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ORIGINAL ARTICLE

Reliability and Validity of a Computerised Cognitive Test of Contamination in Normal People

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ABSTRAK

Dua perasaan penting iaitu ketidakselesaan dan ketakutan terhadap pencemaran sering ditemuidalam kalangan individu yang sihat. Masih sedikit yang diketahui tentang penilaian yang boleh digunakan untuk menilai kedua-dua konstruk ini secara serentak. Kajian ini memperincikan proses pembangunan dan pengesahan pengukuran menggunakan komputer untuk menilai rasa ketidakselesaan dan ketakutan terhadap pencemaran terhadap penyakit, kekotoran/pencemaran dan bahan kimia yang berbahaya. Pakar telah mengesahkan penciptaan bahan digital ini diikuti dengan kajian yang melibatkan 224 peserta yang sihat. Analisis psikometrik dengan Cronbach alfa 0.85 menunjukkan konsistensi dalaman yang kuat. Tiga pembolehubah susunan tiga faktor termasuk sisa manusia, tandas dan perosak ditemui dalam analisis faktor penerokaan dan disahkan dengan analisis faktor pengesahan. Kewujudan beban sederhana pada konstruk laten ketakutan terhadap pencemaran dan ketidakselesaan menyokong pengesahan kesahihan konvergen. Penemuan menunjukkan bahawa soal selidik berkomputer yang baru dibangunkan ini adalah alat multidimensi dengan ketekalan dalaman yang sangat baik dan ia adalah sah untuk menilai ketakutan terhadap pencemaran dan ketidakselesaan.

Kata kunci: Ketakutan terhadap pencemaran; ketidakselesaan; komputer; ujian

ABSTRACT

Two significant feelings, namely disgust, and fear of contamination, are commonly found in healthy people. Little is known about which assessments could simultaneously assess these two constructs. This paper detailed how a computerised measure of disgust and fear of contamination toward disease, dirt/pollution, and hazardous chemicals was developed

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and validated. Experts validated the creation of this digital material, followed by a study involving 224 healthy participants. A psychometric analysis with a Cronbach alpha of 0.85 indicated strong internal consistency. Three-factor order variables, including human waste, toilet, and pest, were found in exploratory factor analysis and confirmed with confirmatory factor analysis. Moderate loadings on the fear contamination and disgust latent constructs supported the confirmation of convergent validity. The findings show that this newly developed computerised questionnaire is a multidimensional construct with excellent internal consistency and that it is valid to assess fear of contamination and disgust.

Keywords: Computer; disgust; fear of contamination; test

INTRODUCTION

The use of computers in the assessment of psychiatric problems has been extensively documented in the literature. Researchers have posed the question of whether the statistical data for clinical prediction through computers are more reliable than clinical judgment (Meehl 1967) to justify the use of computers as an assessment tool. A few researchers have stated that the mechanical technique of computer, which typically includes a formal, algorithmic, objective procedure (such as an equation), is comparable to or better than the clinical method (Dawes et al. 1989; Grove & Meehl 1996) and can be utilised not only for data collection and modeling, but also for assessment and intervention (Das 2002).

Up to now, recent studies continued to show the usefulness of computers as tools to screen psychiatric disorders. Leung and team (2007) investigated whether computers can be used to screen participants for primary healthcare conditions of depression, anxiety, alcoholism and problem gambling. They found the procedure of assessing mental health using a computer in a health kiosk to be helpful and user-friendly (Leung et al. 2007). In a different study, validated psychological distress questionnaires were converted into computerised forms, has allowed researchers to identify people at high risk of developing mental disorders with a consent rate of up to more than 86% (Davison et al. 2020). In specific to obsessive-compulsive disorder (OCD), the oldest evidence in the literature indicated that computers had been used to assess OCD using 55 reasoning principles and 50 natural language questions, but users had not generally embraced this use of technology (Roca-Bennasar et al. 1991). Similarly, there is also less data regarding the widespread use of a computer-interactive version of the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS) (Rosenfeld et al. 1992). Recent findings showed assessment using virtual reality has been able to differentiate contamination problem among healthy adult with OCD and produce no side effect (Inozu et al. 2020; Van Bennekom et al. 2021). Despite all these studies highlighting the suitability of computers to assess OCD symptoms, all this research was conducted in Western countries and offered little information that can be used to other countries. Our recent review showed that certain computerised questionnaires contain automated components that enable them to measure all sorts of psychiatric disorders while only offering a small amount of details on a specific disease, especially for contamination OCD (Baharim et al. 2022). This is important since phenomenology of OCD, especially contamination OCD, varies by country (Williams et al. 2017). Contamination OCD can be broadly classified into four categories: disease, dirt/pollution, mental contamination and hazardous chemicals (Rachman 2004). This OCD symptom may be caused by inappropriate and exaggerated reactions to disgust (Bhikram et al. 2017), which supports a strong relationship between disgust and contamination (Olatunji et al. 2004).

The majority of this research on disgust and fear of contamination has been done so far mostly through the use of paper and pencil tests, with the assessment of these two constructs being done generally independently. More importantly, there has been little quantitative analysis of assessing contamination OCD and disgust using computers, especially in developing countries. During the COVID-19 pandemic, using a computer is a more ideal method (Gopika & Rekha 2023) of inciting feelings of fear due to contamination and disgust. This is because it will lessen the feeling of being contaminated (Lavrakas 2008). The success and widespread use of the computerised scale, which is a vital factor development step of developing an electronic questionnaire, will depend on good psychometric proprieties. Researchers found that particular psychometric standards and norms have to be set for the computerised Wisconsin Card Test separate from the norm Wisconsin Card Sorting Test with the paper version in order to prevent biased scores in the interpretation (Çelik et al. 2021; Feldstein et al. 1999). Their finding showed that the patterns of variation of the acquired scores on both test mediums were different (Çelik et al. 2021; Feldstein et al. 1999). Therefore, this study aimed to develop and ascertain the psychometric properties of a novel computerised questionnaire for evaluating among healthy individuals both disgust and fear of contamination. This study is significant because prior research has demonstrated that people with varying ethnic backgrounds, genders, and nationalities would exhibit increased susceptibility to disgust and contamination (Elwood & Olatunji 2009) in a nation with a higher prevalence of infectious disease threats than in a location with a lower threat of disease (Skolnick & Dzokoto 2013). When researchers utilise healthy subjects, they can collect a wider range of function-related data, sample characteristics from many domains, and test the questionnaire's usability (Moeini et al. 2021) in estimating treatment effects when applied to a clinical population (Edwards 2010). It is also a hope that with the help of the information acquired from this study, clinicians will be able to recognise and assess this fear of contamination and disgust and develop an effective intervention.

