Longitudinal Investigation of the Stable and Dynamic Components of the World Health Organisation Quality of Life Measure Using Generalisability Theory

A research project presented to

Auckland University of Technology

School of Public Health and Psychosocial Studies

In partial fulfillment of the requirements for the degree of Masters

of Health Science in Counseling Psychology

By

Phoenix Norden

2020

Abstract

The abbreviated version of the World Health Organisation Quality of Life questionnaire (WHOQOL-BREF) is a widely used 26-item self-report measure of an individual's subjective Quality of Life (QOL). However, this scale has not been examined using appropriate methods to distinguish between dynamic (state) and stable (trait) aspects of QOL. Generalisability Theory is the most suitable method to differentiate between state or trait aspects and to evaluate the overall reliability and generalisability of psychometric measurement tools. For the current study we will apply Generalisability theory to the WHOQOL-BREF and its four individual domains as well as the two shorter versions, the WHOQOL-5 and WHOQOL-8. A longitudinal design was used with 130 medical students who completed the 26-item WHOQOL-BREF at three time points. Generalisability theory was applied to estimate state and trait components and to examine potential sources of measurement error within the WHOQOL-BREF. The results from this study provide evaluation of the temporal reliability and generalisability of the WHOQOL-BREF and distinguish between stable and dynamic aspects at the scale, subscales and individual item levels. The results from the study indicate that the WHOQOL-BREF single summary score is the most reliable across time as demonstrated with a generalisability coefficient of 0.90. All four domain subscales and both short versions were found to have less acceptable temporal stability, which was reflected by generalisability coefficients ranging from 0.48 to 0.77 for the domain subscales; and 0.47 and 0.52 for the WHOQOL-5 and WHOQOL-8, respectively. The ability to distinguish to what extent items of each subscale of QOL are measuring state or trait will advance knowledge about which QOL aspects are likely to change in one's subjective QOL. The results of this study have distinguished between state and trait components of the WHOQOL-BREF at item level. For example, item 18 (How satisfied are you with your capacity for work?) resulted in a state component index (SCI) value of 0.85 indicating that this item is acting in a state-like manner and could potentially be easily influenced by intervention. In contrast, item 15 (How well are you able to get around?) resulted in a SCI value of 0.23, which means that this item is acting in a trait like manner and therefore would be more resistant to change over time. The potential implications of this study include information about areas where target interventions are likely to have the most impact, and which aspects of QOL are likely to undergo relatively minimal change.

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Attestation of Authorship

I, Phoenix Norden, hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Signed: Phoenix Norden Dated: 8 November 2019

Acknowledgements

I would like to thank the following people:

- My supervisor, Chris Krägeloh, for his many years of ongoing teaching and support, also for this great opportunity to work together again.
- My secondary supervisor, Oleg Medvedev, also for his many years of ongoing teaching and support especially regarding statistical analysis.
- Mataroria Lyndon and Marcus Henning, for their generous allocation of the data set used in the current study and for the opportunity to work together on a journal article.
- My grandparents, for their unconditional love and positive regard, support and belief in me.
- My partner, Jonny, for his ongoing love, encouragement and support of me as I continue to work towards my goals.

Chapter One: Introduction

Brief overview of the theoretical background underpinning the current study

The pursuit of health research emphasises the need for careful attention being placed on measurement of outcomes in health research such as quality of life measurement, as the purpose for this is to gain accurate information related to certain characteristics of populations and any effects of health interventions. Understanding the attributes of outcome measurement tools is therefore essential. The results obtained from any measurement within research is inclusive of true score and errors all measurements may vary from one and another, and this can be dependent upon numerous conditions of measurement. Based on this view, measurement error is not synonymous with 'mistake' as one would imagine but is instead referring to sources of variance in the data that are not reflecting the true score of the underlying psychological construct to be measured. It is one option to state that error is an inherent part of measurement; it is quite another to quantify the error and then specify which conditions of the measurement and research contribute to that error. If one follows the latter approach, it would result in 'ideal' measurement (Brennan, 2011).

Classical Test Theory had been a foundational aspect of measurement theory for over eight decades. Classical Test Theory treats error variance as a single factor, meaning that any measurement results in an observed score which is equal to the sum of a true score plus error variance (Allen & Yen, 1979). Classical test theory also only considers different aspects of reliability independently such as test-retest, inter-rater or internal consistency (Cronbach's alpha), which is a limitation because it fails to provide an overall, comprehensive estimation of reliability. Not only does it look at aspects of reliability independently, it is also incapable of defining the origin of the error variance, meaning we do not know where the error is coming from, what is causing the error or if the error is even meaningful or not (Cronbach, 1963).

Generalisability theory expands on classical test theory and by its engagement of mixed ANOVA (analysis of variance) it allows us to examine the various sources error variance within a measurement (Bloch & Norman, 2012). What this means is that, instead of having a true score and a broad estimation of "error" as mentioned with classical test

theory, Generalisability theory can be very useful to identify specific sources of error. Generalisability theory breaks down and examines all identifiable error sources inclusive of error from person, error from item, error from occasion, and error from the interactions between person and item, item and occasion, person and occasion and person-item-occasion (Bloch & Norman, 2012). If one can identify the source of the error and assess its relative contribution, it can help us to implement ways to minimise that error.

Another specific advantage of Generalisability theory is that, due to its ability to estimate where the error is coming from it allows us to accurately estimate the variance components reflecting dynamic (state) and stable (trait) features of an overall measure but also of subscales and even at item level (Medvedev et al., 2017). For the purposes of this project, the terms state and trait are used to describe qualities of the global single score, subscales scores and items of the abbreviated version of the World Health Organisation Quality of Life (WHOQOL-BREF) measurement (WHOQOL Group, 1998). Trait in reference to measurement is defined as relatively stable or enduring pattern and state as representative of individuals' unique experience in a given moment, occasion or condition. In terms of G Theory, state can be determined by the interaction between person and occasion (Medvedev et al, 2017). Items from the WHOQOL-BREF may reflect/measure both stable and dynamic aspects of the measurement to varying degrees. Items may be more of a state or more of a trait or a relatively equal combination, meaning that aspects of the measurement that are reflecting more state are dynamic/changeable over time. In contrast to this, aspects of the measurement that are reflecting trait are seen as more longstanding and stable, relatively unchangeable phenomenon. This is reflected in the fact that trait-like items are sluggish to change meaning change over time will take a lot of time and for effort put in, change as a result may seem minimal or there may be no change at all.

History of the development of the WHOQOL

The development of scales and questionnaires to measure quality of life by the World Health Organisation began in the early 1990s. The first measurement developed was the WHOQOL-100, this was developed by the WHOQOL Group in 15 international field centres simultaneously, for the purposes of developing a quality of life measure that would be applicable across cultures (WHOQOL Group, 1994). This development involved the 15 field centres working together to decide upon facets of life that were inherently important

to the assessment of quality of life, operationalising these facets and contributing items to be included within a pilot version of the assessment. The original pilot version had a total of 236 items, and after distributing the pilot version to at least 300 people from varying backgrounds with a range of health problems, 100 items were selected to be included in the resulting WHOQOL-100 measurement. This measurement contains items that reflect 24 facets of life that were universally regarded as important in assessing quality of life by all 15 field centres (WHOQOL Group 1998). The WHOQOL-100 is a reliable and comprehensive assessment tool for the measurement of quality of life, however, it has been criticised for being too lengthy especially in regard to large studies where this may not be the only measurement tool being used (Berwick et al., 1991). Leading to measurement and assessment tools being more likely to be used in studies if they are brief, accurate and it is convenient to do so (Berwick et al. 1991). This feedback led to the development of an abbreviated version known as the WHOQOL-BREF. When conceptualising this idea, the WHOQOL group decided that to maintain comprehensiveness any short version should include one item from each of the 24 facets of the WHOQOL-100. There were certain criteria involved in the selection of items described elsewhere (WHOQOL Group, 1998). This resulted in a 26-item version of the WHOQOL which contained 24 items – one from each facet and two global items, namely those assessing overall quality of life and the other assessing general health (WHOQOL Group, 1998).

Following on from this, even shorter version of the WHOQOL have been developed and so have additional modules for the WHOQOL-BREF. The EUROHIS-QOL 8 (referred to in this paper as the WHOQOL-8) was developed in 2005 purely as an adaptation of the WHOQOL-100 and WHOQOL-BREF (Schmidt, Muhlan & Power, 2005). The WHOQOL-5 was developed in 2010 as a further adaptation of previous quality of life measurements (Geyh et al., 2010)

Literature Review of Recent WHOQOL-BREF Publications

An individual's subjective quality of life has been a topic of interest to researchers and clinicians for many years now. This is most likely due to the importance of quality of life within health research. Hence the creation and validation of a psychometric tool allowing us to measure this construct. The World Health Organisation (WHO) has defined quality of life as "individuals' perception of their position in life in the context of the culture and value

systems in which they live and in relation to their goals, expectations, standards and concerns" (WHOQOL Group, 1998). Quality of life is an extensive construct that is affected in complex ways by several variables such as one's physical and/or psychological state, their personal beliefs, social relationships and their relationship to pertinent aspects of their environment. To date, according to Google Scholar, one of the original WHOQOL-BREF articles (WHOQOL Group, 1998) has been cited 3,494 times since it was first published (according to a search on Google Scholar on 4 November 2019). This demonstrates that it is a highly utilised psychometric tool that is relied upon by many individuals as the gold standard in subjective quality of life measures. This is further substantiated by the fact that to date approximately 26 non-government mental health recovery organisations within New Zealand use this measurement tool with their clients and populations (Rex Billington, Personal Communication, 2019).

There is growing research evidence supporting the use of the WHOQOL-BREF for gauging the subjective quality of life for a wide range of populations including psychological conditions and health-related outcomes. This includes recent research conducted with university students in association with stress and quality of life (Ribeiro et al., 2018; Henning et al., 2019), psychiatric samples (Oliveira, Carvalho & Esteves, 2016), substance use (Muller, Skurtveit & Clausen, 2019), hospitalised trauma patients (Kruithof et al., 2018), and military veterans (Lindsay, Ferrer, Davis & Nichols, 2017) just to name a few examples.

