12	−0.01	−0.06	0.07	0.04
K-DS-R total	0.27**	−0.005	0.20**	0.03	0.21**	0.18**

K-DS-R indicates Korean version of the DS-R.
* $P < .05$.
** $P < .01$.
# $P < .1$.

Table 3
Sex differences in the DS-R total score and the subscales

	Total sample (n = 1117)		Male (n = 498)		Female (n = 619)		*P*
	Mean	SD	Mean	SD	Mean	SD	
Core disgust	28.60	7.33	25.93	6.84	30.75	6.99	<.001
Animal reminder disgust	19.71	6.29	18.19	5.96	20.93	6.28	<.001
Contamination-based disgust	6.62	3.35	6.04	3.32	7.09	3.31	<.001
K-DS-R-core disgust-touch	16.85	6.59	15.07	6.16	18.29	6.59	<.001
K-DS-R-animal reminder disgust	16.03	4.89	14.90	4.73	16.94	4.83	<.001
K-DS-R-core disgust-dirt	13.29	3.59	11.94	3.52	14.37	3.26	<.001
K-DS-R-contamination-based disgust	3.48	2.22	3.37	2.23	3.57	2.20	.14
K-DS-R-social intolerance disgust	5.27	1.99	4.86	2.02	5.60	1.91	<.001
K-DS-R total	54.92	14.21	50.15	13.45	58.76	13.64	<.001

positive correlations with the harm avoidance scale from the TCI and the neuroticism scale of the EPQ, whereas they did not show any significant correlations with the novelty seeking scale of the TCI and the lie scale of the EPQ. The original subscales were also positively correlated with state anxiety and trait anxiety of the STAI.

Of the new 5 subscales of the Korean version of the DS-R, the core disgust-touch, animal reminder disgust, and core disgust-dirt subscales were significantly positively correlated with the harm avoidance scale of the TCI and the neuroticism scale of the EPQ. However, they showed no significant correlations with the novelty seeking scale of the TCI and the lie scale of the EPQ. Neither contamination-based disgust nor social intolerance disgust correlated with any subdimensions of the TCI, EPQ, or STAI (Table 2).

In the comparisons based on sex, females (n = 619) exhibited significantly higher disgust sensitivity for the total scale and the 3 original subscale scores of DS-R, as compared with males (n = 498; Table 3). For 5 factors of the Korean version of the DS-R, females also showed higher scores than males, although the differences on the Korean contamination subscale did not reach statistical significance. In addition, patients with OCD (n = 66) had a significantly higher score for the contamination-related disgust from the original scale and the Korean version, as compared with healthy subjects (n = 66; Table 4).

4. Discussion

The purpose of this study was to evaluate the psychometric properties of the Korean version of the DS-R scale and to develop an instrument to measure disgust sensitivity.

The present study was conducted with a large sample. The test-retest reliability was satisfactory. The Cronbach α coefficient of all 25 items of the DS-R was reliable (α = .86). The α coefficients for the original 3 subscales, core disgust, animal reminder disgust, and contamination-based disgust, were 0.77, 0.80, and 0.55, respectively. The whole items of the DS-R and subscales of core disgust and animal reminder disgust had good internal consistency reliability; however, Cronbach α for the contamination-based disgust scale (α = .55) was relatively low. With respect to the judgment of a reasonable α, DeVellis [23] has argued for a general threshold of 0.65 and an acceptability of 0.6. Still, the internal consistency of the contamination-related disgust seemed to be at boundary for the acceptable level. Similar to the findings of this study, Olatunji et al [8] reported a Cronbach α estimate for the contamination-based disgust (5 items) subscale of the DS-R that was relatively low (0.61). Inadequate Cronbach α coefficients were also reported for each of the 8 factors in previous research, using a version of the DS with 8 subscales (Haidt et al [1], α = 0.33 ~ 0.65; Olatunji et al [8], α = 0.22 ~ 0.66) [1,8]. Although the 3 subscales of the DS-R provide higher internal consistency than the original 8 disgust domains, it would be helpful to develop additional appropriate items of disgust sensitivity and to refine the instrument, especially for the contamination-based disgust subscale.

The factor structure of the Korean version of the DS-R in the present study consisted of 5 dimensions of core disgust-touch, animal reminder disgust, core disgust-dirt, contamination-based disgust, and social intolerance disgust. Although animal reminder disgust and contamination-based disgust on the Korean version exhibited characteristics similar to the 3 original subscales, the core disgust-touch, core disgust-dirt, and social intolerance disgust scales were newly extracted in the present study.