MATERIALS AND METHODS

The development of computerised contamination disgust questionnaire (CCDQ) involved three phases; (i) item generation; (ii) content validity and face validity; and (iii) full study (Figure 1).

(i) Phase 1: Item Generation Items

The Malay Contamination is a paper pencil questionnaire, to measure disgust and contamination anxiety, served as the basis for this computerised item questionnaire. This scale was created to assess the level of disgust and fear of being contaminated that is appropriate for diverse cultural and normative contexts. Eight items were taken from a 49-item validated Malay contamination paper and pencil questionnaire that had higher means when compared to other items and factor loading over 0.7 (Floyd & Widaman 1995; Marcus-Roberts & Roberts 1987; Tavakol & Wetzel 2020) and these items were utilised to create a new computerised Malay contamination questionnaire. These 8 items based on three Rachman's (2004) classifications (disease, dirt, and harmful substances) were translated into 8 pictures including a dirty toilet, a biohazards specimen, a mouse crawling on food, and lastly spotting a crumple of glued hair on rice, used as measures of disgust and fear of contamination. These items were utilised to create a new computerised Malay contamination and disgust questionnaire. However, due to problems in producing an adequate picture, mental contamination, an additional form of fear contamination proposed by Rachman (2004), was left out of the study.

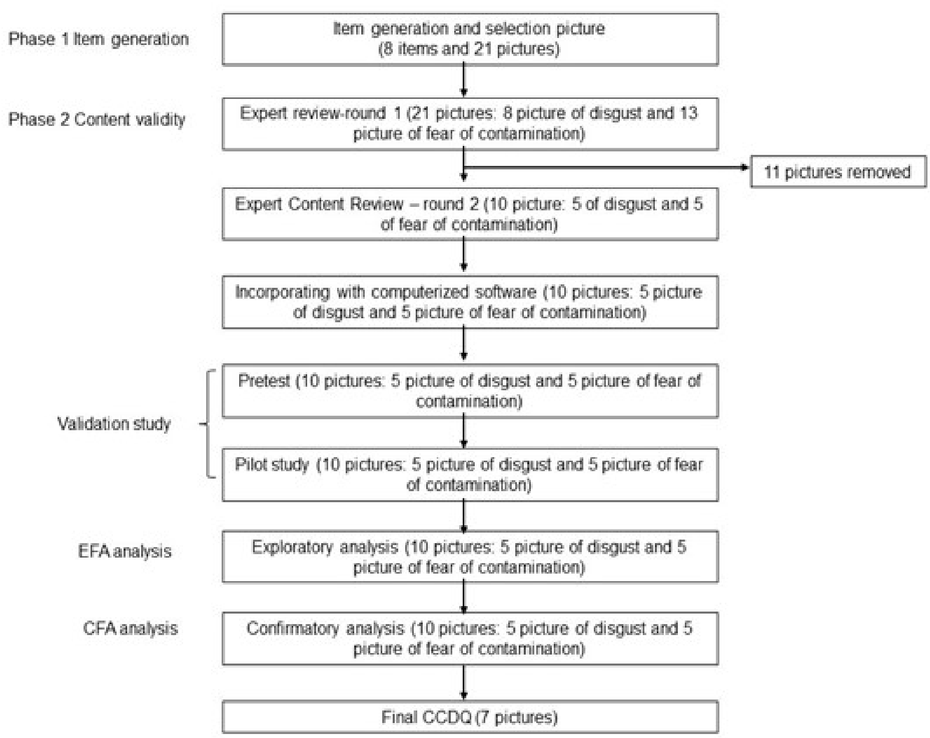

FIGURE 1: Flowchart of research process

Once each item was identified, a suitable picture that represented accurate items was taken in a real situation was used. The pictures were also taken from web images that were readily available and then examined by research professionals. The selection of each picture adhered to what was suitable in cultural and normative contexts as well as did not pose any adverse effect. Various cultural scenarios connected to peoples' fear of contamination and disgust were discussed and incorporated during the item development and picture selection. The pictures taken from online sources used in this study were specifically examined for commercialisation and copyright violations. By emailing the original author, permission was sought from each before using the image. In this study, free images or pictures that were cited appropriately were used (Figure 2). While unapproved photos or images were swapped out for ones taken using the researcher's camera that accurately depicted measures of fear and disgust (Figure 3). The 10 chosen images that represented 5 items of contamination and 3 disgust questionnaire

FIGURE 2: Mouse eating food (Heritage Pest Control 2020)

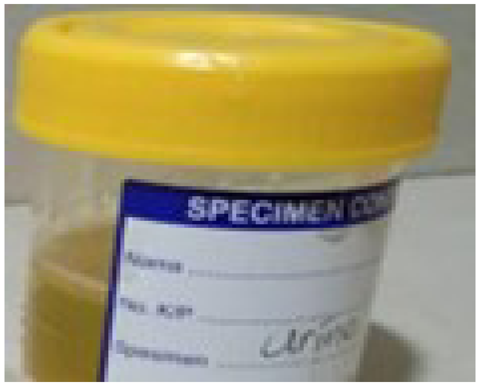

FIGURE 3: Dirty urine taken using camera

items were then tested for face validity among 10 healthy individuals, and the highest mean was used to choose the best image, which supported the majority of respondents agreed on the variable (Field 2013; Marcus-Roberts & Roberts, 1987). Out of 10 pictures, 5 pictures were chosen by healthy respondents that clearly showed. The picture with the lowest mean was omitted as it did not accurately represent the construct fear of contamination and disgust. 16 new pictures were added following the suggestion from the respondents that could represent a measure of the fear of contamination and disgust. A total of 21 photos were divided into two categories, namely domain contamination (13 photos), and disgust (8 photos), then submitted to the content expert.

