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**Gregory J. Boyle**, PhD (Delaware), PhD (Melbourne), DSc (Queensland), is a Fellow of the Association for Psychological Science, and of the Australian Psychological Society, and was Professor of Psychology at Bond University, Queensland for 20 years. Currently, he is a Professorial Fellow in the Melbourne Graduate School of Education, University of Melbourne, and Head of School at the Australian Institute of Psychology. He also served as Associate Dean for Research at Bond University for several years, and as a research consultant to the Australian Army Psychology Corps (Hon Rank: LTCOL) for over two decades. In 2005, he was recipient of the Buros Institute of Mental Measurements Distinguished Reviewer Award. Professor Boyle has given invited lectures in prominent universities including Oxford University, Stanford University, and Princeton University. He has contributed over 200 publications, is co-author of a book on statistical methods, and senior editor of international handbooks, including *The SAGE Handbook of Personality Theory and Assessment* (2 Vols.), the SAGE benchmark series on *Individual Differences* (4 Vols.), and *Psychological Assessment* (4 Vols.), and more recently, *Measures of Personality and Social Psychological Constructs* (Academic Press). He is also a co-editor of the current volumes.

**John G. O'Gorman** PhD (Queensland) is currently an Adjunct Professor in the School of Applied Psychology, Griffith University, Queensland, Australia. Previously, he was the Foundation Professor of Psychology and inaugural Dean of the Faculty of Health and Behavioural Sciences at Griffith University, for many years. Subsequently, Professor O'Gorman served as Pro-Vice-Chancellor at the Australian Catholic University with special responsibility for quality management. He is a Fellow of the Australian Psychological Society, and former Chair of the Australian Psychological Society (APS) College of Organisational Psychologists. His extensive research interests include selection and assessment, as well as personality and organisational psychology. He is a co-author, with Shum, Myers and Creed, of *Psychological Testing and Assessment* published by Oxford University Press. He is also a co-editor of the current volumes.

**Gerard J. Fogarty**, PhD (Sydney), is an Adjunct Professor in the Australian Centre for Sustainable Business Development at the University of Southern Queensland (USQ). After completing his PhD in 1984, he worked in industry as a training technology manager until 1988 when he accepted the position of Principal Lecturer in Psychology at USQ. Since then, he has held various positions including Head of the Department of Psychology, Director of the Centre for Organizational Research and Evaluation, and Pro-Vice-Chancellor (Research). Outside the university, he holds the rank of LTCOL within the Australian Defence Force where he contributes to research projects conducted by the Directorate of Flying Safety, Fleet Air Arm, and the Directorate of Occupational Psychology and Health Analysis. He is a Fellow of the Australian Psychological Society, a member of the Australian Aviation Psychology Association, a member of the American Psychological Association – Society for Industrial and Organisational Psychology (SIOP), and a highly-published researcher in the fields of organisational psychology, human factors, aviation psychology, intelligence, and sport psychology. He is also a co-editor of the current volumes.

SAGE BENCHMARKS IN PSYCHOLOGY

# **WORK AND ORGANISATIONAL PSYCHOLOGY**

## **VOLUME I**

*Research Methodology*

Edited by

Gregory J. Boyle,  
John G. O’Gorman and Gerard J. Fogarty

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Production controller: Bhairav Dutt Sharma  
Proofreader:  
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# Introduction: Research Methodology in I/O Psychology

*Gregory J. Boyle, John G. O’Gorman and Gerard J. Fogarty*

Changes are constantly occurring in industrial-organisational (I/O) psychology in response to the emergence of new theories and adoption of new research methodology (see Porter & Schneider, 2014). For example, the issue of bias in selection testing (Volume II) has had a dramatic impact on the organisational psychology (OP) field and has stimulated research into new constructs, such as organisational behaviour (OB), and pre-employment integrity tests (Ones et al., 2003). In addition, problems that employees face transferring newly acquired skills to the workplace have also been the subject of considerable research efforts (Baldwin & Ford, 1988). In recent decades, there have been major advances in I/O research methodology and multivariate statistical procedures, most notably, meta-analysis. Likewise, as Aamodt (2013) point out, there have been advances in technology with the advent of the *World Wide Web* (Internet) enabling online screening and recruitment of job applicants, use of social media (Twitter, Facebook, LinkedIn), e-learning and distance education.