Table 4
Comparisons on the DS-R scores between patients with OCD and normal controls

	OCD (n = 66)		NL (n = 66)		*P*
	Mean	SD	Mean	SD	
Core disgust	27.80	8.97	27.59	8.14	.89
Animal reminder disgust	20.38	7.04	20.32	6.39	.96
Contamination-based disgust	8.82	4.62	6.08	3.32	<.001
K-DS-R-core disgust-touch	16.89	9.37	15.42	6.76	.30
K-DS-R-animal reminder disgust	16.21	5.23	16.91	4.75	.42
K-DS-R-core disgust-dirt	12.58	4.36	12.77	4.24	.79
K-DS-R-contamination-based disgust	5.32	2.96	3.27	2.24	<.001
K-DS-R-social intolerance disgust	6.00	2.08	5.61	2.06	.28
K-DS-R total	57.00	17.86	53.98	15.51	.30

The first factor of the Korean version of the DS-R consisted of 5 items from the original core disgust scale (17, 20, 22, 25, and 27 items), 2 items from the original animal reminder disgust scale (19 and 24 items), and 2 items from the original contamination-based disgust scale (23 and 26 items). This new factor was labeled as core disgust-touch, as all of the 9 items seemed to be related to the direct sensational experience of disgust through touch, smell, and taste. The disgust response seems to be stronger according to proximity of the potential contaminants [24]. As such, this factor may be linked to direct sensation and may induce a stronger physiologic disgust response and oral rejection rather than the other subdimensions of disgust sensitivity.

The second new factor consisted of 6 items (2, 5, 7, 10, 14, and 21 items) and was derived entirely from the original animal reminder subscale. All items of this subdimension were disgust elicitors related to death, and this dimension was labeled with the original name, animal reminder disgust. Animal reminder disgust reflects responses to reminders of death, blood, and injury [3]. Animal reminder disgust appears to be involved in blood-injection-injury phobia [25,26]. It serves as a reminder of the animal origins of humans and thereby humanizes our animal body and defends against undesirable, dehumanizing characteristics by pushing them away through the disgust reaction [2]. As such, animal reminder disgust may be related to higher cortical processing than core disgust. Animal reminder disgust may be more qualitatively distinguished from other categories of disgust elicitors.

The core disgust-dirt dimension (5 items; 3, 6, 8, 11, and 15 items), a third factor of the Korean version of the DS-R, was derived entirely from the original core disgust dimension. The factor contained items, including "cockroach in the house," "mucous throat," "maggot in meat," "vomiting," and "rat in a park," and this domain was associated with 3 domains of disgust elicitors, including food, body waste products, and small animals. This dimension seemed to be specifically related to the specific motivation associated with hunger and food aversion. This factor may represent disgust as revulsion at the prospect of encountering an offensive object involving contaminants [3].

The fourth factor, the contamination-based disgust subscale (3 items; 4, 9, and 18 items) consisted of some of the original items from the contamination-based disgust subscale. The items included "the cook with a cold," "touch the toilet seat," and "drank from the used glass" were related to the threat of interpersonal transmission of diseases and germs.

The last factor, social intolerance disgust (2 items; 1 and 13 items) was derived from the original core disgust subscale. The items were labeled as social intolerance disgust because the items consisted of "eating monkey meat" or "soup stirred by a used but thoroughly washed flyswatter" are an inappropriate and unacceptable behaviors according to sociocultural norms. Actually, the DS-R does not cover moral disgust, such as unwanted intimacy or sociomoral violations. Although the 2 items do not represent moral disgust itself, these items may be similar to the concept of *moral disgust*, as moral disgust plays a role in moral judgment and sociomoral violations [27,28].

The newly extracted factors in the Korean version of the DS-R include core disgust-touch, core disgust-dirt, and social intolerance disgust, which were mainly derived from the original core disgust subscale. Because core disgust may be rooted in evolution of the emotion of "disgust" [2,3], several new factors seem to be based in core disgust. A recent study that investigated physiologic reaction patterns associated with the core disgust and animal reminder disgust domains showed that there were no differences in physiologic reactivity according to these specific domains of disgust elicitors [24]. These findings suggest that disgust is a general hard-wired protective mechanism to prevent contamination by pathogens.