(ii) Phase 2: Content Validity for Selection of Pictures

Six professionals, including one clinical psychologist and five psychiatrists (Table 1), consented to take part in confirming the test's content (Lynn 1986). The relevance of the image in determining contamination

TABLE 1: Demographics for 6 expert in phases 1 and 2

Variable	Description
Age (range)	30-60 years old
Gender	
Female	4
Male	2
Designation	
Psychiatrist	5
Psychologist	1

or disgust, clarification of the instruction and the image (Yaghmaie 2003), and the possibility of a side effect as a result of exposure to the image were the questions rated by the experts. According to each item's relevance, clarity, and adverse effect, experts are asked to assign a score using a Google Form. Two types of content validity index (CVI) were calculated in order to determine the content validity of a questionnaire: CVI for items (I-CVI) and CVI for scales (S-CVI). S-CVI were calculated by averaging the I-CVI scores for all of the scale's items (S-CVI/Ave) and the percentage of items that all experts rated as relevant on a scale of 3 or 4 based on the universal agreement method (S-CVI/UA) (Almanasreh et al. 2019; Polit et al. 2007).

According to Table 2, out of 21 pictures, 5 images of contamination and 4 images of disgust had high CVI individual relevance values of over 0.83 (Lynn 1986; Polit & Beck 2006). Toilet (pictures 1 and 4) and hair on food (pictures 6), a mouse (picture 8) and a big syringe containing blood (picture 11) had been identified as pertinent images in the contamination domain: Similarly, toilet (pictures 1 and 4,) crumpled hair in the food (picture 6) and mice (pictures 7 and 8) were classified as important images in the disgust domain. This implied that the image served as a suitable unit of measurement for contamination and disgust. The domain contamination for the average CVI and S-CVI/UA values were 0.32 and 0.51, respectively, which indicated that the images needed to be changed and improved in the second content validity as well as posed negative side effects evaluated by the expert. The average CVI and S-CVI/UA values for the disgust domain indicated high values that suggested good agreement between experts connected to pictures that can measure disgust. In a similar vein, every expert said that the four disgusting and the five contaminated photos had appropriate CVI values that showed no negative effects and could be seen by participants.

- Content validity

After review and refining, a few photos were shot again with cameras that were just as vivid as the ones used for the first validation. Picture that had high side effect (big syringe with blood) was removed. 4 pictures (mouse and toilet), 2 pictures from disgust, and 2 from contamination were retained, and 6 new pictures represented cultural aspects were submitted for evaluation by the same expert. The result of CVI and S-CVI/UA values for second content validity were 0.92 and 0.93 were within satisfactory level stated in Table 3 (Yusoff 2019).

- Computerised contamination and disgust test

This study used the free, open-source psychology experiment building language (PEBL) software, which enabled researchers

TABLE 2: First content validity

Domain	Measured item	Picture no	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Experts in agreement	CVI	UA	S-CVI	S-CVI /UA
Contamination	Relevancy	Picture 1 (Dirty toilet)	1	1	0	1	1	1	5	0.83	0.83	0.32	0.51
		Picture 2 (Washing dirty toilet)	0	0	0	0	0	0	0	0	0		
		Picture 3 (Dirty toilet	0	0	0	0	0	0	0	0	0		
		Picture 4 (Dirty toilet)	1	1	1	1	1	0	5	0.83	0.83		
		Picture 5 (Crumpled hair in cake)	0	0	0	0	0	0	0	0	0		
		Picture 6 (Crumpled hair in food)	1	1	1	1	1	1	6	1	1		
		Picture 7 (Mouse in dirt restaurant)	0	0	0	0	0	0	0	0	0		
		Picture 8 (Mouse eating human food)	1	1	1	1	1	1	6	1	1		
		Picture 9 (Tissue in the toilet bowl)	1	1	0	0	1	1	4	0.67	0.67		
		Picture 10 (Urine in the toilet bowl)	0	0	1	1	0	0	2	0.33	0.33		
		Picture 11 (Big syringe and blood)	1	1	1	0	1	1	5	0.83	0.83		
		Picture 12 (Urine specimen for analysis)	0	1	0	0	0	0	1	0.17	0.17		
		Picture 13 (Biohazard dustbin)	1	0	0	0	0	0	1	0.17	0.17		

continued...

