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Does e-assessment always fit digital natives? A within-subject comparison between paper- and tablet-based gambling assessments in adolescents

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Abstract

Technological development has enabled the use of sophisticated methods for assessing multiple human behaviors. Despite the advantages of these new technologies, concerns exist regarding their equivalence with paper-based measures in epidemiological and health-related surveys. To date, literature on this topic in relation to adolescents is virtually nonexistent. This study compares respondents' performance on the same survey using both paper- and electronic tablet-based assessment methods. A final sample of 135 adolescents (mean age 17.30 years, $SD = 0.59$; 56.3% males) consecutively completed two versions of the same survey on gambling behaviors and two questionnaires: The Gambling Motives Questionnaire (GMQ) and the South Oaks Gambling Screening-Revised for Adolescents (SOGS-RA). An ad-hoc questionnaire assessing participants' satisfaction levels with each method was also used. The digital survey yielded a lifetime, past year, and past month gambling prevalence of 54.1%, 45.2%, and 27.4%, respectively. Paper-based prevalence rates were 3.7-5.2% lower (all $p < .092$) and there were discrepancies in gambling activities. Although the reliability of the questionnaires was high in both formats, total scores were consistently higher in the paper-based format. GMQ and SOGS-RA intraclass correlations between versions ranged from .856-.884. Unexpectedly, students preferred the paper-based survey to the e-assessment (51.5% vs. 48.5%) and also enjoyed it more (31.3% vs 26.1%). Paper- and tablet-based surveys yield different, albeit non-statistically significant, estimations of gambling behaviors even when the same participants were surveyed at one time. We recommend that consistency be routinely checked across assessment formats when adapting paper-and-pencil measures to digital formats.

Keywords: Tablet-based assessment; paper-and-pencil; health survey; gambling; adolescents.

Resumen

¿La evaluación electrónica siempre se adapta a los nativos digitales? Una comparación intra-sujeto de la evaluación del juego de azar entre papel y tabletas electrónicas en adolescentes. El desarrollo tecnológico ha permitido el uso de métodos sofisticados de evaluación de múltiples comportamientos humanos. A pesar de los avances de estas nuevas tecnologías, existen preocupaciones sobre su equivalencia con las medidas de papel y lápiz en encuestas epidemiológicas y de salud. Hasta la fecha, la literatura en el tema en relación con los adolescentes es prácticamente inexistente. Este estudio compara el desempeño de los participantes sobre la misma encuesta utilizando métodos de evaluación de papel y lápiz y electrónicos. Una muestra de 135 adolescentes (edad media 17.30 años, DT = 0.59; 56.3% hombres) completaron consecutivamente os versiones de la misma encuesta sobre conductas de juego y dos cuestionarios: el Cuestionario de Motivos de Juego (GMQ) y el Cribado de Juego de South Oaks en su versión revisada para adolescentes (SOGS-RA). También se utilizó un cuestionario ad-hoc para evaluar el nivel de satisfacción de los participantes en cada método. La encuesta digital arrojó una prevalencia de juego vida, año y mes de 54,1%, 45,2%, y 27,4%, respectivamente. Las prevalencias en papel fueron 3,7-5,2% menores (todas $p < ,092$) y se mostraron discrepancias en las actividades de apuestas. A pesar de que la fiabilidad de los cuestionarios fue alta en ambos formatos, las puntuaciones totales fueron consistentemente más altas en el formato en papel. Las correlaciones intraclase en el GMQ y SOGS-RA oscilaban entre ,856 - ,884. Inesperadamente, los estudiantes preferían la encuesta en papel sobre el formato digital (51,5% vs. 48,5%) y también lo disfrutaron más (31,3% vs 26,1%). La encuesta en papel y en tableta electrónica mostraron estimaciones diferentes, aunque no estadísticamente significativas, en las conductas de juego, incluso a pesar de haber sido encuestados en el mismo momento. Recomendamos comprobar de manera rutinaria la consistencia entre formatos de evaluación cuando se adapten medidas de papel y lápiz a formato digital.