The WHOQOL has been a useful tool in both cross-sectional as well as intervention studies, and the purposes of these studies have generally been to test the effects of health interventions or to identify needs that specific populations and patient groups may have. This is demonstrated by several examples below. Klein and colleagues (2009) used the WHOQOL-BREF and other measures for pre- and post-test evaluations of their ten-week online cognitive behavioural intervention for post-traumatic stress disorder. They reported not finding any differences on the WHOQOL-BREF measurement after implementation of their intervention (Klein et al., 2009).

Another study conducted using WHOLQOL-BREF as an outcome measure only with patients who suffer from major depressive disorder undergoing treatment found that they saw improvement in quality of life during the acute phase only and that quality of life scores

remained low compared to healthy control group even when symptoms of the disorder are in remission (IsHak et al., 2011).

Furthermore, a study conducted by Ramachandra and colleagues (2009) with men and women suffering from cancer using the WHOQOL-BREF measurement as a pre- and post-measure claims to have found statistically significant improvement of quality of life after a brief self-administered psychological intervention. This improvement was very small and there is no explanation of what caused the improvement other than the intervention itself (Ramachandra et al., 2009).

It is evident from the above discussion that the WHOQOL-BREF has been used as a comparative outcome measure to support the use of certain interventions within a range of different presentations. Whilst some are reporting statistically significant improvement, others are reporting no improvement at all, which leads to the questions if we knew more about the tool and how it operates, could interventions be more effective, and findings be better explained.

The present study aims to investigate stable and dynamic components of the measurement WHOQOL-BREF by applying generalisability theory to the WHOQOL-BREF, its two short versions (WHOQOL-5 and WHOQOL-8) and also the four individual domains which will allow us to distinguish between state and trait components of the measurement. This study has been conducted in order to better inform psychological interventions within psychological practice in the context of New Zealand. The hypothesis for this study is that the WHOQOL-BREF is a stable measure of quality of life although it will consist of items that express varying levels of states and trait of quality of life.

Chapter Two: Methods

Participants

The present study included 130 students enrolled in the medical programme, Bachelor of Medicine and Bachelor of Surgery (MBChB) at the University of Auckland. The medical programme consists of six years of undergraduate study, where the first three years focus on mainly theory and content of sciences and the last three years are clinically focused. The sample size (*n*=130) satisfied criteria for a reliability study in research (Shoukri, Asyali, & Donner, 2004) and is adequate for generalisability analysis as G-coefficients are essentially similar to reliability coefficients (Bloch & Norman, 2012). All 130 participants, that provided data at three different time intervals were New Zealand university students who identified as, 77 females (59%) and 53 males (41%). Age ranges from 20-36years old with a mean age of 22.73.

Procedure

Given the cross-sectional nature of this study, where the focus is on the stability of the measurement at set intervals over a specific period of time, no attempt was made to set up a control group. The participants were recruited by means of convenience sampling methods whereby they were asked to participate in their lectures filling out the questionnaire at the beginning of the lecture or during a short recess. Completed questionnaires were returned the filled-out questionnaire either to the researcher or to a lock box in their respective faculty office. Participations were provided with a participant information sheet, and completion of the questionnaire was judged as consent to participate. Three time intervals were chosen to increase the variability of dynamic subjective quality of life, and data were collected across yearly intervals. The students were asked to create a unique ID containing letters and number (e.g., ABC123), which could not be used to identify them but to match the questionnaires completed by the same person on three different occasions.

Ethics approval for this study was obtained from the University of Auckland UAHEPC (Ref 8467) and is part of a larger study involving collaborators of the supervisors of the present practice research project. The results have not been published to date. The results

reported in the present dissertation are currently being prepared for submission as a journal article (Norden, Lyndon, Henning, Krageloh & Medvedev, in preparation).

Measure

The World Health Organisation Quality of Life Question – short version (WHOQOL-BREF) is a 26-item questionnaire that measures subjective quality of life across four domains: physical health (7 items), psychological health (6 items), social relationships (3 items) and environmental health (8 items) and also includes two general questions; one from the overall QOL facets and the other from the general health facet. Each item within this measure is rated on a five-point Likert scale whereby for example, 1 = Very Poor, 2 = Poor 3 = Neither poor nor good, 4 = Good and 5 = Very good. The general questions within the measure are used in order to gauge an overall sense of how one perceives their QOL, and these questions are: a) How would you rate your quality of life. And, b) How satisfied are you with your health. The physical domain has 7 items and includes questions that are related to how one perceives their own physical health for example; a) Do you have enough energy for everyday life. And, b) How well are you able to get around. The psychological health domain has 6 items and encompasses aspects of psychological health as evident in the questioning for example; a) How much do you enjoy life. And, b) How satisfied are you with yourself. The third domain is the social relationships domain and this domain is the smallest of them all with a total of 3 items which are as follows; a) How satisfied are you with your personal relationships; b) How satisfied are you with your sex life; and lastly, c) How satisfied are you with the support you get from your friends. The last domain is the environmental health domain which is interested in the physical environment one navigates on a daily basis. This domain has the highest number of items totalling 8 items and includes questions relating to the individuals home environment for example; a) How healthy is your physical environment. And, b) How satisfied are you with the conditions of your living place. This domain also accesses information around the individuals' public environment examples from the questionnaire include; a) How satisfied are you with your access to health services. And, b) How satisfied are you with your transport. This measure is appropriate for use within this study as is it a comprehensive and well-validated measure. During its development and as it was being normed trials were completed in 20 field centres across 18

different countries resulting in this measure being available worldwide and currently translated into 19 different languages (WHO, 2019).

Data Analyses

IBM Statistics package SPSS 25 (IBM Corp, 2017) was employed for frequency analysis of demographic information, descriptive statistics, and comparison of scores across time points for repeated-measures ANOVA. Generalisability analyses were conducted using EduG 6.1e software (Swiss Society for Research in Education Working Group 2006) by following the guidelines described by Medvedev et al. (2017). Generalisability study (G-study) is an analysis that estimates reliability by producing G-coefficients (G-relative [G_r] and G-absolute [G_a]), and the analysis allows for identification of sources of error variance within the measure. A decision study (D-study) is based on the results from the G-study allowing the researcher to use the G-study information to experiment with designs (for example fixed or random facets) for the purposes of trying to reduce measurement error. Both G-study and D-study use a random effect design: person (P) by item (I) by occasion (O), expressed as P x I x O, where the P and O facets are infinite and the facet I is fixed in this case 26. Person is the object of measurement (differentiation facet) and not a source of error while I and O are instrumentation facets (Cardinet et al., 2010). The effects for all facets are presented by observed scores *X* which are calculated for the G-study (Shavelson et al. 1989) as follows:

$X = \mu$ (grand mean)

$X_p = \mu_p - \mu$ (person effect)

$X_i = \mu_i - \mu$ (item effect)

$X_o = \mu_o - \mu$ (occasion effect)

$X_{pi} = \mu_{pi} - \mu_p - \mu_i + \mu$ (person x item effect)

$X_{po} = \mu_{po} - \mu_p - \mu_o + \mu$ (person x occasion effect)

$X_{io} = \mu_{io} - \mu_i - \mu_o + \mu$ (item x occasion effect)

$X_{pio} = \mu_{pio} - \mu_{pi} - \mu_{po} - \mu_{io} + \mu_p + \mu_i + \mu_o - \mu$ (residual/ person x occasion effect)

Each of the effects has estimated variance components, which were possible sources of error that might have an impact on measurement and were calculated as follows:

Person variance component: $\sigma^2_p = (MS_p - MS_{pi} - MS_{po} + MS_{pio})/n_i n_o$

Item variance component: $\sigma^2_i = (MS_i - MS_{pi} - MS_{io} + MS_{pio})/n_p n_o$

Occasion variance component: $\sigma^2_o = (MS_o - MS_{io} - MS_{po} + MS_{pio})/n_i n_o$

Person x Item variance component: $\sigma_{2pi} = (MS_{pi} - MS_{pio})/n_o$

Person x Occasion variance component: $\sigma^2_{po} = (MS_{po} - MS_{pio})/n_i$

Item x Occasion variance component: $\sigma^2_{io} = (MS_{io} - MS_{pio})/n_p$

Residual or Person x Item x Occasion variance component: $\sigma^2_{pio} = MS_{pio}$; where MS stands for the mean of effect square and n represents facet sample size.

There are two different generalisability coefficients computed by EduG software that estimate reliability: relative G-coefficient (G_r) and absolute G-coefficient (G_a) for the object of measurement (person). G_r explains variance directly related to the object of measurement which may have an influence on a relative measurement (e.g. person x occasion and person x item interactions) (Shavelson et al., 1989):

$$Gr = \frac{\sigma^2_p}{\sigma^2_p + \sigma^2_\delta} \text{ ; here } \sigma^2_\delta = \sigma^2_{po} + \sigma^2_{pi} + \sigma^2_{poi} \text{ is the relative error variance}$$

G_a is computed using an adjustment procedure introduced by Whimbey, Vaughan, and Tatsuoka (1967). It accounts for an absolute error variance ($\sigma^2_\Delta = \sigma^2_o + \sigma^2_i + \sigma^2_{io} + \sigma^2_{po} + \sigma^2_{pi} + \sigma^2_{poi}$) that includes item and occasion interaction which may have an indirect influence an absolute measure (Cardinet et al., 2010):

$$Ga \backsimeq \Phi = \frac{\sigma^2_p}{\sigma^2_p + \sigma^2_\Delta}$$

A state component index (SCI) and trait component index (TCI) were obtained which reflect the proportion of variance attributed to a dynamic (state) and an enduring (trait) component in a measure, respectively (e.g. where σ^2_{po} is the interaction between person

and occasion reflecting an individual state). The formulae used for these estimates were developed by Medvedev et al. (2017):

$$\mathrm{SCI} = \frac{\sigma^2_{\mathrm{po}}}{\sigma^2_{\mathrm{po}} + \sigma^2_{\mathrm{p}}};\ \mathrm{TCI} = \frac{\sigma^2_{\mathrm{p}}}{\sigma^2_{\mathrm{po}} + \sigma^2_{\mathrm{p}}}$$

In the D-study, variance components were obtained for each individual item, and SCI were calculated applying the formula described above. Items which show high SCI (e.g. ≥0.70) are very sensitive to changes over time and can be considered as state items, and items with higher TCI (e.g. ≥0.70) are reflecting enduring aspects (trait).