...continuing

Disgust	Relevancy	Picture 1 (Dirty toilet)	1	1	1	1	1	1	6	1	1	0.83	0.58
		Picture 2 (Washing dirty toilet)	0.5	0.5	1	0.75	0.5	0.75	1	0.67	0.17		
		Picture 3 (Dirty toilet	0.5	0.75	1	0.75	0.75	0.75	1	0.75	0.17		
		Picture 4 (Dirty toilet)	1	1	1	1	1	0	5	0.83	0.83		
		Picture 5 (Crumpled hair in cake)	0.25	0.25	0.75	0.5	0.5	0.75	0	0.5	0		
		Picture 6 (Crumpled hair in food)	1	1	1	1	1	1	6	1	1		
		Picture 7 (Mouse in dirt restaurant)	1	1	0.5	0.5	1	1	4	0.83	0.67		
		Picture 8 (Mouse eating human food)	1	1	1	0.75	1	1	5	0.96	0.83		

and therapists to construct, run and trade behavioural tests (Mueller & Piper 2014). Using this program it had the following benefit: PEBL 0.13 supported a variety of stimulus types, including images (in a variety of image formats), text rendered in TrueType fonts using single-line stimuli and multi-line text objects, numerous rendered shape primitives (lines, circles, rectangles, etc.), audio recordings, video recordings, and straightforward generated sounds that make it simpler for a researcher to tailor their test (Mueller 2012b; Mueller & Piper, 2014). 10 pictures with (5 domains of contamination and 5 domains of disgust) had been verified, and it was installed in the PEBL software. The syntax and experiment were followed based on the description by Muller in his manual and paper (Mueller 2010; Mueller 2012a). 4-point Likert scale with four response options, respondents may indicate how much they agreed or disagreed with the statement that they were disgusted by the image or that they were afraid of becoming contaminated with an image (Bishop & Herron 2015; Sullivan & Artino 2013). Prior to conducting the full study, we also tested the face validity of the CCDQ using a computer among 30 participants. The results showed a Cronbach alpha of 0.90, indicating that the CCDQ test was simple to use and that the instructions were clear and simple to answer on the computer.

(iii) Phase 3: Full Study

The full study was conducted using a cross-sectional design, employed convenience sampling, and recruited community respondents living in Klang Valley, who were willing to participate in the study. Each participant needed to be

TABLE 3: Second content validity

Domain	Measured item	Picture no	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Experts in agreement	CVI	UA	S-CVI	UA-CVI
Contamination	Relevancy	Picture 1 (Dirty toilet)	1	1	0.75	1	1	1	5	0.83	0.83	0.92	0.67
		Picture 3 (mouse eating food)	1	1	1	1	1	1	6	1	1		
		Picture 2 (Dirty toilet)	0.8	1	1	0.8	1	1	4	0.93	0.67		
		Picture 4 (urine specimen for analysis)	1	1	0.8	0.8	1	1	4	0.93	0.67		
		Picture 5 (crumpled hair on the rice)	1	1	0.6	0.8	1	1	4	0.9	0.67		
Disgust	Relevancy	Picture 6 (dirty toilet)	1	1	1	1	1	1	1	1	1	0.93	0.78
		Picture 8 (mouse eating human food)	1	1	1	0.75	1	1	5	0.96	0.83		
		Picture 7 (dirtiness in toilet)	1	1	1	0.8	1	1	5	0.97	0.83		
		Picture 9 (urine) specimen for analysis)	0.6	0.8	1	1	1	1	4	0.9	0.67		
		Picture 10 (crumpled hair on rice)	0.8	1	1	1	1	1	5	0.97	0.83		

aged from 16 to 60 years old, and able to use a computer well. A participant was excluded if they were far-sighted or had eye problems, or refused to participate in the test. Once the subject gave their agreement to take part in the study, they were asked to complete a computer-based questionnaire. The University Kembangan Malaysia Human Research Ethics Committee gave its approval to this study (Ethics Committee/Irb Reference Number: UKM PPI/111/8/JEP-2020-395).

Statistical Analysis

Software SPSS statistics version 25 was used for the analyses (IBM 2017; Mehta & Patel 2011). When the distribution of the data was examined, a normal distribution was found. Data that could be categorised were expressed as frequency (n) and percentage (%). Data that were regularly distributed were described using the mean and standard deviation (SD). Exploratory Factor Analysis (EFA) was carried out for validity analysis using orthogonal (varimax) rotation. The Kaiser rule (Eigenvalue >1.0) was used to define the number of dimensions to extract, and the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were used to determine sample adequacy. The inter-item relationships between the domains and the entire Computerised Contamination and Disgust questionnaire were examined using Pearson correlation. Cronbach's alpha test for internal consistency was used to conduct a reliability investigation. The cutoff for statistical significance was $p<0.05$.

RESULT

Demographic Data

Table 4 showed the demographic data, including the subjects' age, gender, and ethnicity. A total of 86% of the 224 participants are of Malay ethnicity, followed by Chinese (5.75%), Indians (4.86%), and other individuals (3.53%). 26% of respondents were male, with a mean age of 32 and the majority being female.

TABLE 4: Demographic characteristics

	Mean (SD)	N (%)
Age (years)	32 (13)	
Gender		
Male		59 (27.0)
Female		167 (73.0)
Ethnic		
Malay		194 (86)
Indian		11 (4.9)
Chinese		13 (5.8)
Others		8 (3.5)

Explanatory Factor Analysis

The exploratory factor analysis (EFA) was analysis using SPSS 24 (IBM., 2017). Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity results of 0.712 (with a significance level of Bartlett's of <0.001, df=45) from 102 participants showed that the sample size utilised for the analysis was adequate. Studies showed that values on the KMO scale must be at least 0.5 in order to be considered mediocre; between 0.7 and 0.8 was good; and above 0.9 was excellent (Costello & Osborne 2005; Hair 2009; Kaiser 1974). Three components were finally selected because they exceeded the eigenvalue of 1.0 on the scree plot, which decreased below 1.0 (Figure 4). Similar to this, parallel analysis had confirmed the existence of three domains that were evident in the rotated component matrix (Hayton et al. 2004), as shown in Table 5.

Items with low loadings (below 0.4) should be eliminated to enable dimension reduction and hence increased the stability of the objects. Each item should have a loading of at least 0.4 (moderate), with loadings of near 1.0 being recommended on EFA analysis (Costello & Osborne 2005; Tabachnick et al. 2013). Based on Table 5, factor loading for each domain ranged from 0.68 to 0.8 (human use), 0.76 to 0.8 (toilet), and 0.9 for both Animal domains. This high factor loading suggested a good correlation between the factor and items (Finch 2006).

