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Psychometric Evaluation of the HIV Disclosure Belief Scale: A Rasch Model Approach

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Abstract

This study provides psychometric assessment of an HIV disclosure belief scale (DBS) among men who have sex with men (MSM). This study used baseline data from a clinical trial evaluating the effectiveness of an HIV serostatus disclosure intervention of 338 HIV-positive MSM. The Rasch model was used after unidimensionality and local independence assumptions were tested for application of the model. Results suggest that there was only one item that did not fit the model well. After removing the item, the DBS showed good model-data fit and high item and person reliabilities. This instrument showed measurement invariance across two different age groups, but some items showed differential item functioning between Caucasian and other minority groups. The findings suggest that the DBS is suitable for measuring the HIV disclosure beliefs, but it should be cautioned when the DBS is used to compare the disclosure beliefs between different racial/ethnic groups.

Keywords

HIV; Serostatus disclosure; MSM; Validity

Introduction

Serostatus disclosure is important for reducing HIV transmission. For HIV-positive men who have sex with men (MSM), serostatus disclosure has long been regarded as an important topic among HIV prevention researchers [1, 2]. One reason is that studies have shown a significant proportion (highest is up to 51 %) of HIV-positive MSM participate in risky sexual behaviors [3–7]. While many individuals disclose their serostatus to sexual partners, studies have demonstrated nondisclosure rates ranging from 26 to 46 % [8–10]. Therefore, if

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Conflict of Interest The authors agree there is no conflict of interest.

Compliance with Ethical Standards

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

safer sexual activities are not utilized, serostatus disclosure can contribute significantly to the reduction in the risk of secondary transmission of the HIV virus [11–14]. Another benefit of serostatus disclosure is the potential to garner social support from family, friends, and partners [15–17]. Beyond transmission reduction, research has also shown that serostatus disclosure can have a positive impact on the physical and mental health of HIV-positive MSM [18–20].

One factor related to HIV disclosure is a person's beliefs towards the circumstances surrounding disclosure of his serostatus. To date, however, there has been no known published instrument to measure an individual's beliefs towards disclosure. The disclosure belief scale (DBS) proposed here is the first scale developed for this purpose and has been utilized in other MSM studies (e.g., held for review). The DBS is designed to measure the beliefs of MSM regarding the circumstances under which HIV positive people should disclose their serostatus to their sexual partners. The DBS consists of 14 items and each item describes a circumstance unique disclosure (see Table 1 for details). The purpose of this study was to provide a psychometric assessment of the DBS instrument for validation purpose and to facilitate future research in assessing individual's serostatus disclosure belief.

The Rasch measurement models [21] are widely applied in health studies to develop and validate instruments. Their popularity results from the features of the Rasch measurement including building the theory based on a unidimensional construct, generating equal interval measures, and providing useful tools to evaluate the quality of the whole scale as well as individual items (e.g., item and person fit statistics, item and person reliabilities, item-person map). In other words, the benefits of the Rasch models comprise their capabilities of examining unidimensionality, constructing an ordered set of survey items, and identifying poorly performing items and aberrant responses. In addition, the Rasch models can also be used to evaluate whether each item performs differently across different groups of respondents (i.e., differential item functioning - DIF) [22]. One of the Rasch measurement models, the dichotomous Rasch model, was used to conduct the psychometric assessment of the DBS in this study. The dichotomous Rasch model fits dichotomous data with yes (1) or no (0) answers. This model simply involves two parameters: the person's ability θ and the item difficulty b . In this study, person's ability refers to the person's level of belief regarding the circumstances under which HIV serostatus should be disclosed to a sex partner; item difficulty refers to how likely an item is to be endorsed.

Mathematically, the dichotomous Rasch model specifies the probability of a given person agreeing to a particular item as a logistic function of the difference between a person's ability and an item's difficulty ($\theta - b$). Both the person's ability and the item's difficulty are calibrated on the same log odds (logit) scale. In the Rasch model, when a person's disclosure ability is the same as an item's difficulty, that person would have a 50 % probability of agreeing to that item. Generally, persons who have higher disclosure ability have a greater likelihood of agreeing to all the items, and the items with lower difficulty are more likely to be endorsed.

Methods

The DBS psychometric properties were addressed via the assessment of unidimensionality and local independence assumptions, the content validity, person and item fits, person and item reliability, and the measurement invariance across age and race/ethnicity groups.