Articles in this volume include those that deal with the rise and decline of various methodological approaches, articles that question established research practices and promote improved practices, as well as articles that propose new research strategies and techniques. The review by Aguinis et al. (2011) concludes that changes in I/O research methodology occur only slowly (cf. Scandura & Williams, 2000). Aguinis et al. observe that subjective self-report and survey methods are still the mainstay of data collection and analysis, while also noting an increasing emphasis on longitudinal studies, use of Web-based survey data, and multilevel modelling (MLM) (cf. Rowe, 2003). Articles selected highlight common but problematic methodological issues in organisational research and practice.

## Common Method Bias

It is commonly believed that associations between variables measured using the same method will be inflated due to common method variance (CMV; Podsakoff et al., 2003). Campbell and Fiske (1959) identified CMV as a problem in psychological measurement and proposed a technique for separating

trait from method variance. As is still the case today, the major source of CMV results from the use of self-report measures. Adding to this problem is the consistency motif, when respondents make judgements consistent with their own particular theories, making them “prey to illusory correlations” (Podsakoff & Organ, 1986). Socially desirable responding (Hermes et al., 2015) also may result in distorted responses, so that the use of introspective self-reports or reports of others remains problematic. As Boyle et al. (2008) stated, use of opinionnaires is subject to “item transparency and resultant motivational and response distortion, ranging all the way from deliberate dissimulation, to either conscious or unconscious faking (good or bad), to lack of adequate self-insight, and/or biased perceptions of others.” In an attempt to counteract the impact of biased responding, Podsakoff and Organ suggest some procedural and *post hoc* statistical corrections. In contrast, Spector (2006) suggests that the undue focus on CMV should be replaced with a focus on specific measurement biases and “plausible alternative explanations for observed phenomena, regardless of whether they are from self-reports or other methods.” Clearly, the onus is on researchers to identify as many as possible of the sources of bias and to estimate and control their impact.

Spector and Brannick (2011) highlight the misuse of statistical control variables in I/O research. They report that control variables “not linked to the hypotheses and theories being tested” are included in many I/O studies in the “belief that statistical controls can yield more accurate estimates of relationships among variables of interest.” Spector and Brannick view this as a methodological urban myth, and raise concerns about including control variables. They argue that the “purification principle” leads to erroneous inferences because of the inappropriate manner in which controls are often used. Building on the work of Becker (2005), the authors suggest a more focused, theory-based use of statistical control variables.

## **Research Synthesis Methods: Meta-Analysis**

Historically, meta-analysis (Glass et al., 1981) has been the predominant approach to research synthesis within I/O psychology (Schmidt et al., 2009). “Meta-analysis is the methodology of choice to synthesize existing empirical evidence and draw science-based recommendations for practice in the organisational sciences . . .” (Aguinis et al., 2011). Meta-analysis “has proven to be the most effective tool developed in the I/O field to conduct research synthesis.” (DeGeest & Schmidt, 2011). Given its central role (Cooper, 2010), it is germane to examine the meta-analytic technique itself.

