



From paper to web: Mode equivalence of the ARHQ and NEO-FFI



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ABSTRACT

Mixed-mode questionnaires are increasingly used in research. Psychological measures, developed for paper-and-pencil (paper) administration require measurement equivalence testing when administered in an alternative mode. Here, Icelandic translations of the NEO-FFI personality measure and Adult Reading History Questionnaire (ARHQ) were tested for equivalence of measurement and data quality between paper and web mode. Perceived sensitivity of data and preference for survey mode were also assessed. One hundred adults were recruited to answer both modes in a randomized, crossover design. Eighty-eight participants completed both administrations with an average of 63.8 days ($SD = 2.2$) between them. Within-subjects comparisons of means between modes demonstrated measurement equivalence for both measures. However, differing invalidity coefficients by mode observed by multi-trait multi method (MTMM) analysis suggested systematic effects not captured by traditional psychometric evaluation. Of note was a greater tendency for acquiescence responding to the NEO-FFI observed in web mode. Neither personality traits nor ARHQ reading difficulty scores were associated with preference for survey mode. However, 36% of participants who considered their personality data moderately to highly sensitive scored higher in neuroticism and lower in agreeableness compared to those rating their personality data of low sensitivity.

While the Icelandic NEO-FFI and ARHQ have demonstrated measurement equivalence in paper and web mode, mode equivalence of psychometric measures may require ongoing evaluation as perceptions of web privacy continue to evolve.

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1. Introduction

With rapidly increasing use of the World Wide Web (web), web-surveys have become an attractive, cost-effective alternative to the traditional paper-and-pencil (paper) mode when obtaining self-report data from research participants (Ekman, Dickman, Klint, Weiderpass, & Litton, 2006; Herrero & Meneses, 2006). The advantages of web surveys are well documented; they are less expensive than paper surveys, and increasingly cost-effective as sample size increases (Greenlaw & Brown-Welty, 2009). They provide a way to conduct survey studies when it is otherwise impractical or financially unfeasible to access certain study populations (Andrews, Nonnecke, & Preece, 2003; Ekman et al.,

2006). They ensure rapid access to survey data while reducing risks of processing errors during manual data entry. Some contend that as geographic coverage of the web increases worldwide, and web-platforms become cheaper and more accessible (e.g. in smart-phones and tablets) web surveys will rapidly become the norm in survey research (Ekman & Litton, 2007). Indeed, web surveys are increasingly being incorporated into national survey data collection programs due to their cost/time efficiencies (Shin, Johnson, & Rao, 2012).

Despite their many benefits web surveys also entail weaknesses (Evans & Mathur, 2005). Of main concern to researchers are data quality concerns associated with selection and mode effects (Shin et al., 2012). When using web surveys only, researchers run the risk of selection effects associated with differing levels of web access and computer experience in socioeconomic and age groups or the so-called digital divide, i.e. differing levels of web access and

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computer experience between socioeconomic and demographic groups (Rhodes, Bowie, & Hergenrather, 2003). To counter selection effects, multi-mode methods, allowing participants to choose between survey modes, have been used with good results (Greenlaw & Brown-Welty, 2009; Smith, Smith, Gray, & Ryan, 2007). Mode effects on the other hand are more difficult to counter with study design. Although considerable research has examined mode effects on data quality and measurement errors, findings are inconsistent and vary according to survey samples and study designs (Shin et al., 2012). While a number of studies have reported equivalence between paper and web administrations of various psychometric measures; e.g. a selection of Goldberg's Big Five personality items (Chuah, Drasgow, & Roberts, 2006), measures of psychological distress (Herrero & Meneses, 2006), and multifactor leadership (Cole, Bedeian, & Feild, 2006), other studies have shown evidence to the contrary. These studies have described how some measures, when computerized or administered in web surveys, tend to inflate scores or increase participants' tendency to report severity or clinical importance. This has been noted e.g. in measures of emotional functioning and attachment (Fouladi, McCarthy, & Moller, 2002), and in measures of anxiety, neuroticism, and openness (Fouladi et al., 2002; George, Lankford, & Wilson, 1992; Johnson, 2005). Furthermore, studies have suggested that social desirability responding (the tendency of participants' to provide answers that are in alignment with accepted social norms) can differ between administration modes (Kreuter, Presser, & Tourangeau, 2008; Tourangeau & Yan, 2007). These inconsistent results may relate to both the nature of the research topic, e.g. differences in sensitivity and social desirability bias of the measures compared, and the research design, with an overemphasis on between-group comparisons of survey modes that risk confounding of mode effects with group effects. Experimental studies, which randomize to survey mode and compare measures within subjects, can produce better estimates of mode effects that can be applied to adjustment decisions of subsequently collected data and when combining datasets across administration modes. This, however, raises the question of which mode to adjust to? Although most psychometric measures have been established via paper administration, could web-administration yield more valid and reliable results? If mode effects are demonstrated, web norms for psychometric measures may need to be established as well as traditional paper norms to allow fair comparisons between data obtained in the respective modes.