Chapter Three: Results

Descriptive statistics for the 26-item WHOQOL-BREF, its four internal domains, as well as summary scores for the short versions WHOQOL-5 and WHOQOL-8 are presented in Table 1. Strong internal consistency of the total WHOQOL-BREF at each of the three occasions was reflected by Cronbach's alpha ranging between 0.88 and 0.89. The test-retest reliability scores for Occasion 2 and Occasion 3 (with reference to Occasion 1) were 0.72 and 0.60, respectively, for the complete 26-item WHOQOL-BREF. These reliability values were overall higher than those of both short version (WHOQOL-5 and WHOQOL-8) and the individual domains (Table 1). The mean scores of the WHOQOL-BREF total (e.g. between occasion1 and occasion 2, occasion 2 and occasion 3 and occasion 1 and occasion3), the WHOQOL-8 (e.g. between occasion1 and occasion 2, occasion 2 and occasion 3 and occasion 1 and occasion3) and the individual domains physical (e.g. between occasion1 and occasion 2, occasion 2 and occasion 3 and occasion 1 and occasion3) and psychological (e.g. between occasion1 and occasion 2, occasion 2 and occasion 3 and occasion 1 and occasion3) had increased and were significantly different across occasions. The WHOQOL-5 and the individual domains social and environmental were not significantly different across occasions.

The WHOQOL-Total obtained the highest Cronbach's alpha compared to WHOQOL-5, WHOQOL-8 and the four individual domains. Overall, the WHOQOL-Total, WHOQOL-5, WHOQOL-8 and individual domains showed acceptable internal consistency, most were around 0.70 or very close for example 0.68. An exception was the social domain, which displayed the lowest Cronbach's alpha value of 0.48 at Occasion 2. The test-retest coefficients showed that the WHOQOL-Total, WHOQOL-5, WHOQOL-8 and all individual domains do not have acceptable temporal reliability (acceptable test-retest reliability needs to be <0.80) (Paterson et al., 2017). Skewness and Kurtosis were within the acceptable range of -1.00 to 1.00 (Muthen & Kaplan, 1985) with the exception kurtosis values at Occasion 3 for the physical domain (1.63), psychological domain (1.92), WHOQOL-5 (2.46) and the WHOQOL-8 (1.94).

Table 1. *Means, standard deviation (SD), Cronbach's alpha, test-retest coefficients and skewness and kurtosis values for the 26-item WHOQOL-BREF total, its two short versions WHOQOL-5 and WHOQOL-8 together with the four domain subscales (** $p < 0.01$: * $p < 0.05$).*

Domain/Assessment	Occasion 1	Occasion 2	Occasion 3	P Value
Domain 1: Physical				
Mean (SD)	27.45 (3.43)	27.77 (3.29)	28.47(3.39)	<.001**
Cronbach's alpha	.69	.66	.66	
Test-retest	--	.56**	.35**	
Skewness	-0.08	-0.06	-0.75	
Kurtosis	0.04	-0.53	1.63	
Domain 2: Psychological				
Mean (SD)	22.07(3.28)	22.17(3.42)	21.78(3.36)	.050*
Cronbach's alpha	.74	.79	.76	
Test-retest	--	.66**	.50**	
Skewness	-0.35	-0.24	-0.84	
Kurtosis	-0.27	-0.11	1.92	
Domain 3: Social				
Mean (SD)	11.16(2.17)	11.37(1.91)	11.35(2.17)	.359
Cronbach's alpha	.71	.48	.68	
Test-retest	--	.52**	.48**	
Skewness	-0.17	-0.14	-0.24	
Kurtosis	-0.04	-0.45	-0.48	
Domain 4: Environmental				
Mean (SD)	30.39(4.40)	30.80(4.56)	31.25(4.13)	.121
Cronbach's alpha	.74	.77	.75	
Test-retest	--	.60**	.62**	
Skewness	0.16	-0.14	-0.41	
Kurtosis	-0.71	-0.35	0.86	
WHOQOL-5				
Mean (SD)	19.52(3.04)	19.80(2.68)	19.98(2.85)	.064
Cronbach's alpha	.71	.62	.68	
Test-retest	--	.64**	.54**	
Skewness	-0.42	-0.53	-0.89	
Kurtosis	-0.33	0.75	2.46	
WHOQOL-8				
Mean (SD)	29.86(4.42)	30.15(4.07)	30.59(4.36)	.049*
Cronbach's alpha	.76	.73	.79	
Test-retest	--	.60**	.59**	
Skewness	-0.19	-0.16	-0.69	
Kurtosis	-0.27	0.14	1.94	
WHOQOL-Total				
Mean (SD)	98.98(11.80)	100.16(11.06)	100.89(11.20)	.001**
Cronbach's alpha	.89	.88	.89	
Test-retest	--	.72**	.60**	
Skewness	-0.00	-0.00	-0.25	
Kurtosis	-0.40	-0.46	0.74	

G-Study

Table 2 presents variance components attributed to person (P), item (I), and occasion (O), and their interactions (PxI, PxO, IxO, PxIxO) together with Generalisability coefficients, SCI and TCI for the 26-item WHOQOL-BREF Total, the WHOQOL-5, the WHOQOL-8, and the four individual domain subscales. The best reliability and generalisability of scores across persons and occasions was found for the WHOQOL-BREF Total with both relative and absolute G coefficients (G_r and G_a) of 0.90 and the main source of error variance due to PxO interaction, which accounted for 100% of variance attributed to error after accounting for person variance. Slightly lower but still acceptable G_r and G_a values of 0.77 and 0.70, respectively, were observed for the social domain, with measurement error mainly explained by IxO and PxIxO interactions, which equated to 93% of error variance when combined. The TCI values, which reflect the ability an instrument to reflect a trait were calculated for the WHOQOL-BREF, WHOQOL-5, WHOQOL-8 and the four individual domains, physical, psychological, social and environmental TCI ranging from 0.89 to 0.98. TCI values together with reliability estimates indicate that only the WHOQOL-BREF total and social domain subscale are consistent with expectations of a reliable trait measure meaning that the WHOQOL-BREF is measuring quality of life and this concept is relatively stable across time. In contrast, G_r and G_a for all other individual domain subscales and both of the short versions, WHOQOL-5 and WHOQOL-8 were below 0.70 meaning that the remaining subscales and both of the short versions of the WHOQOL were not meeting expectations of a reliable trait measure (Shavelson et al, 1989).

The SCI reflecting the ability of an instrument to reflect state changes were below expectations for a reliable state measure for all scales and subscales (all SCI<0.20). Even though TCI value for the WHOQOL-5, WHOQOL-8 and the four domain subscales were high, ranging from 0.89 (Physical and Psychological) to 0.98 (WHOQOL-5), all subscales and short versions were affected by measurement error due to various combinations of interactions between person, item and occasion. This resulted in low reliability of the physical, psychological and environmental subscales and the two short versions WHOQOL-5 and WHOQOL-8 in measuring trait (all G_r <0.70) meaning that these subscales and short versions cannot be regarded as reliably measuring enduring (trait) quality of life. Generalisability

analysis software outputs for the WHOQOL-BREF total, the four domains (physical, psychological, social and environmental) and the two short versions WHOQOL-5 and WHOQOL-8 can be found in Appendices A through to G.

Table 2. *G-study estimates for the 26-item WHOQOL-BREF; and the two short versions WHOQOL-5 and WHOQOL-8; and the four domain subscales of the WHOQOL-BREF including, Coefficient G relative (G_r), Coefficient G absolute (G_a), Trait Component Index (TCI), State Component Index (SCI), grand mean (GM), variance components (in %), and for the Person (P) x Occasion (O) x Item (I) design including interactions (n=130).*

	WHOQOL Total		Physical		Psychological		Social		Environmental		WHOQOL5		WHOQOL8	
Domains	σ2	%	σ2	%	σ2	%	σ2	%	σ2	%	σ2	%	σ2	%
P	0.05		0.05		0.05		0.20		0.06		0.05		0.03	
I	0.00	0.0	0.01	10.2	0.01	7.8	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
O	0.00	0.0	0.00	6.4	0.00	0.0	0.00	0.0	0.00	0.0	0.03	28.4	0.00	4.1
PxI	0.00	0.0	0.02	30.9	0.03	38.3	0.00	2.7	0.01	28.8	0.03	29.8	0.01	32.9
PxO	0.01	100.0	0.01	10.6	0.01	9.8	0.00	4.2	0.00	9.9	0.00	0.8	0.00	7.4
IxO	0.00	0.0	0.00	6.6	0.01	10.6	0.03	30.1	0.01	14.9	0.01	7.2	0.01	14.7
PxIxO	0.00	0.0	0.02	35.2	0.02	33.5	0.05	63.0	0.01	46.4	0.03	33.8	0.02	40.9
SCI	0.11		0.11		0.11		0.02		0.06		0.02		0.08	
TCI	0.89		0.89		0.89		0.98		0.94		0.98		0.92	
Gr	**0.90**		0.55		0.48		**0.77**		0.64		0.47		0.52	
Ga	**0.90**		0.48		0.43		**0.70**		0.60		0.36		0.47	

Note: Grand mean = 3.67; Numbers in bold signify acceptable reliability/generalisability coefficients for temporal stability.

D-Study

Individual item analysis was conducted to obtain variance components for individual items by excluding all other items from the analysis software. The estimates for variance of person (P), occasion (O) and person-occasion interaction (PxO) together with computed SCI, mean and SD at Occasion 2, and Rank (of importance in New Zealand) are included in Table 3. The ranked order of importance of WHOQOL-BREF items for New Zealanders was investigated in a study (Krägeloh, Billington, Hsu & Landon, 2015) where questionnaires asking for participants to indicate how important they consider each facet of the WHOQOL-BREF as opposed to standard way of enquiring about their satisfaction. Items were then

ordered in terms of mean importance rating and compared with rankings from the original WHOQOL work. The results from Krägeloh et al. (2015) are also shown in Table 3 to investigate the possibility that there may be a correlation between how New Zealanders rated the subjective importance of these questions and the levels of state or trait components expressed by these items. As illustrated in Table 3, no such relationship could be confirmed.