Data Collection

Data for this study were from the baseline assessment of a larger randomized controlled trial of an intervention designed to assist HIV-positive MSM disclose their serostatus to casual sex partners. This study was conducted in two metropolitan cities (held for review) from December 2009 to December 2014. Recruitment for the trial was conducted through partnership agreements with local AIDS service organizations and through advertisements at HIV-related venues, forums, and businesses frequented by MSM, as well as free, local newspapers. Inclusion criteria were: HIV-positive, sexually active MSM, 18 years of age or older, English speaking, had at least two sexual partners in the last 12 months, interested in learning more about disclosing serostatus to their sexual partners, and planned on living in the study area for at least 1 year. Data were collected through an audio-computer assisted self-interviewing (ACASI) formatted instrument to ensure privacy and objectivity of the data [23].

Participants

The average age of participants ($N = 338$) was 42.1 years ($SD = 11.03$ years; $Range = 19$ –68 years). The average time since diagnosis was 10.73 years ($SD = 8.19$ years; $Range = 0$ –29 years). Half of the participants identified their race/ethnicity as White/Caucasian ($n = 171$, 50.3 %), and a large proportion of the participants identified themselves as Black/African American ($n = 127$, 37.4 %). Only 9.1 % ($n = 31$) of participants identified their race/ethnicity as Hispanic. Self-reported sexual orientation was mostly gay ($n = 267$, 78.5 %), and 74.4 % ($n = 253$) indicated that they had sex only with men. Most participants reported being single ($n = 238$, 70 %). More than half of participants ($n = 224$, 65.8 %) reported having completed at least some college, but most were currently unemployed ($n = 235$, 69.1 %) and approximately six in ten had a monthly income at or below \$1000/month ($n = 198$, 58.2 %).

Measure

The HIV disclosure belief scale (DBS) is an author-derived (held for review) measure that assesses general beliefs of HIV-positive MSM towards the circumstances under which HIV positive people should disclose their serostatus to their sex partners. The DBS contains 14 items. Responses were Likert-type responses ranging from 1 (strongly disagree) to 4 (strongly agree). A higher score reflects more agreeable beliefs towards the circumstances related to serostatus disclosure. Each response set also includes a “not applicable” (NA) response. The NA response accounted for 1.2 % of the data and was kept in the data when conducting Rasch analysis since the Rasch model in ltm [24] and eRm [25] packages in the R language and environment [26], and MPlus 7.3 can accommodate missing data with maximum likelihood estimation. The original 4-point Likert scale was recoded to create a

binary variable: 3–4 representing agree vs. 1–2 representing disagree. The DBS items are displayed in Table 1.

Statistical Analysis

Descriptive Statistics—The observed means and the Rasch means for each item were yielded in the ltm package [24]. The observed mean represents the observed proportion of participants who agreed to the item, while the Rasch mean represents the proportion of participants' agreement estimated by the model.

Examination of Rasch Model Assumptions—The Rasch model has strict assumptions for its application: the unidimensionality and the local independence assumptions [21]. The unidimensionality assumption states that all the items measure only one latent trait from the participants, which is the belief towards disclosure in this study. The local independence assumption states that all the items are independent and the latent trait (i.e., the disclosure belief in this study) is the only factor that correlates the items. If belief is not considered, all the items are uncorrelated. The unidimensionality assumption was assessed by exploratory structural equation modeling (ESEM) with Mplus version 7.3 [27]. ESEM was applied because it integrates advantages of both confirmatory factor analysis (e.g., providing standard errors and goodness of fit statistics) and exploratory factor analysis (e.g., allowing rotations) [28]. The local independence assumption was assessed using the eRm package [25] with a non-parametric test on the inter-item correlations for binary data at the significance level of .01 [29].

Content Validity—The content aspect of validity was assessed with expert review of the items and the Rasch item-measure correlations. The expert review was conducted by three research experts (coauthors of this paper) with content area expertise in HIV/AIDS research among vulnerable populations, epidemiology, and HIV social support. The Rasch item-measure correlation was conducted with the ltm R package [24] representing the point-biserial correlation between the response on each DBS item and the total DBS score calculated from the responses to all the other items. Positive, moderate to high item-measure correlations are desired.