The present study was conducted to assess mode effects of web administration on two paper-developed psychometric measures that have been used within the context of genetic studies in Iceland where participants are offered a choice between paper and web mode. These are the NEO-FFI personality measure by Costa and McCrae (1992) and the Adult Reading History Questionnaire (ARHQ) by Lefly and Pennington (2000). Both measures have been translated to Icelandic and tested in paper administrations to establish Icelandic norms and cutoffs (Bjornsdottir, Jonsson, et al., 2013; Bjornsdottir, Halldorsson, et al., 2013), but their measurement equivalence in web mode had not been tested in any language. Just as translated versions of psychometric measures require testing for measurement equivalence across languages, measures that are "translated" from their original paper mode to other administration modes must also be evaluated (International Test Commission, 2006; Naglieri et al., 2004). Such is the aim of the present study.

2. Previous studies of mode effects on NEO-FFI and ARHQ

2.1. The Adult Reading History Questionnaire (ARHQ)

Measuring reading disabilities with a questionnaire that requires reading and comprehension of written text may intuitively

seem problematic. However, adults with reading disabilities and adult dyslexics were included in testing of the paper ARHQ questionnaire in the original language (Lefly & Pennington, 2000) and the Icelandic ARHQ (Bjornsdottir, Halldorsson, et al., 2013) with good results. Reports on computer and/or web administration of the ARHQ were not found, but these self-administration modes may be particularly beneficial to dyslexic individuals as they can adjust text properties and features that can facilitate reading, such as increasing text size, changing font and adjusting color of text and/or background (McCarthy & Swierenga, 2009). Accordingly, computerized and web-based surveys may become even more appropriate in studies of reading difficulty and dyslexia than the traditional paper mode. Hence, a comparison of web and paper administration of this measure is timely.

2.2. The NEO-FFI personality measure

The NEO-FFI is copyrighted by PAR Inc. and can be ordered for administration in both paper and computer forms implying measurement equivalence. However, the few studies using a within subjects design to compare measurement properties of the NEO-FFI between these modes provide inconsistent results. In a balanced, repeated measures study of the German NEO-FFI translation, 220 participants answered both traditional paper and local computer versions of the measure with 4–6 weeks between administrations (Rammstedt, Holzinger, & Rammesayer, 2004). Means and standard deviations were found comparable across survey modes and internal consistencies, retest reliability, and factorial validity of the computerized and the conventional paper versions proved to be highly similar (Rammstedt et al., 2004). Another study, also using a within-subjects design, administered the NEO-FFI to 76 female US undergraduates in both local computer and paper mode with 10–21 days between administrations (Naus, Philipp, & Samsi, 2009). The results indicated no mode differences for two of the five personality scales (neuroticism and extraversion). However, when answering the computer survey, participants' responses represented higher openness, lower agreeableness, and lower conscientiousness compared to their paper responses, indicating a mode effect (Naus et al., 2009). Anonymous data collected within student samples, often under obligatory conditions for course credit, can, however, be problematic when it comes to data quality, especially in lengthy surveys (Meade & Craig, 2012). Furthermore, the research hypotheses tested in both within-subjects mode-effect studies is that of a difference between modes, the null-hypothesis stating that no difference will be found. Even if the evidence is not strong enough in favor of a difference, equivalence cannot be determined (Walker & Nowacki, 2011).

Although computerization is necessary for web administration, these modes (local computer and web) entail considerable differences especially in terms of participants' perception of privacy and security of their personal data (Denniston et al., 2010). While both modes require interaction with a computer, the computer mode has participants save their data to a computer within a controlled research setting, whereas the web mode requires participants to send their personal data over the web; an entirely different experience with regards to perceived privacy and security of the data sent. Indeed, the perception of privacy of web data may be increasingly compromised in light of recent reports of widespread web surveillance by government agencies (Sengupta, 2013). Hence, studies comparing paper mode to computer mode can at best provide an indication of mode effects in web administration. The inconsistent results of the within subjects paper-computer comparisons of the NEO-FFI and the lack of within subjects web-paper comparisons of both NEO-FFI and ARHQ are further indications for the present study.

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