There were seven items (items 9, 10, 13, 18, 19, 20, and 26) that presented with acceptable to high SCI (>0.60) reflecting moderate to high sensitivity for state changes over time. On the other end of the spectrum, there were eight items (items 6, 7, 11, 15, 17, 21, 22, and 24) with low SCI (<0.40) that are least sensitive to state changes over time reflecting predominantly trait quality of life. All other items had SCI that were situated in between these cut-off values (0.40 < SCI < 0.60) and reflect both state and trait quality of life to a comparable degree. The generalisability software outputs for each individual item can be found in Appendices H.1 through to H.26.

Table 3. *Variance components of Person (P), Occasion (O), and person-occasion interaction (PxO) together with state component index (SCI), mean and SD at Occasion 2 (chosen because the scores were generally going up and Occasion 2 was seen as a value in the middle), and Rank (order of Importance as rated by New Zealand participants in a study published by Krägeloh, Billington, Hsu & Landon, 2015) for each individual item of the WHOQOL-BREF (n=130).*

Items	Domain	P	O	PxO	SCI	Mean (Occasion 2)	SD	Rank
15. How well are you able to get around?	Physical	0.33	0.01	0.10	0.23	4.38	0.79	1
7. How well are you able to concentrate?	Psychol.	0.42	0.00	0.17	0.29	3.25	0.78	11
11. Are you able to accept your bodily appearance?	Psychol.	0.23	0.05	0.11	0.32	3.50	0.97	23
6. To what extent do you feel your life to be meaningful?	Psychol.	0.35	0.06	0.17	0.32	3.91	0.91	18
24. How satisfied are you with your access to health services?	Environ.	0.28	0.00	0.15	0.35	4.13	0.89	5
17. How satisfied are you with your ability to perform your daily living activities?	Physical	0.29	0.01	0.18	0.39	4.03	0.80	1
21. How satisfied are you with your sex	Social	0.24	0.03	0.16	0.40	3.60	0.96	25

life?								
22. How satisfied are you with the support you get from your friends?	Social	0.27	0.06	0.18	0.40	4.05	0.82	24
23. How satisfied are you with the conditions of your living place?	Environ.	0.24	0.13	0.17	0.41	3.99	0.94	7
8. How safe do you feel in your daily life?	Environ.	0.26	0.00	0.21	0.45	4.28	0.75	8
16. How satisfied are you with your sleep?	Physical	0.24	0.02	0.20	0.45	3.08	1.10	10
4. How much do you need any medical treatment to function in your daily life?	Physical	0.26	0.00	0.23	0.47	4.68	0.61	20
12. Have you enough money to meet your needs?	Environ.	0.16	0.06	0.14	0.47	3.17	1.11	13
2. How satisfied are you with your health?	General	0.17	0.04	0.15	0.47	3.80	0.91	3
3. To what extent do you feel physical pain prevents you from doing what you need to do?	Physical	0.16	0.11	0.15	0.48	4.52	0.76	9
1. How would you rate your quality of life?	General	0.20	0.05	0.19	0.49	4.25	0.61	
5. How much do you enjoy life?	Psychol.	0.17	0.10	0.17	0.50	4.05	0.69	4
14. To what extent do you have the opportunity for leisure activities?	Environ.	0.18	0.16	0.22	0.56	3.42	0.88	21
25. How satisfied are you with your transport?	Environ.	0.15	0.04	0.19	0.57	3.85	1.10	17
20. How satisfied are you with your personal relationships?	Social	0.12	0.09	0.18	0.60	3.72	0.95	14
26. How often do you have negative feelings such as blue mood, despair, anxiety, depression?	Psychol.	0.14	0.02	0.23	0.62	3.75	0.76	15
13. How available to you is the information that you need in your day-to-day life?	Environ.	0.12	0.05	0.23	0.66	4.06	0.74	22
19. How satisfied are you with yourself?	Psychol.	0.07	0.04	0.15	0.66	3.70	0.76	12
10. Do you have enough energy for everyday life?	Physical	0.07	0.08	0.17	**0.71**	3.48	0.76	6

9. How healthy is your physical environment?	Environ.	0.05	0.02	0.26	**0.84**	3.91	0.83	16
18. How satisfied are you with your capacity for work?	Physical	0.03	0.02	0.18	**0.85**	3.61	0.83	19

Note: Bold used to signify high SCI (>0.70)

A series of generalisability analyses were conducted by combining the most dynamic items with the highest SCI in attempt to produce a state measure of quality of life. The first analysis used seven dynamic items with the acceptable SCI of >0.60. The second analysis used only three dynamic items with the highest SCI of >0.70. Table 4 shows D-study results including reliability estimates and variance components attributed to person (P), item (I), occasion (O) and their various interactions (PxI, PxO, IxO, PxIxO). The results indicate that person x item x occasion interaction was the main source of error variance across these analyses, 56.3% and 61.8%, respectively, of the total error variance. G_r and G_a for both the analyses conducted using the most dynamic items were below the acceptable generalisability for a trait measure (0.70), and all SCI were below expectations for a state measure (SCI > 0.60). These findings mean that none of the tested item combinations can be used reliably for the assessment of state quality of life. Generalisability analysis software outputs for the D-Study can be found in Appendices I and J.

Table 4. *D-study reliability estimates and variance components for the Person (P), Occasion (O), Item(I) design including their various interactions (PxI, PxO, IxO, PxIxO) for combined WHOQOL-BREF items with the highest state component index (SCI).*

	State Items (SCI >0.60)		State Items (SCI >0.70)	
Domains	σ2	%	σ2	%
P	0.05		0.05	
I	0.01	16.6	0.02	14.2
O	0.00	0.0	0.02	16.6
PxI	0.00	8.9	0.00	0.8
PxO	0.00	6.5	0.00	0.0
IxO	0.01	11.8	0.01	6.6
PxIxO	0.03	56.3	0.07	61.8
SCI	0.06		0.00	
TCI	0.94		1.00	
Gr	0.58		0.41	
Ga	0.50		0.30	

Chapter Four: Discussion

The primary aim of this study was to distinguish between dynamic (state) and stable (trait) components of the WHOQOL-BREF and to examine temporal reliability and generalisability of this assessment measure using Generalisability theory. The results indicated that the total 26-item WHOQOL-BREF has strong reliability in measuring enduring quality of life with a G coefficient of 0.90, meaning that the scores are generalisable across persons and occasions. The results also indicate that the social domain subscale of the WHOQOL-BREF has marginally acceptable reliability in measuring trait, with a G-coefficient of 0.77. However, the remaining three domain subscales, physical, psychological and environmental; and the two short versions, WHOQOL-5 and WHOQOL-8 were found to be less reliable in measuring either state or trait quality of life with G-coefficients below 0.65 and SCI below 0.15. These findings show that individual domain subscales and short versions scores were affected by measurement error due to interactions between person, item, and occasion, which presented the highest percentage of error variance ranging from 34% to 63% across individual domain subscales and short versions. Individual domain subscales and short versions were also affected by interaction between person and item which was specifically evident in the domain subscales physical (31%), psychological (38%), environmental (29%) and the short versions, WHOQOL-5 (30%) and WHOQOL-8 (33%). In contrast to these findings, the WHOQOL-BREF total found a state component of person and occasion interaction that accounted for 100% of the total error variance, but its influence on the overall reliability of the measurement was negligible with a G coefficient 0.90 (Shavelson et al., 1989).

A D-study was conducted in an attempt to create a domain subscale to measure quality of life as a state by combing items identified as the most dynamic over time, which evidently did not result in a sensitive state measure as reflected by extremely low SCI (>0.10). It can be speculated that state changes in specific aspects of quality of life are not occurring at the same time and therefore may cancel each other out when combining different state items. For instance, item 18 (“How satisfied are you with your capacity for work?”) and item 9 (“How healthy is your physical environment?”) had SCI values of 0.85 and 0.84, respectively, which indicates that they are a measure of state aspects of quality of life for the most part. However, combining these items, this may result in a counter

balancing of state changes on each individual aspect over time due to the fact that they are less likely to be occurring at the same time. This phenomenon is supported by the results in Table 4 where we attempted several combinations of state items that all resulted in lower SCI. These findings are consistent with that of other psychometric studies which have demonstrated a reduction of measurement error from individual items by combining them into parcels or "super-items" (Taylor, Medvedev, Owens & Siegert, 2017; Medvedev, Norden, Krägeloh, & Siegert, 2018).

The current study also looked at the SCI values and compared them with the mean values at Occasion 2 and the ranked order of importance of WHOQOL-BREF items to New Zealanders (Krägeloh et al., 2015) and found no correlations between them. This is a robust finding as it was hypothesised that more trait like items should correlate with importance as they are the longstanding relatively unchanging aspects of quality of life, but no support was found for this prediction.

The current study also aimed to compare Generalisability theory and Classical Test Theory methods in evaluating the reliability of the WHOQOL-BREF. While the G-coefficients for the WHOQOL-BREF Total score and the social domain subscale score were generally higher than that of the test-retest reliability scores, G-coefficients estimated for the two short versions of the WHOQOL (5 and 8) and the remaining three individual domain subscales were either overall lower than that of Classical Test Theory (test-retest) reliability estimates, which reflects higher accuracy and the overall robustness of the Generalisability theory methodology and approach accounting for various sources of error simultaneously (Bloch & Norman, 2012). Therefore, it is likely that the Classical Test Theory estimates are inflated due to their indiscriminate nature of determining error variance as a single factor and not accounting for all other potential sources of error variance and their interactions.

Implications for Practice

Before the current study was conducted, no evidence was established using appropriate methodology as to what extent quality of life measures evaluate dynamic or enduring aspects of the construct. The current study has established that the WHOQOL-BREF single score is measuring a trait construct that has very high reliability and temporal stability. The use of the single score has been found to result in a valid measure (Balalla,

Medvedev, Siegert & Krägeloh, 2019). Therefore, if we evaluate the outcome of psychological interventions showing significant improvement on the overall WHOQOL score, this improvement is likely to be long lasting because trait changes would have been achieved. What this means for practice is that if we apply a specific intervention and we see a difference on any WHOQOL-BREF measurement that difference will be an enduring effect meaning it is likely to be a lasting one.