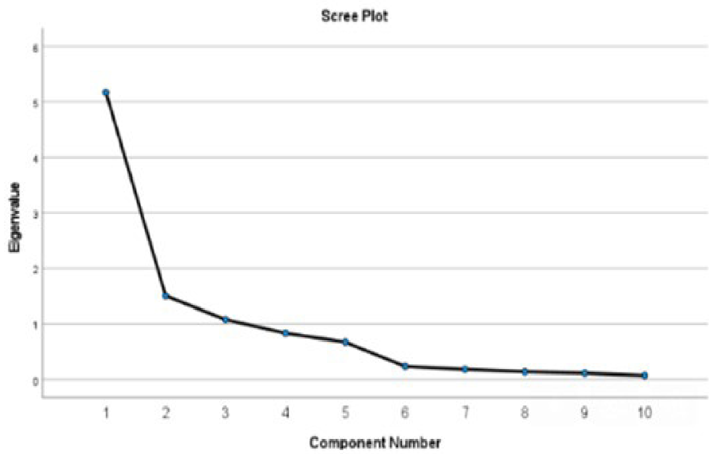

FIGURE 4: Scree plot CCDQ

TABLE 5: Exploratory Factor Analysis (EFA) CCDQ

ID	Component	Item number and content	Factor loading 1	Factor loading 2	Factor loading 3	Corrected Item-Total Correlation
1	Human use	Picture 4 (Contamination)	0.878			0.868
		Picture 9 (Disgust)	0.873			0.876
		Picture 10 (Disgust)	0.773			0.865
		Picture 5 (Contamination)	0.685			0.871
2	Toilet	Picture 6 (Disgust)		0.803		0.869
		Picture 1 (Contamination)		0.798		0.871
		Picture 7 (Disgust)		0.765		0.869
		Picture 2 (Contamination)		0.763		0.878
3	Animal	Picture 3 (Contamination)			0.932	0.885
		Picture 8 (Disgust)			0.923	0.883

Confirmatory Factor Analysis

Using IBM SPSS AMOS, the Confirmatory Factor Analysis (CFA) was performed with 122 data. CFA is a frequent analytical method of choice for designing and improving measuring tools, determining method effects, testing construct validity, and examining factor invariance through time and groups (Brown 2015; Jackson et al. 2009). Research also can identify the discriminant and convergent validity by applying confirmatory analysis. Convergent validity may be assessed by looking at the loadings of each instrument onto its appropriate trait factor, while discriminant validity can be calculated by looking at the correlations between the trait factors (Cole 1987).

According to Barrett (2007), in order for the model to fit the result of RMSEA 0.10, TLI > 0.9, and CFI > 0.9. Four attempts had been made to model fit with a satisfactory result, employing modification indices to find significant associated residual error components, as shown in Table 6.

The first model measurement measured 4 items in the human use latent construct, 4 items in the toilet latent construct, and 2 items in the mouse latent construct, all of which showed poor model fit. Using the Pooled-CFA, analysis had been conducted by pooling redundant items with high modification indices (MI) values, and removing items that had low factor loading induced goodness of fit indices (Awang 2015). The model was now suitable, as indicated in Table 6, by eliminating Pictures 10, 6, and 5. Based on Figure 5, the Malay computerised contamination scale consists of 7 items with the model fit (RMSEA 0.04, TLI 0.9 and CFI 0.97)

Construct Validity

The CFA illustrated the convergence and discriminator features between the constructs using the AVE and CR values (Mahmood et al. 2018). Using CFA, a measurement model's convergence and divergence validity were examined. The new scale's convergent validity assesses how well it correlates with other variables and measures of the same construct (Cheung et al. 2023). Fornell and Larcker (1981) suggested that a satisfactory value for composite reliability (CR) was 0.60 or more and average variance extracted, where the AVE value >0.5. Meanwhile later in 1997, Hair recommended the CR threshold value should be more than 0.70 to validate the good CR. High CR indicated that all items were constantly measured in the same construct. 7 items in the Malay contamination computerised test yielded a CR threshold value of 0.948

TABLE 6: Goodness-of-fit statistics CCDQ

x^2	Df	x^2/df	p <	Measures of Fit			
				RMSEA	TLI	CFI	GFI
Model 1	34	257.565	<0.001	0.231	0.628	0.719	0.759
Model 2	30	116.039	<0.001	0.153	0.838	0.892	0.853
Model 3	16	40.29	<0.001	0.111	0.988	0.973	0.994
Model 4	10	12.541	<0.001	0.045	0.988	0.994	0.973

and an AVE value of 0.723, suggesting high internal consistency reliability (Table 7) (Hair 2009).

Reliability

Based on Table 8, the Cronbach alpha values indicated that internal consistency was acceptable for with a total coefficient of 0.85 (Kaiser & Norman 1991). Animals (2 items) were the first component's coefficient, which was 0.920. Toilet (3 items) came in second with a value of 0.765. The correlation for the two items related to human use was 0.875.