Fernandez and Boyle (1996) provide a detailed guide as to meta-analytic methodology and interpretation, and also discuss its relative merits and shortcomings (see Eysenck, 1984, 1992). Fernandez and Boyle describe meta-analysis as a “quantitative method of cumulating research findings that lends itself especially well to large volumes of literature bedevilled by

conflicting findings... What particularly distinguishes meta-analysis from traditional methods of research review is its focus on the effect size (ES).” The development of meta-analytic techniques to examine the generalizability of predictors of job performance demonstrates that validity coefficients “are not situation-specific and vary mainly because of artefacts like sampling error and range restriction.” Fernandez and Boyle conclude that, “The massive quantitative aggregation ... by meta-analysis has ... enabled a broad, coherent picture to emerge [which] would have been unattainable with the single study and quite elusive in a narrative review of the literature.”

Aguinis et al. (2011) discuss meta-analytic procedures, erroneous understandings, assertions, and underlying assumptions as “myths and urban legends” (MULs) relating to the selection of primary-level studies, advances in meta-analytic methodology on outcomes, and inferences about putative causal relationships. Although Aguinis et al. conclude that, “meta-analysis is the definitive means of summarizing a body of empirical research,” they also point out that the quality of meta-analytic results depends entirely on the quality of the primary studies included (cf. Eysenck, 1984, 1992). The authors also comment on other aspects of meta-analysis, including, for example, the fact that publication bias is no longer assessed using the *failsafe N* procedure (cf. Sutton, 2009).

In a similar vein, DeGeest and Schmidt (2011) trace the development of validity generalisation and its extension to the psychometric meta-analytic techniques within I/O research (Schmidt et al., 2009). De Geest and Schmidt describe the state of I/O research before and after the advent of meta-analytic techniques. According to the authors, prior to the use of meta-analysis, situational specificity theory it was thought that “the predictive validity of personnel selection procedures was situation-specific.” The authors also discuss the impact of meta-analysis on findings within the training and leadership fields. They conclude that, “the psychometric meta-analysis model ... revolutionized thinking in I/O psychology and integrated the concepts of sampling error, measurement error, and range restriction into a compact framework that could be used to develop cumulative knowledge in the field.”

## Exploratory and Confirmatory Factor Analysis

Costello and Osborne (2005) provide best practice guidelines in applying exploratory factor analytic (EFA) methodology. While in software packages such as SPSS and SAS, the outmoded principal components analysis (PCA) method use of the eigenvalues  $\geq 1.0$  criterion, plus varimax orthogonal rotation is the default option, nevertheless, this is a flawed methodology which fails to distinguish between common and unique variance, resulting in spuriously inflated component loadings, and crude solutions (cf. Boyle, 1993). With normally distributed data, the authors recommend use of the maximum-likelihood (ML) method, with factor number determined by the Scree test

(Cattell, 1978), plus direct oblimin oblique rotation. For non-normally distributed data, Costello and Osborne recommend principal axis factoring (PAF). The authors fail to acknowledge that reliance on the eigenvalues  $\geq 1.0$  rule may result in underextraction of factors when the number of variables is  $\leq 20$ , and serious overextraction when there are more than about 35–40 variables (Cattell & Vogelmann, 1977; Hakstian et al., 1982). The authors state that the break in the Scree plot suggests the number of factors. However, Child (1990) has shown that the one additional factor should be extracted (covering the psychometric screen). Costello and Osborne correctly conclude that oblique rotation (direct oblimin or promax) produces more accurate factor solutions than orthogonal (most often varimax) rotation (cf. Cattell, 1978; Gorsuch, 1983). However, Costello and Osborne fail to acknowledge the importance of obtaining *simple structure* solutions (see Thurstone's simple structure criteria in Child, pp. 48–49) by systematically varying the SPSS delta ( $\delta$ ) or kappa ( $\kappa$ ) shift parameters (Boyle & Stanley, 1986). There is no discussion of using the  $\pm .10$  hyperplane count as a quantitative index of simple structure. However, Costello and Osborne show empirically that almost two-thirds of EFA studies in the PscINFO database are based on inadequate sample sizes ( $< 10:1$ ). Even with a ratio of 20:1, only 70% of studies locate the correct factor pattern.