Looking at the results in Table 3, we can see that for the full 26 individual items we have SCI ranging from 0.23 to 0.85. The lower the SCI, the more trait like the item is, reflecting the fact that it will be harder to change and therefore intervention will likely be for a long duration. In contrast, the higher the SCI, the more state like an item is, reflecting the fact that it will likely be relatively easy to change, and an intervention may not require much time to result in a noticeable effect. To emphasise this notion and to demonstrate applicability to the field of psychological practice we are going to take a closer look at the individual items from the WHOQOL-BREF that have SCI values >0.60.

Item 20 (“How satisfied are you with your personal relationships?”), this item has a SCI of 0.60 reflecting that it is sensitive to state changes over time. Currently, there are numerous interventions such as couples’ therapy and education (Bradbury & Lavner, 2012) within psychological practice that can improve interpersonal connectedness and in turn improve the subjective satisfaction perceived by the individual of their personal relationships. One example is a newly investigated phenomenon known as “interpersonal mindfulness”, which is where the concept of mindfulness defined as “paying attention in a particular way; on purpose, in the present moment, and nonjudgmentally’ (Kabbat-Zinn, 1994, page 4) is applied interpersonally. What this means is that an individual is purposefully paying attention to self and others within their interpersonal relationships in a way that encompasses a non-judgemental attitude and a nonreactive manner (Pratscher, Markovitz, Bettencourt, 2016). Being mindful while interacting with others is likely to enhance effective communication which is crucial to healthy functioning of interpersonal relationships. Furthermore, it is not surprising that interpersonal relationships and the support they provide for an individual are likely to enhance overall health and wellbeing (Burgoon, Berger & Waldron, 2000; Holt-Lunstad, 2017; Pratscher, rose, Markovitz & Bettencourt, 2017).

Therefore, applying interpersonal mindfulness training can improve scores for this item, in effect improving overall quality of life.

Item 26 ("How often do you have negative feelings such as blue mood, despair, anxiety, depression?"), this item has a SCI values of 0.62 reflecting its sensitivity to state changes over time. Recent research stipulates that if we use mindfulness training to increase an individual's non-judgemental attitude by 0.40 (40%) consequently their scores for depression, stress and anxiety as reflected by the DASS-21 (Depression, Stress Anxiety Scale; Lovibond & Lovibond, 1995) will be reduced by 1 (Medvedev et al., 2018). What this means for practice is by applying a simple mindfulness intervention targeted at increasing non-judgement this will have a huge effect on reducing the individual's experience of symptoms relating to depression, stress and anxiety which within the current study would be reflective of an improvement in overall quality of life.

Item 13 ("How available to you is the information that you need in your day-to-day life?") has a SCI value of 0.66 reflective of the fact that it is sensitive to state changes over time. It can be speculated that information in generally is readily available to university students by means of the multitude of textbooks within the libraries on each campus, to the internet and its almost limitless selection of journal articles and databases. However, it could be speculated that the information these students need may come from face-to-face time with their tutors or senior lecturers and this could be limited. Another explanation for this could be the way in which people are utilising resources when engaging in information-seeking behaviours. An article investigated this by conducting a pilot study and what they found suggests there is an array of extraneous variables that act as situational influencing factors and these include; individual motivation for information seeking; time in terms of if the information is needed immediately versus short-term and/or long-term; influence of the location in which information is being sought; and lastly the life context of the individual (Julien & Michels, 2004). In order to improve quality of life by making daily information more accessible would require further investigation and evaluation of individual needs.

Item 19 ("How satisfied are you with yourself?") has a SCI value of 0.66 which reflects that it is sensitive to state changes over time. High achievers such as people who choose to undergo postgraduate studies tend to have a perfectionism streak which can result in a highly critical self-evaluation. Studies have shown that improving qualities within

these individuals such as building self-esteem, self-compassion and self-efficacy can result in a positive buffering effect on the detrimental effects of self-criticism (Rice, Ashby & Slaney, 1998; Neff, 2003; Stoeber, Hutchfield & Wood, 2008). With relation to the current study this aspect of quality of life can be improved using a couple of strategies such as a short intervention focusing on one of the three aspects mentioned above or a combination of all three. In short, teaching an individual how to build their self-esteem or self-efficacy (belief in themselves) or training them in some self-compassion exercises for when times get a little hard to handle of the self-criticism grows will have a positive effect on how satisfied they are with themselves in general which will consequently have a similar effect on the improvement of overall quality of life.

Item 10 ("Do you have enough energy for everyday life?") has a SCI value of 0.71 reflecting that it is highly sensitive to state changes over time. This question seems to be about behaviour therefore this question requires a behavioural intervention which will most likely have immediate, positive results regarding individual's energy levels. There is a lot one can do to increase their energy levels and in turn decrease feelings of burnout or fatigue. It is well known that sleep and nutrition have huge effects on energy levels. If an individual has a disruptive sleep and wakes during the night, it is likely that they are not receiving enough REM sleep, it is during this period of rest that the body regenerates itself by manufacturing new cells and repairing damaged cells. Intervention may include working together to create a healthy sleep plan that caters to sleep hygiene which can include aspects such as a sleep schedule, going to sleep and waking up at the same time helps to regulate the body clock which aids going to sleep and staying asleep (National Sleep Foundation, 2019), exercise and limiting screen time before bed allowing the mind and body to wind down in preparation for sleep (Carter, Rees, Hale, Bhattacharjee, & Paradkar, 2016). Another intervention may include assessing your diet by seeking advice from a nutritionist. An unhealthy diet where the body is not receiving the nutrients it needs to complete the daily activity requirements can leave an individual feeling lethargic or fatigued, furthermore if people are skipping meals this can have the same results, in order in be at optimal performance and have enough energy one should be eating the regular 3 meals a day and healthy foods full of nutrients and vitamins the body needs (Farhud, 2015; Bleich, Jones-Smith, Wolfson, Zhu, & Story, 2015). Furthermore, decreasing one's stress can lead to

increased energy, this can be achieved by intervention inclusive of teaching people coping strategies to improve their stress management which may include mindfulness training which has been shown that simple as increasing one's non-judgemental attitude will result in a decrease of stress (Medvedev et al., 2018). There are many interventions both behavioural and psychological that can help to increase a person's energy levels, the intervention should aim to cater for individual needs, regardless of the specific type of intervention an intervention resulting in an increase of energy for an individual will likely also result in an improvement for overall quality of life.

Item 9 ("How healthy is your physical environment?") has a SCI value of 0.84 meaning that it is highly sensitive to state changes over time. This question is specifically related to the area in which an individual resides rather than the 'healthiness' of their actual house, as that is covered by another question. We suggest that the ultimate solution for an intervention targeting this aspect would be to change geographical locations for example if living in Auckland one could move to a different suburb or move to a semi-rural location. Whilst moving to a new house would be the ideal solution it is understandable that this may not be possible for everyone. This question may be open to interpretation for an individual dependent on where they spend most of their time as to what they are viewing as their physical environment, for example if the person is a workaholic their physical environment could be their workplace and therefore the solution may be to change jobs or seek ways to make the physical environment more appeasing. As a university student, the physical environment in question may be their university where they spend most of their time attending lectures and studying in which case a solution could be to change universities or to attend lectures at university but study somewhere more appealing like the beach or the park. A change in your physical environment will have a ripple effect resulting in a change of how you subjectively view that environment which based on the current study may result in improvement to overall quality.

Item 18 ("How satisfied are you with your capacity for work?") has a SCI value of 0.85 which is reflecting that this item is highly sensitive to state changes over time, this item also has the highest SCI of the current study. If we look at the core of this question, we can state that having a job to start with improves quality of life, studies have been conducted that support this statement (Grimby & Ringdahl, 2000; Pirfo et al., 1994). However, if we

assume these people are already employed then the suggestion for intervention would be to take full advantage of any professional development training offered by the employer. Professional development training has many benefits these include upskilling which makes an individual better equipped to do their job and potentially worth more in the long run. Another intervention option would be to find a more suitable career alternative that may be less demanding (Kautonen, Kibler, & Minniti, 2017). A change in employment will influence how an individual subjectively views their capacity for work and this change will have a lasting effect on their overall quality of quality of life.

It is important to note that all these intervention suggestions should be considered with respect for the individual and their own tailored intervention plan made with a specialist such as a psychologist to suit the individuals needs and should also be in conjunction with healthy sleep, diet, exercise and even meditation, which are all important to quality of life as a whole.

Reflecting back to the intervention studies where the WHOQOL-BREF was used as a pre/post-test measure and/or outcomes measure, mentioned in the brief literature review section of this thesis. The present study has highlighted important information about the measurement at item level. The WHOQOL-BREF could have been used in intervention planning target aspects that are relevant to the presentation in a manner which suits, if for example the study on major depressive disorder aimed at improving the quality of life of individuals suffering this disorder planned their intervention targeting WHOQOL-BREF aspects that we already know are related to depression such as item 26, item, 19 and item 10, they would see improvement in quality of life not just in the acute phase but also when symptoms are in remission. In short, this tool cannot only be used as an outcome measurement but with the information on state and trait items it can be used to plan effective intervention for immediate improvement.

Lastly, the results of the G-coefficient confirming temporal stability of the WHOQOL-BREF single summary score are consistent with the recent work of Balalla and colleagues using the WHOQOL-BREF that suggest the most reliable and optimal score is a single score representing a total global quality of life score. Originally, the WHOQOL-BREF was only designed to be scored by its four domains resulting in four individual domain scores and it is argued by some researchers that it should still be this way and that it is not correct to

reduce it to one score (WHOQOL Group, 1996). However, recent work using Rasch analysis has shown that the single score is the most reliable (Balalla, Medvedev, Siegert, & Krägeloh, 2019). Our current study confirms these results and adds to them, by using generalisability theory, we have been able to show that the WHOQOL-BREF total global score has the highest G-coefficient which shows that it has high temporal reliability and is valid measure of trait quality of life. The use of a single score has many benefits for practice such as simplifying the interpretation of results to clients and the understanding of scores for practitioners alike.