Rasch Model Fit Statistics—Rasch fit analyses were conducted with the ltm R package [24] to yield item fit and person fit. Both item fit and person fit statistics measure how accurately the observed responses match the Rasch expected responses [30]. In the ltm package [24], item or person fit was examined by the Chi square statistics proposed by Bock [31]. A significant χ^2 for an item or a person indicates item misfit or person misfit. Considering the Chi square statistics distribution may not be satisfied given our sample size was relatively small for utilizing the Rasch model, a Monte Carlo procedure with 1,000 replications was used to approximate the distribution of the item-fit statistics under the null hypothesis to test the significance of the χ^2 statistics.

For the purpose of cross-validation, additional statistical approaches for item and person fit evaluation were applied. Item fit was also assessed with the infit/outfit mean square statistics (MSQ) analyzed using the eRm R package [25] because the infit and outfit indices were

considered good fit indices of the Rasch model [32]. Infit and outfit calculated with mean square also measure the discrepancy of observed response to estimated response. Infit is more sensitive to unexpected behavior near the disclosure belief estimate, while outfit is more sensitive to unexpected behavior on items [33] far from the disclosure belief estimate. Assessment criteria are that fit values close to 1 are considered perfect fit and fit values between .5 and 1.5 are considered “productive” for measurement [33]. The person fit was also examined by the standardized L_z statistic proposed by Drasgow, Levine, and Williams using the ltm package [24], and the values between -2.05 and $+2.05$ indicated adequate person fit [34].

Reliability—Person reliability, item reliability, and the person-item map that were derived from the ltm package [24] and the eRm package [25] were used to examine the reliability of the DBS. Person reliability is equivalent to the Cronbach’s alpha (or internal reliability) in classical test theory (CTT) for binary data [33].

Item reliability represents how likely the same item location ordering can be expected. High item reliability indicates that the items have a wide range of location levels and the consistency of item estimates is expected. Item reliability was assessed by item information and item location variance. Each item provided information about a person’s disclosure belief and the information provided could be visualized by item information curve (IIC). The closer a person’s disclosure belief level to the item location, the more information an item can provide. Specifically, an easy item provided more information for people with lower disclosure belief score and little information for people with higher disclosure belief score, and vice versa for hard items. The center of each information curve provides the most information. The wider the item location range, the higher the reliability of the scale [33].

The person-item map provides graphical evidence of reliability. In the person-item map, the person and item estimates are plotted on the same graph since they are calibrated on the same logit scale. If the item distribution matches the person distribution well in the map, high item and person reliabilities can be expected.

Measurement Invariance—Measurement invariance examination of the DBS items was focused on whether items function differentially (differential item functioning; DIF) across participants in different age groups and in different racial/ethnic groups, and was conducted in the difR package [35]. For the age DIF analysis, participants were classified into the below or above mean age (42.1 years) group. For the racial/ethnic DIF detection, participants were classified into the Caucasian or other racial/ethnic minority (e.g., African American, Hispanic) group. In other words, the DIF detection for the DBS items was to examine whether participants in different age or racial/ethnic groups have an equal probability of agreeing to each item given the same disclosure belief.

Results

Descriptive Statistics

The DBS has a scale mean score of 11.62 ($SD = 3.17$) indicating participants endorsed most of the items in the scale. Table 1 displayed the observed mean responses and the Rasch

model estimated means for each item. The DBS item means were rank ordered from low (.68) to high (.96), with item 1 having the least endorsement (68 %) and item 14 having the most endorsement (96 %). For example, item 3 had an observed mean of .69, which meant that 69 % of the participants responded “agree” to item 3 when they were asked if they should disclose their HIV status to their sexual partners from whom they received oral sex with a condom. The Rasch model estimated means were either the same or very close to the observed means. For example on item 12, when participants were asked if they should disclose their HIV status to their sexual partners whom they think were HIV-negative, 95 % of participants were observed responding “agree”, and the Rasch model estimated 94 % of the participants responded “agree”. This indicated that the Rasch model captured the observed frequency of participant agreement well.