Whereas EFA seeks to map out an uncharted domain, confirmatory factor analysis (CFA) is employed when there is pre-existing evidence or at least an *a priori* theoretical model as to the structural dimensionality (latent trait structure) of a particular domain. As an example, Boyle and Fabris (1992) administered Holland's *Self-Directed Search* (SDS; Holland, 1994) to a sample of 401 apprentice plumbers. While LISREL congeneric factor analyses supported each of the RIASEC themes (except the Realistic theme), an overall CFA revealed an unsatisfactory fit of the data to the 6-factor RIASEC model on which the SDS instrument is based, raising some concern about the construct validity of the RIASEC model and corresponding SDS instrument.

Multiple linear regression (MLR) analysis is also a commonly employed multivariate technique used to identify which predictor variables explain most of the variance in the dependent variable/s (Nimon & Oswald, 2013). Although MLR is a mainstay of I/O research, intercorrelations between predictor variables (multicollinearity) remain problematic. As the authors indicate, when the predictor variables are correlated, the magnitude of the standardized regression (Beta) coefficients is not reliable. In an attempt to minimize this problem, Nimon and Oswald discuss alternative indices, including, "validity coefficients, structure coefficients, product measures, relative weights, all-possible-subsets regression, dominance weights, and commonality coefficients." The authors also provide software options for computing these alternative indices, in the hope that researchers can "understand the predictive relationships and interrelationships among variables in regression models more closely and from different perspectives."



## Structural Equation Modelling and Multilevel Analysis

Determining the sample size needed to undertake valid structural equation modelling (SEM) or CFA is often problematic. These procedures rely on rules-of-thumb in determining sample size requirements (cf. MacCallum et al., 1996). Wolf et al. (2013) employ Monte Carlo simulation techniques for various CFA and SEM models to develop rules about the sample sizes needed in different contexts. They report that the requisite sample size in a given SEM or CFA analysis depends on the magnitude of factor loadings, missing data, reliability of the measures, number of indicators per factor, complexity of the SEM or CFA model, as well as the magnitude of the intercorrelations between factors. The authors point to the inadequacy of such rules-of-thumb, given the significant variability in CFA and SEM sample size requirements.

In addition, MLM has emerged as a powerful data analytic technique (Rowe, 2003) and is now widely used in I/O psychology. Mathieu and Chen (2011) trace the historical development of MLM and describe a number of its limitations. Mathieu and Chen examine challenges associated with use of MLM in management research, pointing out that the current paradigm is plagued by substantial error variance associated with ambiguous measures, nesting assumption violations, integration of longitudinal approaches and nested-arrangements, modelling of existing and future multilevel models, and finally, multidisciplinary influences on multilevel management theory and investigations. The authors discuss each of these limitations in detail, hoping to bring about a paradigm shift in multilevel research within the management field.

## Misuse of Cronbach Alpha Coefficient

The routine reporting of the Cronbach alpha coefficient as the primary evidence of a scale's unidimensionality and/or reliability is unwarranted (Zinbarg et al., 2005). The alpha coefficient cannot assess the consistency of responses over time, but rather reflects the combined influences of internal consistency, and item redundancy, respectively (Boyle, 1991). High levels of item redundancy (due to rephrasing of items) may well result in high alphas (0.8 or 0.9), whereby each item variant provides little/no additional information about the particular construct/factor being measured. Scales with high alpha coefficients may provide a narrow breadth of measurement. Broader scales would be desirable whereby each item measures additional variance associated with the particular construct/factor under consideration. Indeed, Cronbach himself subsequently argued that measurement error is a better metric for assessing reliability. He stated that, *"I no longer regard the alpha formula as the most appropriate way to examine most data. Over the years, my associates and I developed the complex generalizability (G) theory"* (Cronbach & Shavelson, 2004). As a general guide though, Kline (1986) recommended

that alpha coefficients should lie between 0.3 and 0.7 ( $<0.3$  suggesting insufficient internal consistency;  $>0.7$  suggesting excessive item redundancy).