Limitations and Directions of Further Research

Limitations include the fact that the sample is homogenous, being made up entirely of medical students which may be viewed as a niche subgroup leading to the need for future research to conduct generalisability studies using the WHOQOL-BREF on diverse populations. However, the results do show that the measure is generalisable across persons and occasions within the current study. More studies would aim to support and strengthen these findings. It is important to note here that even though a homogenous sample such as students is usually seen as a limitation, it can be argued that given the results and many results of other studies, students are also a population that can benefit from intervention for example the quality of life of students is often challenged by their exposure to high-stress environments (Henning, Krägeloh & Wong-Toi, 2015).

Another, limitation could be the possibility that some of the items had high values and thus a tendency towards potential ceiling effects. This has often been noted in reference with younger people and with items 3 and 4. This means that values cannot really vary that much (or at least only in one direction – namely going down). This may inflate the trait features of an item. So, directions for future research could investigate that, to see whether the results also hold for samples where the mean values are more around the centre of the Likert-scale.

Reflections and Conclusion

In conclusion, the current study has found that the WHOQOL-BREF is a robust measure with strong reliability and temporal stability if total score is used. The current study has established that the WHOQOL-BREF is a trait measure, overall measurement of quality

of life is something that remains relatively stable. Upon further investigation at item level it has been demonstrated that the measure consists of a mix of state, trait items of varying degrees, this is fantastic for intervention as identification of which items are acting in which way it allows us to work with those items more effectively and therefore plan and implement effective intervention that will result in increase to an individual's quality of life.

In reflection, from doing this project and having the opportunity to present it at and international conference to an audience of experts working in front-facing agencies across New Zealand and Australia, it has become clearly evident that this is a valuable piece of research that has very real applicability within the working field of psychology. One audience member who is using the WHOQOL-BREF measurement face-to-face with clients had this to day at the conclusion of the presentation 'Congratulations for the work that has been done in providing clarity (for the uses of this tool), this is powerful information to use with clients to help instil hope when clients ,may have been working really hard to achieve something but are seeing no changes and this may be explained by the trait quality of what they have been trying to achieve' (Norden, Lyndon, Henning, Krägeloh & Medvedev, 2019).

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Appendices

Appendix A: WHOQOL-BREF full scale G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:34]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	
Occassion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	604.882	129	4.689	0.048	0.054	0.054	5.9	0.007
I	576.954	25	23.078	0.007	0.007	0.007	0.8	0.019
O	0.122	2	0.061	-0.006	0.000	0.000	0.0	0.001
PI	3195.367	3225	0.991	0.151	0.151	0.151	16.5	0.009
PO	120.570	258	0.467	-0.003	0.018	0.018	2.0	0.002
IO	988.252	50	19.765	0.148	0.148	0.148	16.1	0.030
PIO	3468.389	6450	0.538	0.538	0.538	0.538	58.7	0.009
Total	8954.536	10139					100%	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.054		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		(0.000)	0.0
	.....	PI	(0.000)	0.0	(0.000)	0.0
	.....	PO	0.006	100.0	0.006	100.0
	.....	IO	.....		(0.000)	0.0
	.....	PIO	(0.000)	0.0	(0.000)	0.0
Sum of variances	0.054		0.006	100%	0.006	100%
Standard deviation	0.233		Relative SE: 0.077		Absolute SE: 0.077	
Coef_G relative	0.90					
Coef_G absolute	0.90					

Grand mean for levels used: 3.847

Variance error of the mean for levels used: 0.000

Standard error of the grand mean: 0.022

Appendix B. Physical Domain G analysis

File C:\Program Files (x86)\EduG - 6.1e\Data\WHOQOLG130x26x3.gen - [2019-06-29 13:26]

WHOQOLG130x26x3

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 5 6 7 8 9 11 12 13 14 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.050		.....		.....	
	.....	I	.....		0.005	10.2
	.....	O	.....		0.003	6.4
	.....	PI	0.017	40.3	0.017	30.9
	.....	PO	0.006	13.9	0.006	10.6
	.....	IO	.....		0.004	6.6
	.....	PIO	0.019	45.8	0.019	35.2
Sum of variances	0.050		0.041	100%	0.054	100%
Standard deviation	0.225		Relative SE: 0.203		Absolute SE: 0.232	
Coef_G relative	0.55					
Coef_G absolute	0.48					

Grand mean for levels used: 3.870

Variance error of the mean for levels used: 0.013

Standard error of the grand mean: 0.115

Appendix C. Psychological Domain G analysis

File C:\Program Files (x86)\EduG - 6.1e\Data\WHOQOLG130x26x3.gen - [2019-06-29 13:28]

WHOQOLG130x26x3

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 8 9 10 12 13 14 15 16 17 18 20 21 22 23 24 25
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.049		.....		.....	
	.....	I	.....		0.005	7.8
	.....	O	.....		(0.000)	0.0
	.....	PI	0.025	46.9	0.025	38.3
	.....	PO	0.006	12.0	0.006	9.8
	.....	IO	.....		0.007	10.6
	.....	PIO	0.022	41.1	0.022	33.5
Sum of variances	0.049		0.053	100%	0.065	100%
Standard deviation	0.222		Relative SE: 0.231		Absolute SE: 0.256	
Coef_G relative	0.48					
Coef_G absolute	0.43					

Grand mean for levels used: 3.846

Variance error of the mean for levels used: 0.013

Standard error of the grand mean: 0.113

Appendix D. Social Domain G analysis

File C:\Program Files (x86)\EduG - 6.1e\Data\WHOQOLG130x26x3.gen - [2019-06-29 13:29]

WHOQOLG130x26x3

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.203		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		(0.000)	0.0
	.....	PI	0.002	3.8	0.002	2.7
	.....	PO	0.004	6.0	0.004	4.2
	.....	IO	.....		0.026	30.1
	.....	PIO	0.054	90.1	0.054	63.0
Sum of variances	0.203		0.060	100%	0.085	100%
Standard deviation	0.450		Relative SE: 0.244		Absolute SE: 0.292	
Coef_G relative	0.77					
Coef_G absolute	0.70					

Grand mean for levels used: 3.675

Variance error of the mean for levels used: 0.028

Standard error of the grand mean: 0.167

Appendix E. Environmental Domain G analysis

File C:\Program Files (x86)\EduG - 6.1e\Data\WHOQOLG130x26x3.gen - [2019-06-29 13:30]

WHOQOLG130x26x3

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 10 11 15 16 17 18 19 20 21 22 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.058		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		(0.000)	0.0
	.....	PI	0.011	33.9	0.011	28.8
	.....	PO	0.004	11.6	0.004	9.9
	.....	IO	.....		0.006	14.9
	.....	PIO	0.018	54.5	0.018	46.4
Sum of variances	0.058		0.033	100%	0.039	100%
Standard deviation	0.241		Relative SE: 0.182		Absolute SE: 0.198	
Coef_G relative	0.64					
Coef_G absolute	0.60					

Grand mean for levels used: 3.818

Variance error of the mean for levels used: 0.007

Standard error of the grand mean: 0.081

Appendix F. WHOQOL-5 G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:55]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	3 4 5 6 7 8 9 10 11 12 13 14 15 16 18 19 21 22 24 25 26
Occassion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	204.234	129	1.583	0.044	0.050	0.050	5.3	0.014
I	34.085	4	8.521	-0.019	-0.019	-0.018	0.0	0.022
O	124.378	2	62.189	0.072	0.076	0.076	8.1	0.068
PI	524.182	516	1.016	0.159	0.159	0.159	16.8	0.022
PO	115.222	258	0.447	-0.019	0.002	0.002	0.2	0.009
IO	124.278	8	15.535	0.115	0.115	0.115	12.2	0.053
PIO	557.455	1032	0.540	0.540	0.540	0.540	57.3	0.024
Total	1683.834	1949					100%	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.050		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		0.025	28.4
	.....	PI	0.027	46.3	0.027	29.8
	.....	PO	0.001	1.2	0.001	0.8
	.....	IO	.....		0.006	7.2
	.....	PIO	0.030	52.5	0.030	33.8
Sum of variances	0.050		0.058	100%	0.089	100%
Standard deviation	0.224		Relative SE: 0.240		Absolute SE: 0.299	
Coef_G relative	0.47					
Coef_G absolute	0.36					

Grand mean for levels used: 3.991

Variance error of the mean for levels used: 0.033

Standard error of the grand mean: 0.181

Appendix G. WHOQOL-8 G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:57]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	3 4 5 6 7 8 9 11 13 14 15 16 18 21 22 24 25 26
Occassion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	191.271	129	1.483	0.027	0.033	0.033	3.7	0.008
I	143.491	7	20.499	-0.011	-0.011	-0.010	0.0	0.033
O	43.321	2	21.661	-0.002	0.005	0.005	0.5	0.017
PI	828.509	903	0.918	0.136	0.136	0.136	15.6	0.015
PO	107.762	258	0.418	-0.011	0.008	0.008	0.9	0.005
IO	340.715	14	24.337	0.183	0.183	0.183	21.0	0.066
PIO	917.535	1806	0.508	0.508	0.508	0.508	58.2	0.017
Total	2572.604	3119					100%	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.033		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		0.002	4.1
	.....	PI	0.012	40.6	0.012	32.9
	.....	PO	0.003	9.1	0.003	7.4
	.....	IO	.....		0.005	14.7
	.....	PIO	0.015	50.3	0.015	40.9
Sum of variances	0.033		0.030	100%	0.037	100%
Standard deviation	0.180		Relative SE: 0.174		Absolute SE: 0.193	
Coef_G relative	0.52					
Coef_G absolute	0.47					

Grand mean for levels used: 4.079

Variance error of the mean for levels used: 0.008

Standard error of the grand mean: 0.087

Appendix H. Item G analysis

H1. Item 1 G analysis

File C:\Program Files (x86)\EduG - 6.1e\Data\WHOQOLG130x26x3.gen - [2019-06-29 13:34]

WHOQOLG130x26x3

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.196		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.046	19.6
	.....	PI	.....		.....	
	.....	PO	0.190	100.0	0.190	80.4
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.196		0.190	100%	0.236	100%
Standard deviation	0.442		Relative SE: 0.436		Absolute SE: 0.486	
Coef_G relative	0.51					
Coef_G absolute	0.45					