Rasch Model Assumptions

The unidimensionality test showed that there was one factor structure in the DBS data: RMSEA = .04, CFI = .99, TLI = .99. Marsh and colleagues [36] suggested excellent fit when CFI > .95, TLI > .95, and RMSEA < .05. The local independence test showed that the following item pairs had significant correlations at $p = .01$ level: Items 1 and 2 ($r = .64, p = .002$), Items 1 and 3 ($r = .82, p < .001$), Items 2 and 4 ($r = .65, p < .001$), Items 3 and 4 ($r = .55, p = .006$), Items 3 and 5 ($r = .57, p = .006$), Items 3 and 7 ($r = .64, p < .001$), Items 5 and 7 ($r = .67, p < .001$), Items 6 and 8 ($r = .62, p < .001$), and Items 10 and 11 ($r = .62, p < .001$). After re-examining the stems of the items, this pattern was found to probably be due to the way the questions were worded. For example, Items 1, 3, 5 and 7 were asked with “with a condom”, Items 2, 4, 6, and 8 were asked with “without a condom”. Considering the local independence assumption being violated on only 9 out of 91 item pairs, it was concluded that the local independence assumption was met to an appropriate degree for the application of the Rasch model.

Content Validity

It was agreed among the experts that the 14 items in the DBS scale covered sexual behaviors that posed major risks for HIV-positive MSM, including anal sex and oral sex in receptive and insertive forms with and without condoms as well as casual and regular partners who were HIV-positive and -negative. Rasch item-measure correlation results (see Table 2) showed that most items had positive, moderate to high item-measure correlations (r ranging from .31 to .72), except Item 14 ($r = .13$). For example, Item 3 had an item-measure correlation of .72, indicating that the response on Item 3 had a positive, moderately high correlation with the total DBS score that was calculated across all items except Item 3. However, Item 14 with low item-measure correlation showed a weak relationship between the response on Item 14 and the total score. This finding suggests that all the items except for Item 14 (*People with HIV should disclose their HIV status to sexual partners when the sexual partner specifically asks*) had a strong association with each other. Item 14 might measure a different construct from others.

Rasch Model Fit Evaluation

Results of the item fit (see Table 2) showed that Item 14 had a poor fit ($\chi^2 = 111.08, p < .05$; *Outfit MSQ* = 5.74), indicating that this item did not match the underlying construct of the

DBS. The rest of the 13 items displayed non-significant χ^2 values and acceptable infit and outfit values ranging between .5 and 1.5, except Item 6 that also showed some deviance in outfit (2.15). Poor fitting items need to be reviewed or to be removed from the scale. Infit statistics were more informative when investigating the fit of the items based on the Rasch model [37, 38]. Therefore, Item 6 was kept even though the outfit value of this item was larger than 1.50, its infit value was 1.12. Item 14 did not show an acceptable fit based on both the χ^2 index and outfit statistic. As mentioned earlier, the item-measure correlation for Item 14 in Table 2 was also very low ($r = .13$), indicating that the response on Item 14 had a very weak relation with the total DBS score. Based on these considerations, Item 14 was removed from the scale and the analyses were continued with the remaining 13 items. Table 2 also showed the item fit result without Item 14. The item fit statistics in the table showed the exactly same results as those with Item 14, indicating the remaining 13 items had good item fit, which means that these items measure the same construct.

Results of the person fit χ^2 statistic indicated that only 14 out of the 338 participants (i.e., about 4 % of participants) showed person misfit ($p < .05$ for χ^2), indicating that the 14 participants' responses differed from the expectations based on the Rasch model. One option was to remove these participants from the data set; however, they were not removed since the purpose of this study was to provide validity evidence to the DBS items. As for the person fit result based on L_z , person fit standardized L_z statistics were not tabulated due to the sample size (results available upon request to the first author), instead they were presented in a histogram (see Fig. 1). Figure 1 presents the frequency distribution of standardized person fit L_z values across the participants. As shown in Fig. 1, person fit L_z values ranged from -3.5 to $+2$, with most values falling between 0 and $+1$. With the criterion that the L_z values between -2.05 and $+2.05$ indicate good person fit [34], approximately 96 % of participants in this study showed good person fit, suggesting that most of participants' responses to the DBS items matched the Rasch-modeled expectations.