In discussing abuses and misuses of the Cronbach alpha coefficient, Schmitt (1996) also points out that the all too common practice of providing only the alpha coefficient as an index of scale reliability is insufficient and not to be recommended. Schmidt also bemoans that the magnitude of the alpha coefficient does not necessarily indicate the unidimensionality or homogeneity of a scale (since reliability is directly linked to test length – see Spearman-Brown prophecy formula). The author also points out that with multidimensional scales, corrections for attenuation based on the alpha coefficient tend to be excessive. Schmidt also points out that psychometric scales with low alpha levels may still be quite valid and useful.

Likewise, Sijtsma (2009) also highlights the misuse and limited usefulness of the Cronbach alpha coefficient, pointing out that it is neither a measure of “internal consistency” nor “unidimensionality” and that its magnitude often falls outside the range of possible reliability values. The author cautions that, “by continuing to use alpha as *the* estimate of reliability test constructors and test users do themselves injustice. . . . The result of this misinterpretation of alpha is that due to a high alpha value, trait validity . . . often is taken for granted when, in fact, it has not been investigated at all.”

Adding further “fuel to the fire”, Cho and Kim (2015) also discuss common misconceptions surrounding the Cronbach alpha coefficient – that it measures reliability, that it estimates internal consistency, that scale reliability is increased by deleting items using “alpha if item deleted,” and that its magnitude should be  $\geq 0.7$ . Cho and Kim conclude that, “Alpha is a relatively inferior method despite its widespread use . . .” They argue that articles accepted for publication in I/O journals should not rely solely on the inferior alpha coefficient. The authors recommend that SEM-based estimates of reliability should be reported, rather than alpha coefficients when either the assumptions of unidimensionality or tau-equivalency are not satisfied.

## **Temporal Consistency Reliability**

Temporal consistency is typically examined by means of test–retest correlations – both for immediate test–retest (dependability) coefficients and longer-term test–retest (stability) coefficients over days, weeks, months, years, and so on (cf. Cattell, 1973). For both state and trait measures, dependability coefficients should be high (0.8 or 0.9), while longer-term stability coefficients should remain high for trait measures, but for situationally sensitive state measures, test–retest correlations should be lower (Boyle et al., 2008). Historically, test–retest correlations have been calculated on total scores, but as DeSimone (2015) points out, this practice overlooks important information related to the consistency of (1) individual items, (2) item inter-relationships, and (3) individual responding. DeSimone suggests additional

statistics for assessing temporal consistency of a scale (cf. Revelle & Condon, 2014; Thompson & Vacha-Haase, 2000). In addition, DeSimone points out that, “inclusion of random and inconsistent responders has the potential to occlude estimates of temporal consistency. G-theory provides tools to assess the amount of observed score variance attributable to persons and items.” Inclusion of fully worked examples is helpful in understanding the principles underlying the new techniques and demonstrates the potential utility of each proposed new statistic to enhance the assessment of temporal consistency.

## Summary

Evidently, changes in methodological approaches used in organisational research occur slowly. Despite the well-documented limitations, much of the I/O research continues to rely on introspective (subjective) self-report measures. Although common method bias has been discussed extensively in the literature, this still remains problematic. The inappropriate use of “control variables” in organisational research continues to invalidate the testing of hypotheses. Research synthesis methods, such as meta-analysis have revolutionized the field of I/O psychology, with thousands of meta-analytic studies having been published over recent decades, adding greatly to our knowledge. In addition, advances in other multivariate techniques including EFA and CFA, as well as SEM, and MLM have greatly enhanced the I/O psychology knowledge base. However, the commonplace reliance on the Cronbach alpha coefficient as an estimate of “internal consistency” and/or “reliability” of a scale has been shown by several authors to be misplaced, and a range of alternative and more appropriate statistics are discussed.

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