Grand mean for levels used: 4.100

Variance error of the mean for levels used: 0.049

Standard error of the grand mean: 0.222

H. 2. Item 2 G analysis

File C:\Program Files (x86)\EduG - 6.1e\Data\WHOQOLG130x26x3.gen - [2019-06-29 13:46]

WHOQOLG130x26x3

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.173		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.044	22.3
	.....	PI	.....		.....	
	.....	PO	0.153	100.0	0.153	77.7
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.173		0.153	100%	0.197	100%
Standard deviation	0.416		Relative SE: 0.391		Absolute SE: 0.443	
Coef_G relative	0.53					
Coef_G absolute	0.47					

Grand mean for levels used: 4.179

Variance error of the mean for levels used: 0.046

Standard error of the grand mean: 0.215

H. 3. Item 3 G analysis

File C:\Program Files (x86)\EduG - 6.1e\Data\WHOQOLG130x26x3.gen - [2019-06-29 13:47]

WHOQOLG130x26x3

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.160		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.109	42.1
	.....	PI	.....		.....	
	.....	PO	0.150	100.0	0.150	57.9
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.160		0.150	100%	0.259	100%
Standard deviation	0.400		Relative SE: 0.387		Absolute SE: 0.509	
Coef_G relative	0.52					
Coef_G absolute	0.38					

Grand mean for levels used: 3.818

Variance error of the mean for levels used: 0.111

Standard error of the grand mean: 0.334

H. 4. Item 4 G analysis

File C:\Program Files (x86)\EduG - 6.1e\Data\WHOQOLG130x26x3.gen - [2019-06-29 13:48]

WHOQOLG130x26x3

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.258		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.001	0.3
	.....	PI	.....		.....	
	.....	PO	0.227	100.0	0.227	99.7
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.258		0.227	100%	0.227	100%
Standard deviation	0.508		Relative SE: 0.476		Absolute SE: 0.477	
Coef_G relative	0.53					
Coef_G absolute	0.53					

Grand mean for levels used: 3.418

Variance error of the mean for levels used: 0.004

Standard error of the grand mean: 0.066

H. 5. Item 5 G analysis

File C:\Program Files (x86)\EduG - 6.1e\Data\WHOQOLG130x26x3.gen - [2019-06-29 13:49]

WHOQOLG130x26x3

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.170		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.100	37.2
	.....	PI	.....		.....	
	.....	PO	0.169	100.0	0.169	62.8
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.170		0.169	100%	0.268	100%
Standard deviation	0.412		Relative SE: 0.411		Absolute SE: 0.518	
Coef_G relative	0.50					
Coef_G absolute	0.39					

Grand mean for levels used: 3.890

Variance error of the mean for levels used: 0.102

Standard error of the grand mean: 0.320

H. 6. Item 6 G anaylsis

File C:\Program Files (x86)\EduG - 6.1e\Data\WHOQOLG130x26x3.gen - [2019-06-29 13:50]

WHOQOLG130x26x3

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.345		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.063	27.5
	.....	PI	.....		.....	
	.....	PO	0.165	100.0	0.165	72.5
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.345		0.165	100%	0.227	100%
Standard deviation	0.587		Relative SE: 0.406		Absolute SE: 0.477	
Coef_G relative	0.68					
Coef_G absolute	0.60					

Grand mean for levels used: 3.549

Variance error of the mean for levels used: 0.066

Standard error of the grand mean: 0.258

H. 7. Item 7 G analysis

File C:\Program Files (x86)\EduG - 6.1e\Data\WHOQOLG130x26x3.gen - [2019-06-29 13:52]

WHOQOLG130x26x3

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.415		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		(0.000)	0.0
	.....	PI	.....		.....	
	.....	PO	0.168	100.0	0.168	100.0
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.415		0.168	100%	0.168	100%
Standard deviation	0.644		Relative SE: 0.410		Absolute SE: 0.410	
Coef_G relative	0.71					
Coef_G absolute	0.71					

Grand mean for levels used: 3.636

Variance error of the mean for levels used: 0.004

Standard error of the grand mean: 0.067

H. 8. Item 8 G analysis

File C:\Program Files (x86)\EduG - 6.1e\Data\WHOQOLG130x26x3.gen - [2019-06-29 13:58]

WHOQOLG130x26x3

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.261		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		(0.000)	0.0
	.....	PI	.....		.....	
	.....	PO	0.213	100.0	0.213	100.0
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.261		0.213	100%	0.213	100%
Standard deviation	0.511		Relative SE: 0.461		Absolute SE: 0.461	
Coef_G relative	0.55					
Coef_G absolute	0.55					

Grand mean for levels used: 4.018

Variance error of the mean for levels used: 0.004

Standard error of the grand mean: 0.060

H. 9. Item 9 G analysis

File C:\Program Files (x86)\EduG - 6.1e\Data\WHOQOLG130x26x3.gen - [2019-06-29 14:00]

WHOQOLG130x26x3

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.051		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.023	8.0
	.....	PI	.....		.....	
	.....	PO	0.262	100.0	0.262	92.0
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.051		0.262	100%	0.285	100%
Standard deviation	0.226		Relative SE: 0.512		Absolute SE: 0.533	
Coef_G relative	0.16					
Coef_G absolute	0.15					

Grand mean for levels used: 3.900

Variance error of the mean for levels used: 0.025

Standard error of the grand mean: 0.159

H. 10. Item 10 G analysis

File C:\Program Files (x86)\EduG - 6.1e\Data\WHOQOLG130x26x3.gen - [2019-06-29 14:04]

WHOQOLG130x26x3

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.069		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.075	30.5
	.....	PI	.....		.....	
	.....	PO	0.172	100.0	0.172	69.5
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.069		0.172	100%	0.247	100%
Standard deviation	0.262		Relative SE: 0.414		Absolute SE: 0.497	
Coef_G relative	0.29					
Coef_G absolute	0.22					

Grand mean for levels used: 4.400

Variance error of the mean for levels used: 0.077

Standard error of the grand mean: 0.278

H. 11. Item 11 G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:35]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 10 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.232		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.053	33.1
	.....	PI	.....		.....	
	.....	PO	0.107	100.0	0.107	66.9
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.232		0.107	100%	0.160	100%
Standard deviation	0.481		Relative SE: 0.327		Absolute SE: 0.400	
Coef_G relative	0.68					
Coef_G absolute	0.59					

Grand mean for levels used: 3.674

Variance error of the mean for levels used: 0.056

Standard error of the grand mean: 0.236

H. 12. Item 12 G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:39]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 10 11 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.155		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.059	30.1
	.....	PI	.....		.....	
	.....	PO	0.137	100.0	0.137	69.9
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.155		0.137	100%	0.197	100%
Standard deviation	0.394		Relative SE: 0.371		Absolute SE: 0.443	
Coef_G relative	0.53					
Coef_G absolute	0.44					

Grand mean for levels used: 3.882

Variance error of the mean for levels used: 0.061

Standard error of the grand mean: 0.248

H. 13. Item 13 G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:41]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 10 11 12 14 15 16 17 18 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.119		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.050	17.8
	.....	PI	.....		.....	
	.....	PO	0.233	100.0	0.233	82.2
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.119		0.233	100%	0.283	100%
Standard deviation	0.346		Relative SE: 0.482		Absolute SE: 0.532	
Coef_G relative	0.34					
Coef_G absolute	0.30					

Grand mean for levels used: 3.538

Variance error of the mean for levels used: 0.053

Standard error of the grand mean: 0.230

H. 14. Item 14 G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:42]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 10 11 12 13 15 16 17 18 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.175		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.159	41.6
	.....	PI	.....		.....	
	.....	PO	0.223	100.0	0.223	58.4
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.175		0.223	100%	0.382	100%
Standard deviation	0.419		Relative SE: 0.472		Absolute SE: 0.618	
Coef_G relative	0.44					
Coef_G absolute	0.31					

Grand mean for levels used: 3.654

Variance error of the mean for levels used: 0.162

Standard error of the grand mean: 0.402

H. 15. Item 15 G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:43]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 10 11 12 13 14 16 17 18 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.334		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.011	10.1
	.....	PI	.....		.....	
	.....	PO	0.102	100.0	0.102	89.9
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.334		0.102	100%	0.114	100%
Standard deviation	0.578		Relative SE: 0.320		Absolute SE: 0.337	
Coef_G relative	0.77					
Coef_G absolute	0.75					

Grand mean for levels used: 3.836

Variance error of the mean for levels used: 0.015

Standard error of the grand mean: 0.122

H. 16. Item 16 G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:44]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 17 18 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.244		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.017	7.9
	.....	PI	.....		.....	
	.....	PO	0.200	100.0	0.200	92.1
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.244		0.200	100%	0.217	100%
Standard deviation	0.493		Relative SE: 0.447		Absolute SE: 0.466	
Coef_G relative	0.55					
Coef_G absolute	0.53					

Grand mean for levels used: 3.718

Variance error of the mean for levels used: 0.020

Standard error of the grand mean: 0.143

H. 17. Item 17 G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:45]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 18 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.286		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.007	3.4
	.....	PI	.....		.....	
	.....	PO	0.183	100.0	0.183	96.6
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.286		0.183	100%	0.190	100%
Standard deviation	0.535		Relative SE: 0.428		Absolute SE: 0.436	
Coef_G relative	0.61					
Coef_G absolute	0.60					

Grand mean for levels used: 3.969

Variance error of the mean for levels used: 0.010

Standard error of the grand mean: 0.101

H. 18. Item 18 G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:46]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.032		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.024	11.9
	.....	PI	.....		.....	
	.....	PO	0.178	100.0	0.178	88.1
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.032		0.178	100%	0.202	100%
Standard deviation	0.177		Relative SE: 0.421		Absolute SE: 0.449	
Coef_G relative	0.15					
Coef_G absolute	0.14					