DISCUSSION

The present study was designed to develop a novel design for a computerised for use in testing fear of CCDQ and its psychometric properties. The weight of using the technology as a medium of assessment is higher than traditional paper and pencil. Despite this assessment, the use of paper and pencil assessment and clinical methods see greater use than computerised methods. It takes more work to develop an effective computer program or assessment than to simply type text from a manual, existing questionnaire, literature, or therapy session into a computer (Marks et al. 1998; Proudfoot et al. 2003). This new automated questionnaire was meticulously and arduously designed and required a standardised and tactual step-by-step procedure to ensure that the computerised questionnaire was suitable to be used to accurately assess the intended construct (Boateng et al. 2018; Gehlbach & Artino 2018; Gehlbach & Brinkworth 2011). When extensive computer configuration and programming are involved, producing tests for computers is more expensive and requires multidisciplinary teamwork,

TABLE 7: Convergent validity for CCDQ (7 items)

	Factor loading	SMC	1-SMC	CR	AVE
Picture 1 (contamination)	0.878	0.771	0.229	0.948	0.723
Picture 2 (contamination)	0.873	0.762	0.238		
Picture 3(contamination)	0.798	0.637	0.363		
Picture 4 (contamination)	0.765	0.585	0.415		
Picture 9 (disgust)	0.763	0.582	0.418		
Picture 7 (disgust)	0.932	0.869	0.131		
Picture 8 (disgust)	0.923	0.852	0.148		

TABLE 8: Reliability result for all 3 components in CCDQ

Items	Reliability, α
Animal	0.920
Toilet	0.765
Human waste	0.875
Total Score	0.853

which takes more time and money (Cresswell et al. 2012). The design of this questionnaire was made simpler by the usage of PEBL software as opposed to other freely accessible options, which allows researchers to create their own experiments or utilise pre-built ones, is versatile, and requires less hardware or operating system (Mueller & Pipe 2014).

The most important relevant finding is that the new design questionnaire presented adequate psychometric proprieties. The right item and appropriate content picture were selected, as verified by experts with scores above 0.90, to detect relevancy, clarification, and the side effects of the questionnaire. This content validity is the first step in designing a questionnaire. Evidence of the content validity of this assessment tool shows how closely its constituent parts relate to and represent the targeted construct for a specific assessment purpose and address the topic for the intended audience (Almanasreh et al. 2019; Haynes et al. 1995). This study also found that three domains with seven items were found as a consequence of exploratory factor analyses, which were used to find common factors or dimensions that could explain the order and structure among measured variables (Tucker & MacCallum 1997; Watkins 2018). To verify and effectively construct the fitness index of the model, a few attempts have been conducted by deleting one item that conveys the low factor loading, and employing the Pooled-CFA analysis with factor loadings with more than 0.6 (Awang 2015); this confirmed highly convergent results supporting 3 factors (Carlson & Herdman 2012). This multidimensional factor also has good internal consistency ranging from 0.70-0.90, suggesting that this test is reliable (Tavakol & Dennick 2011) to use in the assessment of fear of contamination and disgust. Overall, this is the first development and validation study of a CCDQ, which demonstrates good psychometric proprieties. One unanticipated finding was that people's fear of being contaminated can also elicit feelings of disgust for the same content or picture, suggesting a relationship between the emotion of disgust and the fear of contamination. Typically, disgust can be measured using a specific disgust scale (Olatunji et al. 2007) that lacks information about contamination that can be addressed by this automated questionnaire. Researchers have discovered that people with high contamination fears performed much better on all disgust categories than people with low contamination fears (Olatunji et al. 2004). The categories of disgust that predicted contamination concern appear to have an underlying similarity of the possibility of contagion (Olatunji et al. 2004), as demonstrated by picture material that featured rodents eating food, dirtiness in toilets, and other similar situations. It has been discovered that heightened sensitivity to disgust and greater anxiety about contamination are found in a variety of diseases, including OCD and phobias (Olatunji et al. 2004), leading to a call for an effective strategy to address both disgust and contamination.

Given that this computerised questionnaire was created and evaluated within the Malaysian context, it can be regarded as the first tool for assessing fear of contamination and disgust among Malaysians. Notwithstanding this advantage, a possible drawback is that because the study was carried out in healthy populations, the results cannot be generalised to clinical groups. To enable the measure to aid in the detection of disease and to compare it with other reliable diagnostic interviews, particularly with OCD disorders, more future research was recommended, with a stronger emphasis on different clinical groups (Ismail et al. 2023). A further drawback of this research is its small sample size, which may lead to poor statistical power and make it challenging to draw population-wide conclusions. Further research is required to ascertain the stability of this computerised questionnaire's internal consistency and the degree of correlation between it and other questionnaires that can assess construct validity and test-retest reliability (Weir 2005; Westen & Rosenthal 2003). Further study should also be conducted to examine the concurrent validity of the CCDQ. A suitable goal-standard questionnaire and appropriate measures are needed to test concurrent validity with the CCDQ, which can provide information about whether it can be used to predict other outcomes and interventions (Taherdoost 2016).

CONCLUSION

This study aimed to use computerised methods to assess OCD in healthy adults. The CCDQ software has been shown to have good psychometric properties for measuring fear of contamination and disgust. This computerised questionnaire method is easy to administer and assist clinicians in screening for fear of contamination and disgust, together with the OCD questionnaire, and designing effective interventions.

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REFERENCES

Almanasreh, E., Moles, R., Chen, T.F. 2019. Evaluation of methods used for estimating content validity. *Res Social Adm Pharm* **15**(2): 214-21.

Awang, Z. 2015. *SEM made simple: A gentle approach to learning Structural Equation Modeling*: MPWS Rich Publication, Bangi.

Baharim, N.S., Sharip, S., Sarnin, E.F., Mahady, Z.A., Sharip, Z. 2022. Virtual reality assessment for obsessive compulsive disorder: A review. *Med & Health* **17**(2): 15-35.

Barrett, P. 2007. Structural equation modelling: Adjudging model fit. *Pers Indiv Differ* **42**(5): 815-24.

Bhikram, T., Abi-Jaoude, E., & Sandor, P. 2017. OCD: obsessive-compulsive … disgust? The role of disgust in obsessive-compulsive disorder. *J Psychiatr Neurosci* **42**(5): 300-6.

Bishop, P.A., Herron, R.L. 2015. Use and misuse of the likert item responses and other ordinal measures. *Int J Exercise Science* **8(**3): 297-302.