Palabras clave: Evaluación con tabletas; papel y lápiz; encuesta de salud; juego de apuestas; adolescentes.

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Introduction

Fostered by technological development, there are available a plethora of highly sophisticated methods for assessing human behavior. Computerized systems are more efficient and cost-effective than paper-and-pencil formats and present several advantages such as being easier to store and less probable to misplace, or having less or no missing data. Also, electronic assessments can handle complex skip patterns, which allows professionals to provide participants with personalized surveys by presenting only relevant questions (Gwaltney et al., 2008). These and other advantages of e-assessments (Noyes & Garland, 2008) help to reduce errors when collecting data, which is especially relevant in population-based health surveys. However, the growing use of such technology has also raised concerns about its disadvantages, such as the lack of environmental control, software- or hardware-related issues, or confidentiality concerns among others (Noyes & Garland, 2008).

One of the most important issues is the variance of scores and their equivalence across different assessment formats (Monteiro et al., 2018). Previous empirical evidence and systematic reviews on educational and cognitive tests have yielded mixed results on this issue. While some studies suggest that computer-based tests are more reliable and efficient than paper-and-pencil ones (Piaw, 2011), others found no difference in reliability or validity (Boo & Vispoel, 2012; Monteiro et al., 2018; Piaw, 2012), at least when using the classical test theory paradigm (Retnawati, 2015). Also, a recent study found a higher reliability for paper-based (vs computer-based) formats (Bailey et al., 2018). The authors showed that measurement equivalence between formats was not found for some tasks and that the assessment method was related to specific errors made by the participants on a spatial visualization task. This is important because electronic adaptations of classical tests may modify some of their features, precluding critical behavioral processes from being elicited and jeopardizing the potential utility of this technology. For example, replacing the oral response to listed stimuli with manual responses to single stimulus in e-versions of the Stroop test diminishes the interference effect (Penner et al., 2012).

Most of the evidence introduced above stems from cognitive tests where participants have to respond to different tasks, so the results may not generalize to epidemiological studies. Few studies have compared the two assessment formats in research exploring the prevalence of health-related behaviors. E-assessment in clinical settings and epidemiological studies reduces time needed to assess target populations, and increases accuracy (Lai et al., 2016), especially when surveying about sensitive behaviors. In this sense, the use of digital devices to assist surveys increases the response rate in questions about sex, makes it more probable that participants will finish the assessment, and reduces the probability of missing data in adolescents and young adults (Spark et al., 2015). Setting the web-based survey as predetermined compared to offering both paper- and web-based options also seems to reduce missing data without causing differences in response rates or health indicators (Mauz et al., 2018).

Surveys on substance use also benefit from e-assessment as participants may distort their responses in face-to-face interviews. In fact, computer-assisted assessments, compared to paper-based ones (Gnambs & Kaspar, 2014) and telephone interviews (Beck et al., 2014), yielded higher rates of substance use, especially among the most undesirable behaviors (use of cocaine, heroin, LSD) and in the youngest participants. Higher informed use of cannabis in a web group compared to offline respondents was also reported (Khazaal et al., 2015). However, the authors suggested that this variation may be derived from differences in participants' characteristics (the website focused on people seeking help for cannabis addiction vs primary health care, general psychiatric clinic, and addiction treatment facilities) (Khazaal et al., 2015).

In line with the continuum from desirable to undesirable behaviors (Spark et al., 2015), one of the few studies conducted in adolescents found no differences in alcohol use between paper- or web-based surveys (Livingston et al., 2015). However, it is possible that differences exist in less prevalent or more socially-sanctioned behaviors among adolescents such as gambling. Considering the problems in contacting and surveying gamblers (Meyer et al., 2015), the use of new technologies may overcome existing barriers, as these technologies are preferable to most professionals and patients in clinical settings (Lai et al., 2016) and increase participant's motivation to take tests (Piaw, 2011) by offering more operational features than paper-based protocols (Boo & Vispoel, 2012).