Reliability

The Cronbach's alpha was .89 in the baseline assessment for the DBS, indicating very high internal consistency and high person reliability. Figure 2 presents item information curves across disclosure belief levels for the 13 DBS items. As seen in Fig. 2, the item information curves for the 13 DBS items were spread out along a wide range of the disclosure belief levels, indicating good item separation and high item reliability. Table 3 displayed that the item difficulties had a wide range from -1.83 (Item 12; the easiest endorsed item) to $-.52$ (Item 1; the hardest endorsed item) with the standard errors of the difficulty estimates ranging from .08 to .13, indicating the estimates of the item difficulty were precise and accurate. Figure 3 is the person-item map that presents the distributions of person estimates on the top and of item estimates on the bottom. As shown in the person-item map, the items and persons were matched well on the logit scale, also indicating that the DBS had high item reliability. Based on these analytical results, the DBS possessed high item and person reliabilities.

Measurement Invariance

Table 3 presents the results of measurement invariance test across age groups and race/ethnicity groups. As seen in Table 3, all the DBS items did not show significant differences in item difficulties between two age groups. This finding indicated that these items showed measurement invariance across participants in below and above mean age groups. That is, no items exhibited differential item functioning (DIF) across two age groups among 13 DBS items. Items that showed measurement invariance across age groups also meant that participants in both age groups had the same probability of endorsement to each item given the same disclosure belief score (i.e., the same ability level).

However, as also shown in Table 3, there were 7 items that had significant differences in item difficulties between the Caucasian and racial/ethnic minority groups. These items showed measurement non-invariance or DIF. Among these 7 DIF items, Item 1 (*give oral sex with a condom*), Item 2 (*give oral sex without a condom*), and Item 3 (*receive oral sex with a condom*) showed lower difficulty levels ($-.54$, $-.94$, and $-.61$, respectively) for the racial/ethnic minority group, compared with those ($-.34$, $-.77$, and $-.38$, respectively) for the Caucasian group, suggesting these three items favoring the racial/ethnic minority group. Even though participants in the two groups have the same disclosure belief scores or the ability levels, the racial/ethnic minority group had higher probabilities of agreeing to Items 1, 2, and 3, compared to the Caucasian group.

In contrast, Item 6 (*insertive anal sex without a condom*), Item 8 (*receptive anal sex without a condom*), Item 10 (*just met*), and Item 11 (*casual sex partners*) showed lower difficulty levels (-1.88 , -1.53 , -1.32 , and -1.42 , respectively) for the Caucasian group, compared with those (-1.21 , -1.00 , $-.68$, and -1.00 , respectively) for the racial/ethnic minority group. This indicated that these items favored the Caucasian group, suggesting participants in the Caucasian group had higher probability of agreeing to Items 6, 8, 10, and 11 than those in the racial/ethnic minority group even though they had the same disclosure belief.

Discussion

The DBS scale is the only known measure of HIV disclosure belief. It would be of practical value if validity and reliability evidence could be provided to the DBS instrument so that it can be widely adopted in the field of HIV research; as such, this study fills the gap and provides psychometric assessment to the DBS scale. Based on the results of the content analysis and item fit analysis, Item 14 (*People with HIV should disclose their HIV status to sexual partners when the sexual partner specifically asks*) in the DBS was found to possess a very easy endorsement level, significant item misfit, and low item-measure correlation, indicating that this item does not measure the same underlying construct as the remaining 13 items. Considering Item 14 may be conceptually different from the other items, since it is the only item involving communication between the participant and the partner for the HIV disclosure, it has been removed from the DBS. The remaining 13 items in the DBS show good psychometric qualities in terms of item fit, person fit, item reliability, and person reliability.

Another focused evaluation for the DBS items in this study was to examine if all the items maintain measurement invariance across groups of interest. It is a common practice to conduct group comparisons (e.g., males vs. females or Caucasian vs. racial/ethnic minorities) of the observed raw scores derived from the survey items using traditional statistics such as *t* test or analysis of variance. The validity of comparing group differences based on the observed scores is established on the assumption that items in the survey function equivalently across groups. However, this assumption might not always hold in reality. It is an essential step to examine the tenability of measurement invariance across groups for the survey items because with differently functioning items in the survey the observed mean difference across groups might be misleading. The results of DIF test in this study indicated that the 13 DBS items showed measurement invariance between below and above mean-age participants. With the establishment of measurement invariance across different age groups for the DBS items, one can confidently argue that the observed mean difference between below and above mean age participants on the DBS is due to the true difference in disclosure belief.