Boateng, G.O., Neilands, T.B., Frongillo, E.A., Melgar-Quiñonez, H.R., Young, S.L. 2018. Best practices for developing and validating scales for health, social, and behavioral research: A primer. *Front Public Health* **6:** 149.

Brown, T.A. 2015. *Confirmatory factor analysis for applied research*: Guilford publications.

Carlson, K.D., Herdman, A.O. 2012. Understanding the impact of convergent validity on research results. *Organ Res Methods* **15**(1): 17-32.

Çelik, S., Oğuz, M., Konur, U., Köktürk, F., Atasoy, N. 2021. Comparison of computerized and manual versions of the Wisconsin Card Sorting Test on schizophrenia and healthy samples. *Psychol Assess* **33**(6): 562.

Cheung, G.W., Cooper-Thomas, H.D., Lau, R.S., Wang, L.C. 2023. Reporting reliability, convergent and discriminant validity with structural equation modeling: A review and

best-practice recommendations. *Asia Pac J Manag* **41**: 745-83.
Cole, D.A. 1987. Utility of confirmatory factor analysis in test validation research. *J Consult Clin Psychol* **55**(4): 584.
Costello, A.B., Osborne, J. 2005. Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Pract Assess Res Eval* **10**(1): 7.
Cresswell, K., Majeed, A., Bates, D.W., Sheikh, A. 2012. Computerised decision support systems for healthcare professionals: an interpretative review. *Inform Prim Care* **20**(2): 115-28.
Das, A.K. 2002. Computers in psychiatry: A review of past programs and an analysis of historical trends. *Psychiatr Q* **73**: 351-65.
Davison, B., Liddle, R., Fitz, J., Singh, G.R. 2020. Computerised emotional well-being and substance use questionnaires in young Indigenous and non-Indigenous Australian adults. *SAGE Open Med* **8**: 2050312120906042.
Dawes, R.M., Faust, D., Meehl, P.E. 1989. Clinical versus actuarial judgment. *Science* **243**(4899): 1668-74.
Edwards, P. 2010. Questionnaires in clinical trials: Guidelines for optimal design and administration. *Trials* **11**: 2.
Elwood, L.S., Olatunji, B.O. 2009. *A cross-cultural perspective on disgust*: American Psychological Association.
Feldstein, S.N., Keller, F.R., Portman, R.E., Durham, R.L., Klebe, K.J., Davis, H.P. 1999. A comparison of computerized and standard versions of the Wisconsin Card Sorting Test. *Clin Neuropsychol* **13**(3): 303-13.
Field, A. 2013. *Discovering statistics using IBM SPSS statistics*: Sage.
Finch, H. 2006. Comparison of the performance of varimax and promax rotations: Factor structure recovery for dichotomous items. *J Educ Meas* **43**(1): 39-52.
Floyd, F.J., Widaman, K.F. 1995. Factor analysis in the development and refinement of clinical assessment instruments. *Psychol Assess* **7**(3): 286.
Fornell, C., Larcker, D.F. 1981. Evaluating structural equation models with unobservable variables and measurement error. *J Mark Res* **18**(1): 39-50.
Gehlbach, H., Artino, A.R., Jr. 2018. The Survey Checklist (Manifesto). *Acad Med* **93**(3): 360-6.
Gehlbach, H., Brinkworth, M.E. 2011. Measure twice, cut down error: A process for enhancing the validity of survey scales. *Rev Gen Psychol* **15**(4): 380-7.
Gopika, J.S., Rekha, R.V. 2023. Awareness and use of digital learning before and during COVID-19. *Int J Edu Reform* 105678792311733.
Grove, W.M., Meehl, P.E. 1996. Comparative efficiency of informal (subjective, impressionistic) and formal (mechanical, algorithmic) prediction procedures: The clinical-statistical controversy. *Psychol Public Policy Law* **2**(2): 293.
Hair, J.F. 2009. Multivariate data analysis. 7th Edition, Prentice Hall, Upper Saddle River; 761.
Haynes, S.N., Richard, D.C.S., Kubany, E.S. 1995. Content validity in psychological assessment: A functional approach to concepts and methods. *Psychol Assess* **7**(3): 238-47.
Hayton, J.C., Allen, D.G., Scarpello, V. 2004. Factor retention decisions in exploratory factor analysis: A tutorial on parallel analysis. *Organ Res Methods* **7(**2): 191-205.
Heritage Pest Control 2020. Keeping rodents out of your new jersey restaurant. https://www.heritagepestcontrolnj.com/blog/post/keeping-rodents-out-of-your-new-jerseyrestaurant [31 July 2023].
IBM. 2017. *IBM SPSS statistics for windows*. In: IBM corp Armonk, New York.
Inozu, M., Celikcan, U., Akin, B., Cicek, N.M. 2020. The use of virtual reality (VR) exposure for reducing contamination fear and disgust: Can VR be an effective alternative exposure technique to in vivo? *J Obsessive Compuls Relat Disord* **25**(2020): 100518.
Ismail, K., Azil, A., Ahmad, N., Sharip, S. 2023. Validation of a specific phobia questionnaire by university students in Malaysia. *Med & Health* **18*:*** 32-45.
Jackson, D.L., Gillaspy Jr, J.A., Purc-Stephenson, R. 2009. Reporting practices in confirmatory factor analysis: An overview and some recommendations. *Psychol Methods* **14**(1): 6.
Kaiser, H.F. 1974. An index of factorial simplicity. *Psychometrika* **39**(1): 31-6.
Kaiser, H.F., Norman, W.T. 1991. Coefficients alpha for components. *Psychol Rep* **69**(1): 111-4.
Lavrakas, P.J. 2008. *Encyclopedia of survey research methods*: Sage publications.
Leung, S.F., French, P., Chui, C., Arthur, D. 2007. Computerized mental health assessment in integrative health clinics: A cross-sectional study using a structured interview. *Int J Ment Health Nurs* **16**(6): 441-6.
Lynn, M.R. 1986. Determination and quantification of content validity. *Nurs Res* **35**(6): 382-6.
Mahmood, M.I., Shah, S.A., Ahmad, N., Rosli, N.M. 2018. Cancer screening perception scale: development and construct validation. *J Cancer Educ* **33**: 269-77.
Marcus-Roberts, H.M., Roberts, F.S. 1987. Meaningless statistics. *J Educ Stat* **12**(4): 383-94.
Marks, I., Shaw, S., Parkin, R. 1998. Computer-aided treatments of mental health problems. *Clin Psychol* **5**(2): 151-70.
Meehl, P.E.1967. What can the clinician do well.