Current available evidence presents different methodological limitations which preclude the establishing of definitive results regarding the equivalence of these methods. One of the most important limitations is that, with some exceptions (Monteiro et al., 2018), the extant evidence is based on cohort or quasi-experimental studies with Solomon designs where different participants use different assessment methods. Although correlations between formats are similar to the test-retest correlation of the same format (Gwaltney et al., 2008), studies are required that compare the same sample participating in both assessment methods.

The objective of the present study was twofold: 1) to compare results from the same gambling survey carried out via two different formats (i.e., tablet- and paper-based) by the same group of adolescents, and 2) to collect participants' feedback and levels of satisfaction with the two assessment methods. We expect the e-assessment to yield a higher prevalence of gambling. Also, we expect adolescents to prefer and consider safer (in terms of confidentiality) the tablet-based rather than the paper-based assessment.

Materials and methods

Participants

Cases

Participants were a subsample of a cohort study comprising 1,267 students from 16 Spanish high schools, assessed between October and December 2015 (González-Roz et al., 2017; Weidberg et al., 2018), and selected based on their scores in the South Oaks Gambling Screen questionnaire. Of all participants, 498 reported past year gambling of whom 67 were at-risk (n = 52) or problem gamblers (n = 15). Schools were re-contacted after two years (January-March 2018). Of the 16 participating high schools, three destroyed the documents relating the ID codes to the participants' names, thereby precluding their inclusion in the present study (12 at-risk gamblers were missed). Of the 13 remaining schools, two declined to participate in the follow-up assessment (including 3 at-risk and 3 problem gamblers). Of the 49 remaining participants identified as problem gamblers in the first wave, 18 were still attending the high school (21 at-risk and 10 problem gamblers were missed) and 14 returned their parents' written consent to participate in a follow-up assessment (4 at-risk gamblers were missed). Therefore, the case group was comprised of 14 participants, who were classified in the first wave as either at-risk (n = 12) or

problem (n = 2) gamblers.

Controls

Controls were selected from the remaining 1,199 participants without problem gambling (González-Roz et al., 2017), considered as two categories: non-gamblers and gamblers without problem gambling. Participants were randomly selected from the participating centers. Of the 91 non-problem gamblers and 108 non-gambler controls, 69 in each category (75.8% and 63.9%, respectively) agreed to participate.

Final sample

The final sample comprised 152 participants, of whom 14 were problem gamblers, 69 non-problem gamblers, and 69 non-gamblers. Due to random responses during the assessment, data from 17 participants were excluded. The sample used in this study was 135 (mean age 17.30 years, *SD* = 0.59; 56.3% males), of whom 11 (8.14%) were classified in the first wave as at-risk or problem gamblers, 64 (47.41%) as non-problem gamblers, and 60 (44.4%) as non-gamblers. The local educational authorities and the participating schools approved this study.

Procedure

Students were assessed in their classroom, sitting at individual desks. They were required to complete a battery of questions in two different formats (paper and digital). Both formats had the same questions and the assessing order was counterbalanced. The digital assessment was performed with electronic tablets (Samsung Galaxy Tab 2 10.1), which enabled the verification of consistent responses (e.g., frequency of gambling between different time periods) and the selection of relevant questions in accordance with the respondents' previous answers. After completing both assessments, participants were asked to evaluate the two formats in terms of confidentiality and comfort using a paper-and-pencil questionnaire.

Instruments

Demographic data and validity control. Data regarding age and sex were collected. The Oviedo Infrequency Scale (Fonseca-Pedrero et al., 2009) was also used with the aim of detecting random responses. The questionnaire consists of 12 Likert-type items (from totally disagree to totally agree). Participants with three or more wrong answers were excluded as per authors' guidelines.

Gambling behavior. The frequency of lifetime, past year, and past month engagement in seven gambling activities [bingo, poker, other casino games (OCGs), sports betting, lottery, scratch-tickets and slots/electronic gaming machines (EGMs)] was assessed through an *ad-hoc* questionnaire. Data on age of onset, type of gambling venue (i.e., land-based or online), and time and money invested in gambling were also collected.