DIF test results in this study also found that the 4 DBS items related to anal sex without a condom and to casual and just-met partners favored the Caucasian group, which means that even with the same disclosure belief, the Caucasian participants still had a higher probability of agreeing to these items than the racial/ethnic minority participants. This finding may have been due to lower self-efficacy and higher stigma among racial/ethnic minority participants. O'Leary et al. found that HIV-positive African American MSM displayed lower self-efficacy towards disclosing serostatus to sex partners than European-American MSM [39]. Loutfy et al. concluded in their study that Black, Asian/Latin-American and people of other racial identification showed higher stigma score than White individuals [40]. Rao and colleagues concluded that Black participants reported higher stigma on items showing discrimination from others using the IRT method [41]. Thus, the racial/ethnic minority participants with lower self-efficacy and higher stigma may result in a lower probability of agreeing to disclose their HIV serostatus to casual or just-met partners with whom they engage in higher-risk sexual activities, such as anal sex. On the other hand, we found that the 3 DBS items related to giving oral sex with or without a condom, and receiving oral sex with a condom favored the racial/ethnic minority group (i.e., given the same disclosure belief, the racial/ethnic minority group had a higher probability of agreeing to these items). One possible explanation could be that oral sex has a lower HIV transmission risk [42], so racial/ethnic minority participants may feel less likely to be rejected by their partners even with lower self-efficacy and higher stigma. As a result, the racial/ethnic minority participants tended to have a higher probability of agreeing to these items.

Additionally, external validity was also conducted by correlating the DBS scores to the actual disclosure behavior scale of the participants who had disclosed to their sexual partners ($n = 94$; $r = .40$, $p > .05$). This correlation was not surprising because the disclosure behavior may be more influenced by other factors such as fear of being rejected, fear of physical abuse or losing sexual partners which were other interesting topics for future research.

In summary, after removing Item 14, the remaining 13 DBS items measure the same underlying construct and provide adequate person fit and item fit based on the Rasch

measurement model. In addition, the DBS items also show measurement invariance across different age groups. Thus, the DBS can be utilized for measuring HIV serostatus disclosure belief as well as for conducting group comparisons of the disclosure belief across different age participants with confidence. However, 7 DBS items were found to exhibit measurement non-invariance across racial/ethnic groups. At the test level, the DIF effect may be cancelled out across items because some DIF items favor the Caucasian group while some DIF items favor the racial/ethnic minority group. As a result, the DIF items will not change the interpretation of the total DBS score [43]. Without testing this cancellation of the DBS DIF items across racial/ethnic group, it is suggested that the DBS be used with caution when used to examine racial/ethnic group differences [44]. One way to explore why the Caucasian and the racial/ethnic minority groups respond differently to these DIF items is to better understand the cognitive processes of participants' responses. Researchers can conduct one-on-one cognitive interviews or focus groups interviews. This qualitative focus in combination with participants' cultural backgrounds may provide more insight into how different racial/ethnic participants respond to these items and why they respond differently.

This study only examined the Rasch model assumption, model fit, reliability, and the measurement invariance across different age and racial/ethnic groups of the DBS. There are other limitations to this study. The dichotomization of the DBS may lead to loss of information. Due to the relative small sample size of 338, it was not feasible to fit a polytomous model. Future researchers may consider examining the external validity evidence of the DBS to related variables, or expanding the sample size to ensure a more robust testing of the validity and reliability of the DBS. Similarly, examining the psychometric properties of the DBS with other populations (e.g., young MSM, older MSM) and in other regions of the country and world may also be beneficial for measuring its general use and disclosure beliefs among persons living with HIV. Lastly, the DBS mainly focuses on male-to-male sexual behaviors. Therefore, future researchers may also include adaptation of the DBS to heterosexual males or females to further examine its psychometric properties among different populations.

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Fig. 1. Frequency distribution of person fit L_z Values for the DBS. The L_z values between -2.05 and $+2.05$ indicate good fit.

Fig. 2.

Item Information Curves for the 13 DBS items. The more spread out the item information curves, the more reliable the disclosure belief scale.

Fig. 3.

Person-item map that presents the distributions of person and item estimates. Person and item estimates are desired to match on the same disclosure belief logit scale.