In *Problems in human assessment.* Edited by Douglas NJ, Samuel M. New York: McGraw-Hill; 594-9.

Mehta, C.R., Patel, N.R. 2011. IBM SPSS exact tests. Armonk, NY: IBM Corporation, 23, 24.

Moeini, S., Watzlaf, V., Zhou, L., Abernathy, R.P. 2021. Development of a weighted well-being assessment mobile app for trauma affected communities: A usability study. *Perspect Health Inf Manag* **18**(Winter), 1o.

Mueller, S.T. 2010. *The PEBL manual*: Lulu. com. [17 November 2023].

Mueller, S.T. 2012a. Developing open source tests for psychology and neuroscience. In: Dec. [17 November 2023].

Mueller, S.T. 2012b. The psychology experiment building language, Version 0.13. Retrieved from http://pebl. sourceforge. net [17 November 2023].

Mueller, S.T., Piper, B.J. 2014. The psychology experiment building language (PEBL) and PEBL test battery. *J Neurosci Meth* **222:** 250-9.

Olatunji, B.O., Sawchuk, C.N., Lohr, J.M., de Jong, P.J. 2004. Disgust domains in the prediction of contamination fear. *Behav Res Ther* **42**(1): 93-104.

Olatunji, B.O., Williams, N.L., Tolin, D.F., Abramowitz, J.S., Sawchuk, C.N., Lohr, J.M., Elwood, L.S. 2007. The disgust scale: Item analysis, factor structure, and suggestions for refinement. *Psychol Assess* **19**(3): 281.

Polit, D.F., Beck, C.T. 2006. The content validity index: are you sure you know what's being reported? Critique and recommendations. *Res Nurs Health* **29**(5): 489-97.

Polit, D.F., Beck, C.T., Owen, S.V. 2007. Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. *Res Nurs Health* **30**(4): 459-67.

Proudfoot, J., Swain, S., Widmer, S., Watkins, E., Goldberg, D., Marks, I., Gray, J.A. 2003. The development and beta-test of a computer-therapy program for anxiety and depression: Hurdles and lessons. *Comput Hum Behav* **19**(3): 277-89.

Rachman, S. 2004. Fear of contamination. *Behav Res Ther* **42**(11): 1227-55.

Roca-Bennasar, M., Garcia-Mas, A., Llaneras, N., Blat, J., Roca, P. 1991. Kraepelin: An expert system for the diagnosis of obsessive-compulsive disorders. *Eur Psychiatry* **6**(4): 171-5.

Rosenfeld, R., Dar, R., Anderson, D., Kobak, K.A., Greist, J.H. 1992. A computer-administered version of the Yale-Brown Obsessive-Compulsive Scale. *Psychol Assess* **4**(3): 329.

Skolnick, A.J., Dzokoto, V.A. 2013. Disgust and contamination: A cross-national comparison of ghana and the United States. *Front Psychol* **4**: 91.

Sullivan, G.M., Artino, A.R., Jr. 2013. Analyzing and interpreting data from likert-type scales. *J Grad Med Educ* **5**(4): 541-2.

Tabachnick, B.G., Fidell, L.S., Ullman, J.B. 2013. *Using multivariate statistics. Volume 6.* Pearson Boston, MA.

Taherdoost, H. 2016. Validity and reliability of the research instrument; How to test the validation of a qu*estionnaire/survey in a research (August 10, 2016).* https://ssrn.com/abstract=3205040 [17 October 2023].

Tavakol, M., Dennick, R. 2011. Making sense of Cronbach's alpha. *Int J Med Educ* **2**: 53.

Tavakol, M., Wetzel, A. 2020. Factor Analysis: A means for theory and instrument development in support of construct validity. *Int J Med Educ* 11: 245.

Tucker, L.R., MacCallum, R.C. 1997. Exploratory factor analysis. *Unpublished manuscript, Ohio State University, Columbus*, 1-459.

Van Bennekom, M.J., De Koning, P.P., Gevonden, M.J., Kasanmoentalib, M.S., Denys, D. 2021. A virtual reality game to assess OCD symptoms. *Front Psychiatry* **11***:* 550165.

Watkins, M.W. 2018. Exploratory Ffactor analysis: A guide to best practice. *J Black Psychol* **44**(3): 219-46.

Weir, J.P. 2005. Quantifying test-retest reliability using the intraclass correlation coefficient and the SEM. *J Strength Cond Res* **19**(1): 231-40.

Westen, D., Rosenthal, R. 2003. Quantifying construct validity: Two simple measures. *J Pers Soc Psychol* **84**(3): 608.

Williams, M.T., Chapman, L.K., Simms, J.V., Tellawi, G. 2017. Cross-Cultural phenomenology of obsessive-compulsive disorder. In *The Wiley handbook of obsessive compulsive disorders.* Edited by Abramowitz JS, McKay D, Storch EA. Wiley Blackewell; 56-74.

Yaghmaie, F. 2003. Content validity and its estimation. *J Med Educ* **3**(1): e105015.

Yusoff, M.S.B. 2019. ABC of content validation and content validity index calculation. *Educ Med J* **11**(2): 49-54.