Gambling motives. Gamblers were also asked about their gambling motives using the Spanish version (Grande-Gosende et al., 2019) of the Gambling Motives Questionnaire (GMQ; Stewart & Zack, 2008). This questionnaire assesses three motives (i.e., enhancement, coping, and social) using 15 Likert-type questions (from never or almost never = 1, to almost always or always = 4). The internal consistency of the three scales was adequate (ENH: α = .85; COP: α = 0.87; SOC α = 0.80).

Problem gambling severity. Participants who reported having gambled in the past year were asked to complete the Spanish version (Becoña, 1997) of the South Oaks Gambling Screen for Adolescents (SOGS-RA) (Winters et al., 1993). This questionnaire uses 12 dichotomous items to classify gamblers into three categories: non-problem (scores 0-1), at-risk (scores 2-3), and problem (scores 4 points or more) gamblers. The internal consistency was good (α = .80).

Confidentiality, comfort, and veracity questionnaire. After finishing both batteries, participants completed a survey on the perceived confidentiality, comfort, and veracity of each format. Specifically, participants were asked about their concerns regarding the possibility of others being able to see their responses, the most confidential format, the most preferable/enjoyable format, whether they experienced any problems when completing each survey, the likelihood of answering sincerely in each format, and the belief of having made any mistakes when answering the questions.

Data analysis

Descriptive statistics were used to inform on the prevalence of gambling as well as to characterize participants in terms of their gambling involvement. The reliability of the SOGS-RA and GMQ scales in each format was estimated through Cronbach's alpha for internal consistency. With the aim of exploring the consistency of responses between formats, the intraclass correlation for absolute agreement (ICC; two-way-mixed) was calculated for the SOGS-RA and GMQ scales. The Cronbach's alpha of the subscales of both questionnaires was also compared across formats using Feldt's method (Muñiz, 2018). Prevalence of gambling and gambling problems was compared between the two formats using McNemar's test. Descriptive statistics were used to report participants' opinions on both formats. All analyses were performed using SPSS v.24.

Results

Prevalence of gambling

Lifetime, past year, and past month gambling prevalence as reported in both formats is shown in Table 1. McNemar's tests suggested non-statistically significant differences between formats. The mean age of gambling onset was virtually the same in the electronic (M = 13.51; SD = 2.39) and paper-based (M = 13.63; SD = 3.28) assessments. However, the latter evinced more dispersion and the age of onset for each gambling activity differed considerably. For instance, when using the e-assessment, participants reported the earliest age for land-based scratch-tickets (M = 13.24 years; SD = 2.7), online lotteries (M = 13.33 years; SD = 4.04), and land-based bingo (M = 13.55 years; SD = 3.36). The paper-and-pencil method informed of *almost* the same gambling activities but with differences in the mean age and standard deviation: land-based scratch-tickets (M = 13.03 years; SD = 3.44), bingo (M = 13.21 years; SD = 2.85), and lotteries (M = 14 years; SD = 3.09). The greatest difference was shown in online poker (d = 0.67 years) and land-based lotteries (d = .53 years).

Table 1. Gambling prevalence comparison between electronic- and paper-based assessment formats

	E-assessment *n* (%)	Paper-based assessment *n* (%)	McNemar's test χ^2 (*p*-value)
Lifetime prevalence	73 (54.1)	68 (50.4)	0.94 (.332)
Past year prevalence	61 (45.2)	56 (41.5)	1.07 (.302)
Sport betting	31 (23)	30 (22.2)	
Lotteries	22 (16.3)	17 (12.6)	