Sociocultural characteristics among populations may play a pivotal role in the subdimensional structures of disgust. Korean population rooted in Confucian culture has different sociocultural background from Western countries, which may affect development of moral norm and the different construct of disgust sensitivity. Although the original DS-R is composed of the 3 dimensions of core disgust, contamination-based disgust, and animal reminder disgust, Korean version reflects additional but very closely related subdimension of core disgust-dirt as a midway between core disgust (in Korean version, core disgust-touch) and contamination-based disgust and also reflects the social intolerance disgust as another form of moral disgust.

The reliabilities of some of the subscales of the Korean version DS-R appear to be weaker than those found in previous research among other populations. In particular, the α values of the contamination-based disgust and social intolerance disgust subscales of Korean version were not high enough. One reason that these scales may have shown lower internal consistency reliability is related to the relatively small number of items on these subscales (3-item contamination-based disgust and 2-item social intolerance disgust). The limitations of the low internal consistency reliability of the social intolerance disgust ($\alpha = .34$) subscale may be improved if the item numbers would be increased. For more acceptable and comprehensive DS-R, further research should devote considerable attention to the development of new additional items aimed as assessing moral disgust. When considering the importance of including moral disgust, the 2-item social intolerance disgust subscale, which is similar to moral disgust, was not deleted from the Korean version of the DS-R. At present, because of low reliability and the small number of items, it may be difficult to apply the newly identified 5 subscales of the DS-R. However, the internal consistency of all 25 items of the DS-R was reliable at 0.86. As a whole, the DS-R can be applied as an acceptable tool to measure disgust sensitivity among Korean populations.

The convergent and discriminant validity of the DS-R was assessed by examining the correlation coefficients with other theoretically related scales, including the TCI, EPQ, and STAI. Previously, an association between disgust sensitivity and harm avoidance has been reported [1]. In addition, disgust sensitivity is known to be positively associated with neuroticism-related traits [29]. As expected, total DS-R scores and the original 3 subscales were positively correlated with the harm avoidance scale of the TCI and the neuroticism scale of the EPQ in the present study. There were also positive correlations observed between the DS-R total scale and the state and trait anxiety scores of the STAI. However, evidence for discriminant validity was found in the absence of significant correlations between the DS-R and the novelty seeking scale of the TCI or the lie scale of the EPQ, which is consistent with previous findings [1]. These correlation patterns were also observed for the 5 newly extracted Korean subscales. Although the values of the correlation coefficients were weak, the lack of an adequate instrument to assess the construct validity may be viewed as a limitation. However, because these findings were comparable with those of previous research [1], the DS-R appears to have acceptable convergent and discriminant validity among Korean populations.

The group differences observed across sexes and the OCD comparison in disgust sensitivity also supported the construct validity of the DS-R scale. Consistent with previous research [1,30], females exhibited significantly higher disgust sensitivity than males. Higher levels of disgust sensitivity among females may partially explain the increased vulnerability to some psychiatric disorders among females, such as phobia [31]. Furthermore, patients with OCD had significantly higher scores on the contamination-related disgust subscale than healthy subjects. This finding implies that the contamination-based disgust scores may allow for predictable differentiation between patients with OCD and normal controls. Because the contamination-based disgust subscale has revulsion against contaminants in common with contamination symptoms in OCD, the exposure to those items may induce high anxiety and urges of washing or cleaning rituals in patients with OCD. Although previous research has not shown consistent findings for the involvement of specific subdomains of disgust sensitivity in OCD, there has been growing evidence of the association between OCD and disgust [7]. In particular, individuals with OCD have been shown to display differential patterns of activation in the insula and related regions, which have been implicated in disgust processing [32,33]. As such, these findings support the usefulness of the DS-R in assessing susceptibility for OCD.

There were some limitations in the present study. For example, to make direct comparisons between the results of this study and the original results of Olatunji et al [8] is difficult because of changes in the applied scoring system. Moreover, an important drawback of this study is the lack of an external instrument to assess the criterion-related validity of the scales. Because there have been few available tools for measuring disgust sensitivity in Korean populations, it was difficult to measure criterion-related validity to demonstrate the accuracy of a measure by comparing with another measure, which has been shown to be a valid tool of disgust sensitivity. A behavioral measure of the willingness to use disgusting food objects, which was used in Swedish study of the psychometric properties of the DS, may be used in future studies to assess the criterion-related validity [30].

In summary, the present study provided evidence for the psychometric properties of the DS-R in a large Korea sample. As a whole, the Korean version of the DS-R was a reliable, valid, and acceptable tool for use with Korean populations. Further refinement of the DS-R, in particular, for the contamination-based disgust scale, will be beneficial in the development of a more comprehensive assessment tool in the measure of disgust sensitivity.

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