Grand mean for levels used: 3.933

Variance error of the mean for levels used: 0.026

Standard error of the grand mean: 0.160

H. 19. Item 19 G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:47]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 20 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.074		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.036	19.5
	.....	PI	.....		.....	
	.....	PO	0.146	100.0	0.146	80.5
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.074		0.146	100%	0.182	100%
Standard deviation	0.271		Relative SE: 0.383		Absolute SE: 0.427	
Coef_G relative	0.33					
Coef_G absolute	0.29					

Grand mean for levels used: 4.395

Variance error of the mean for levels used: 0.037

Standard error of the grand mean: 0.193

H. 20. Item 20 G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:48]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 21 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.118		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.089	33.7
	.....	PI	.....		.....	
	.....	PO	0.175	100.0	0.175	66.3
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.118		0.175	100%	0.264	100%
Standard deviation	0.344		Relative SE: 0.418		Absolute SE: 0.514	
Coef_G relative	0.40					
Coef_G absolute	0.31					

Grand mean for levels used: 3.828

Variance error of the mean for levels used: 0.091

Standard error of the grand mean: 0.302

H. 21. Item 21 G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:49]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 22 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.244		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.026	13.7
	.....	PI	.....		.....	
	.....	PO	0.161	100.0	0.161	86.3
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.244		0.161	100%	0.186	100%
Standard deviation	0.494		Relative SE: 0.401		Absolute SE: 0.432	
Coef_G relative	0.60					
Coef_G absolute	0.57					

Grand mean for levels used: 3.621

Variance error of the mean for levels used: 0.029

Standard error of the grand mean: 0.169

H. 22. Item 22 G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:50]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 23 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.268		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.056	23.6
	.....	PI	.....		.....	
	.....	PO	0.182	100.0	0.182	76.4
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.268		0.182	100%	0.238	100%
Standard deviation	0.517		Relative SE: 0.426		Absolute SE: 0.487	
Coef_G relative	0.60					
Coef_G absolute	0.53					

Grand mean for levels used: 3.577

Variance error of the mean for levels used: 0.059

Standard error of the grand mean: 0.244

H. 23. Item 23 G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:51]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 24 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.240		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.127	42.9
	.....	PI	.....		.....	
	.....	PO	0.168	100.0	0.168	57.1
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.240		0.168	100%	0.295	100%
Standard deviation	0.490		Relative SE: 0.410		Absolute SE: 0.543	
Coef_G relative	0.59					
Coef_G absolute	0.45					

Grand mean for levels used: 3.877

Variance error of the mean for levels used: 0.130

Standard error of the grand mean: 0.360

H. 24. Item 24 G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:51]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 25 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.277		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		(0.000)	0.0
	.....	PI	.....		.....	
	.....	PO	0.151	100.0	0.151	100.0
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.277		0.151	100%	0.151	100%
Standard deviation	0.526		Relative SE: 0.388		Absolute SE: 0.388	
Coef_G relative	0.65					
Coef_G absolute	0.65					

Grand mean for levels used: 3.762

Variance error of the mean for levels used: 0.003

Standard error of the grand mean: 0.057

H.25. Item 25 G analysis

File C:\Users\fdh3728\Desktop\WHO.gen - [2019-07-06 11:52]

WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 26
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.146		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.036	15.8
	.....	PI	.....		.....	
	.....	PO	0.193	100.0	0.193	84.2
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.146		0.193	100%	0.229	100%
Standard deviation	0.382		Relative SE: 0.439		Absolute SE: 0.479	
Coef_G relative	0.43					
Coef_G absolute	0.39					

Grand mean for levels used: 3.910

Variance error of the mean for levels used: 0.039

Standard error of the grand mean: 0.197

H. 26. Item 26 G analysis

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WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Occassion	O	3	INF	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.142		.....		.....	
	.....	I	.....		.....	
	.....	O	.....		0.023	9.2
	.....	PI	.....		.....	
	.....	PO	0.231	100.0	0.231	90.8
	.....	IO	.....		.....	
	.....	PIO	.....		.....	
Sum of variances	0.142		0.231	100%	0.255	100%
Standard deviation	0.377		Relative SE: 0.481		Absolute SE: 0.505	
Coef_G relative	0.38					
Coef_G absolute	0.36					

Grand mean for levels used: 3.931

Variance error of the mean for levels used: 0.026

Standard error of the grand mean: 0.162

Appendix F. WHOQOL-5 G analysis

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WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	3 4 5 6 7 8 9 10 11 12 13 14 15 16 18 19 21 22 24 25 26
Occassion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	204.234	129	1.583	0.044	0.050	0.050	5.3	0.014
I	34.085	4	8.521	-0.019	-0.019	-0.018	0.0	0.022
O	124.378	2	62.189	0.072	0.076	0.076	8.1	0.068
PI	524.182	516	1.016	0.159	0.159	0.159	16.8	0.022
PO	115.222	258	0.447	-0.019	0.002	0.002	0.2	0.009
IO	124.278	8	15.535	0.115	0.115	0.115	12.2	0.053
PIO	557.455	1032	0.540	0.540	0.540	0.540	57.3	0.024
Total	1683.834	1949					100%	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.050		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		0.025	28.4
	.....	PI	0.027	46.3	0.027	29.8
	.....	PO	0.001	1.2	0.001	0.8
	.....	IO	.....		0.006	7.2
	.....	PIO	0.030	52.5	0.030	33.8
Sum of variances	0.050		0.058	100%	0.089	100%
Standard deviation	0.224		Relative SE: 0.240		Absolute SE: 0.299	
Coef_G relative	0.47					
Coef_G absolute	0.36					

Grand mean for levels used: 3.991

Variance error of the mean for levels used: 0.033

Standard error of the grand mean: 0.181

Appendix E. WHOQOL-8 G analysis

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WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	3 4 5 6 7 8 9 11 13 14 15 16 18 21 22 24 25 26
Occassion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	191.271	129	1.483	0.027	0.033	0.033	3.7	0.008
I	143.491	7	20.499	-0.011	-0.011	-0.010	0.0	0.033
O	43.321	2	21.661	-0.002	0.005	0.005	0.5	0.017
PI	828.509	903	0.918	0.136	0.136	0.136	15.6	0.015
PO	107.762	258	0.418	-0.011	0.008	0.008	0.9	0.005
IO	340.715	14	24.337	0.183	0.183	0.183	21.0	0.066
PIO	917.535	1806	0.508	0.508	0.508	0.508	58.2	0.017
Total	2572.604	3119					100%	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.033		.....		.....	
	.....	I	.....		(0.000)	0.0
	.....	O	.....		0.002	4.1
	.....	PI	0.012	40.6	0.012	32.9
	.....	PO	0.003	9.1	0.003	7.4
	.....	IO	.....		0.005	14.7
	.....	PIO	0.015	50.3	0.015	40.9
Sum of variances	0.033		0.030	100%	0.037	100%
Standard deviation	0.180		Relative SE: 0.174		Absolute SE: 0.193	
Coef_G relative	0.52					
Coef_G absolute	0.47					

Grand mean for levels used: 4.079

Variance error of the mean for levels used: 0.008

Standard error of the grand mean: 0.087

Appendix I. SCI <0.60 G analysis

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WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 11 12 14 15 16 17 20 21 22 23 24 25
Occassion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	193.716	129	1.502	0.048	0.049	0.049	5.4	0.011
I	213.173	5	42.635	0.064	0.064	0.061	6.7	0.061
O	11.468	2	5.734	-0.015	-0.010	-0.010	0.0	0.011
PI	467.161	645	0.724	0.033	0.033	0.033	3.6	0.016
PO	138.866	258	0.538	-0.014	0.010	0.010	1.1	0.009
IO	176.620	10	17.662	0.131	0.131	0.131	14.4	0.055
PIO	806.380	1290	0.625	0.625	0.625	0.625	68.7	0.025
Total	2007.383	2339					100%	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.049		.....		.....	
	.....	I	.....		0.008	16.6
	.....	O	.....		(0.000)	0.0
	.....	PI	0.004	12.5	0.004	8.9
	.....	PO	0.003	9.0	0.003	6.5
	.....	IO	.....		0.006	11.8
	.....	PIO	0.028	78.5	0.028	56.3
Sum of variances	0.049		0.035	100%	0.049	100%
Standard deviation	0.222		Relative SE: 0.188		Absolute SE: 0.222	
Coef_G relative	0.58					
Coef_G absolute	0.50					

Grand mean for levels used: 4.016

Variance error of the mean for levels used: 0.015

Standard error of the grand mean: 0.121

Appendix J. SCI <0.70 G analysis

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WHO_G

Observation and Estimation Designs

Facet	Label	Levels	Univ.	Reduction (levels to exclude)
Person	P	130	INF	
Item	I	26	26	1 2 3 4 5 6 7 8 11 12 13 14 15 16 17 19 20 21 22 23 24 25 26
Occassion	O	3	INF	

Analysis of variance

				Components				
Source	SS	df	MS	Random	Mixed	Corrected	%	SE
P	122.144	129	0.947	0.048	0.048	0.048	5.4	0.016
I	60.956	2	30.478	0.053	0.053	0.051	5.7	0.057
O	59.674	2	29.837	0.052	0.054	0.054	6.1	0.056
PI	172.822	258	0.670	0.003	0.003	0.003	0.3	0.024
PO	131.438	258	0.509	-0.051	-0.025	-0.025	0.0	0.020
IO	39.439	4	9.860	0.071	0.071	0.071	8.0	0.044
PIO	341.450	516	0.662	0.662	0.662	0.662	74.5	0.041
Total	927.922	1169					100%	

G Study Table

(Measurement design P/IO)

Source of variance	Differ-entiation variance	Source of variance	Relative error variance	% relative	Absolute error variance	% absolute
P	0.048		.....		.....	
	.....	I	.....		0.016	14.2
	.....	O	.....		0.018	16.6
	.....	PI	0.001	1.2	0.001	0.8
	.....	PO	(0.000)	0.0	(0.000)	0.0
	.....	IO	.....		0.007	6.6
	.....	PIO	0.068	98.8	0.068	61.8
Sum of variances	0.048		0.068	100%	0.109	100%
Standard deviation	0.219		Relative SE: 0.262		Absolute SE: 0.331	
Coef_G relative	0.41					
Coef_G absolute	0.30					

Grand mean for levels used: 4.078

Variance error of the mean for levels used: 0.042

Standard error of the grand mean: 0.205