	E-assessment *n* (%)	Paper-based assessment *n* (%)	McNemar's test χ^2 (*p*-value)
Bingo	20 (14.8)	18 (13.3)	
Scratch tickets	16 (11.9)	19 (14.1)	
OCGs	16 (11.9)	17 (12.6)	
Poker	10 (7.4)	13 (9.6)	
EGM	9 (6.7)	9 (6.7)	
Online sport betting	8 (5.9)	12 (8.9)	
Online OCG	5 (3.7)	7 (5.2)	
Online poker	1 (0.7)	1 (0.7)	
Past month prevalence	37 (27.4)	30 (22.2)	2.77 (.092)
Sport betting	20 (14.8)	23 (17)	
OCGs	13 (9.6)	12 (8.9)	
Lotteries	9 (6.7)	4 (3)	
Bingo	9 (6.7)	2 (1.5)	
Scratch tickets	8 (5.9)	8 (5.2)	
Online sport betting	5 (3.7)	7 (5.2)	
Online OCG	5 (3.7)	2 (2.2)	
Poker	3 (2.2)	3 (2.2)	
EGM	2 (1.5)	3 (2.2)	

Note. OCG: Other casino games; EGM: Electronic gaming machines

Gambling behavior

Comparison between assessment formats in terms of gambling involvement is presented in Table 2. Although the absolute figures are quite similar, when it comes to percentages, the difference is considerable. Use of land-based venues and non-strategic and mixed-games were more frequently reported when surveyed through electronic devices (see Table 2). Time expended in gambling was also higher in the e-assessment (*M* = 36.24 minutes, *SD* = 49.40; *Mdn* = 15.5) than in the paper-based version (*M* = 20.36 minutes, *SD* = 26.04; *Mdn* = 9.17). The average bet per game did not differ significantly: e-assessment mean = 3.59 € (*SD* = 3.30, *Mdn* = 2.33) vs 4.02 € (*SD* = 4.54, *Mdn* = 2.10).

Table 2. Gambling involvement comparison between electronic- and paper-based assessment formats

	E-tablet assessment *n* (%)	Paper-based assessment *n* (%)
Past year		
Gambling venues		
Land-based	51 (83.6)	43 (76.8%)
Online	3 (4.9%)	3 (5.4%)
Both	7 (11.5%)	10 (17.9%)
Gambling type[1]		
Strategic games	19 (31.1%)	21 (37.5%)
Non-strategic games	22 (36.1%)	18 (32.1%)
Mixed games	20 (32.8%)	17 (30.4%)
Past month		
Gambling venues		
Land-based	30 (83.3%)	22 (73.3%)
Online	1 (2.8%)	1 (3.3%)
Both	5 (13.9%)	7 (23.3%)
Gambling type[1]		
Strategic games	16 (43.2%)	17 (56.7%)
Non-strategic games	10 (27%)	5 (16.7%)
Mixed games	11 (29.7%)	8 (26.7%)

Note. [1] as classified by Moragas et al. (2015)

Gambling Motives

Cronbach's alpha was comparably low in both formats for enhancement (e-assessment α = .25; paper-based α = .27; ICC = .89) and social (e-assessment α = .44; paper-based α = .44; ICC = .88) motives. The internal consistency of coping motives was higher in the e-assessment (α = .46) than in the paper-based format (α = .31; ICC = .86). Nonetheless these differences were not statistically significant (*p*-values .180 - .503). Mean scores of the three factors were consistently lower in the e-assessment (*M* = 1.92, 1.72, and 2.79; *SD* = 1.58, 1.87, and 1.89, respectively) than in the paper format (*M* = 2.16, 1.96 and 3.36; *SD* = 1.70, 1.83 and 1.91, respectively).

Gambling severity

Internal consistency of the SOGS-RA in the e-assessment (α = .60) was comparable to that of the paper-based one (α = .56; W = 1.089, *p* = .373), as were the mean scores (*M* =0.98 and 1.02; *SD* =1.48 and 1.38, respectively). Despite variations in the number of non-problem gamblers (*n* = 50 and 42, respectively), both formats detected virtually the same cases of at-risk (*n* = 9 and 8) and problem gamblers (*n* = 2 and 3). These figures represent a prevalence of at-risk gambling of 6.7% and 5.9%, and of problem gambling of 1.5% and 2.2% for the tablet- and paper-based formats, respectively. The difference in the prevalence of non-problem gambling vs at-risk/problem gambling between formats was not statistically significant ($\chi^2(1) = 0.167$, *p* = .683). The intraclass correlation between formats was ICC = .88.

Confidentiality, comfort, and veracity survey

Virtually no participants reported concerns about the possibility of others seeing their responses (97.8% and 98.5% were *not* concerned when using the tablet- and paper-based survey, respectively) and over half of them believed the tablet-based format was more private (50.8%) than the paper-pencil assessment (49.2%). Surprisingly, 51.5% (vs 48.5%) of participants preferred the paper-based format and 31.3% (vs 26.1%) enjoyed it "quite a lot" or "a lot". Of all participants, 12.7% experienced a problem when answering using the tablet-based format and 73.9% (vs 68.7%) enjoyed it "not at all" or "a bit". Despite these differences, enjoyment in both formats was statistically equivalent ($\chi^2(1) = 1.44$, *p* = .230). Finally, although 50.8% (vs 49.2%) of participants reported that they were more likely to tell the truth when surveyed using the tablet, a higher percentage (31.3% vs 28.4%, $\chi^2(1) = .432$, *p* = .511) thought that they had made some mistakes when using the tablet compared to paper.

Discussion

This study explored differences in gambling-related indicators among the same participants using two different assessment formats. We highlight two major findings: 1) despite considerable variation in some specific gambling indicators, there were no statistically significant differences between formats in gambling prevalence, gambling motives, or severity; and 2) although both formats were considered private enough, participants preferred the paper-based format and enjoyed it more.

In line with previous evidence (Boo & Vispoel, 2012; Monteiro et al., 2018; Piaw, 2012), e-assessments appeared to be as reliable as paper-based questionnaires. Nonetheless, some indicators such as age at onset, types of gambling activities or gambling venues, and time

expended in gambling yielded higher values in the tablet-based format. Given that participants were surveyed twice in the same session, it would be expected that the recall effect and the salience of the surveyed behaviors had led to higher consistency between formats. The relative variations in the prevalence as indicated by percentages might suggest significant differences if confirmed at the population level. The individual administration of electronic surveys may have prompted participants to report their actual gambling involvement, as it is the case with sexual behaviors (Spark et al., 2015) or illicit drug use (Beck et al., 2014). In light of the cumulative evidence on the reliability of e-assessments on health-related indicators (Gnambs & Kaspar, 2014; Gwaltney et al., 2008), public institutions would be encouraged to perform national surveys implementing these assessment formats.

Contrary to our hypothesis and some previous evidence in adults and young adults (Boo & Vispoel, 2012; Lai et al., 2016; Piaw, 2011), participants found the two formats equally safe and confidential, and a majority of the participants preferred the paper-based assessment and found it more enjoyable. Moreover, a slightly higher percentage of adolescents thought they made more mistakes in the tablet-based formats, despite being digital natives. Evidence on the absence of differences in reading comprehension between formats (Margolin et al., 2013; Porion et al., 2016) suggests that software-related characteristics are critical to improving e-assessment usability and acceptability. Based on these results, we encourage future studies using e-assessment procedures to implement pilot studies to explore evidence for consistency, reliability, and validity based on relationships with paper-based formats, as well as to explore software usability and acceptability using focus groups.

In conclusion, both tablet- and paper-based surveys yielded comparable results on gambling prevalence, motives, and severity. Differences in gambling involvement characteristics call for larger within-subjects studies exploring the effect of formats on epidemiological data. The authors advocate including the examination of the consistency and usability of the between-formats scores as a good practice policy when adapting assessments into digital formats.

Conflict of interest

The authors declare no conflict of interest.

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VML performed the formal analysis and wrote the original draft. AGR collaborated in writing the manuscript. EGC reviewed the manuscript. AGG collaborated in the assessment design, collected the data, and reviewed the manuscript. JRFH conceptualized the study and acquired the funding. All authors approved the manuscript in its current form and its submission to the journal. We want to thank the participating schools, their staff and their students for their collaboration in the present study.

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