Table 1

DBS items, observed means, and Rasch means

Item ordering	DBS item	Observed mean	Rasch mean
Hardest/least endorsement	1. People with HIV should disclose their status to sexual partners to whom they give oral sex with a condom	.68	.67
	3. People with HIV should disclose their HIV status to their sexual partners from whom they receive oral sex with a condom	.69	.68
	2. People with HIV should disclose their status to sexual partners to whom they give oral sex without a condom	.78	.78
	7. People with HIV should disclose their HIV status to their sexual partners with whom they have receptive anal sex (they are the bottom) with a condom	.80	.80
	9. People with HIV should disclose their HIV status to their sexual partners with whom they engage in any other sexual behavior	.81	.80
	10. People with HIV should disclose their HIV status to sexual partners they just met	.83	.82
	5. People with HIV should disclose their HIV status to their sexual partners with whom they have insertive anal sex (they are the top) with a condom	.84	.83
	4. People with HIV should disclose their HIV status to their sexual partners from whom they receive oral sex without a condom	.85	.85
	11. People with HIV should disclose their HIV status to casual sexual partners	.88	.88
	8. People with HIV should disclose their HIV status to their sexual partners with whom they have receptive anal sex (they are the bottom) without a condom	.89	.89
Easiest/most endorsement	13. People with HIV should disclose their HIV status to their sexual partners whom they think are HIV-positive	.91	.91
	6. People with HIV should disclose their HIV status to their sexual partners with whom they have insertive anal sex (they are the top) without a condom	.93	.93
	12. People with HIV should disclose their HIV status to their sexual partners whom they think are HIV-negative	.95	.94
	14. People with HIV should disclose their HIV status to sexual partners when the sexual partner specifically asks	.96	.96

Table 2

Item-measure correlation and item fit statistics with and without item 14

DBS items	IMC 14 Items	$\chi^2 (p)$	Infit MSQ	Outfit MSQ	IMC 13 Items	$\chi^2 (p)$	Infit MSQ	Outfit MSQ
1. Give oral sex with a condom	.66	8.63 (.65)	.91	.96	.66	5.91 (.89)	.92	1.07
3. Receive oral sex with a condom	.72	10.77 (.49)	.78	.65	.72	9.79 (.56)	.78	.65
2. Give oral sex without a condom	.69	14.99 (.16)	.82	.74	.70	12.05 (.29)	.82	.78
7. Receptive anal sex with a condom	.69	11.81 (.29)	.75	.63	.70	8.59 (.53)	.76	.65
9. Other sex behavior	.60	28.68 (.05)	1.01	1.20	.61	22.40 (.05)	1.03	1.26
10. Just met	.49	2.89 (.97)	1.16	1.45	.48	.74 (1)	1.21	1.57
5. Insertive anal sex with a condom	.64	8.75 (.48)	.86	.71	.64	9.20 (.42)	.88	.75
4. Receive oral sex without a condom	.62	7.37 (.61)	.90	.69	.62	5.80 (.75)	.92	.73
11. Casual sex partners	.53	13.37 (.17)	.97	.85	.53	4.04 (.92)	1	.95
8. Receptive anal sex without a condom	.44	12.92 (.18)	1.10	.98	.44	14.50 (.13)	1.14	1.05
13. HIV positive partner	.54	10.27 (.32)	.87	.81	.55	7.39 (.60)	.89	.83
6. Insertive anal sex without a condom	.31	18.06 (.07)	1.12	2.15	.30	21.15 (.07)	1.2	2.40
12. HIV negative partner	.47	14.95 (.14)	.78	.92	.46	12.34 (.24)	.85	1.08
14. Partner specifically asks	.13	111.08 (.03)	1.42	5.74				

IMC item-measure correlation, MSQ mean square

Table 3

Item difficulty and DIF test

Item ordering	DBS items	<i>b</i>	<i>b_{se}</i>	DIF on age		DIF on race	
				<i>b</i> < mean age	<i>b</i> > mean age	<i>b</i> Caucasian	<i>b</i> Racial minority
Hardest/least endorsement	1. Give oral sex with a condom	-.52	.08	-.58	-.52	-.34 ^a	-.54 ^a
	3. Receive oral sex with a condom	-.57	.08	-.56	-.61	-.38 ^a	-.61 ^a
	2. Give oral sex without a condom	-.92	.09	-1.06	-.87	-.77 ^a	-.94 ^a
	7. Receptive anal sex with a condom	-.98	.09	-1.09	-.95	-.90	-.84
	9. Other sex behavior	-1.00	.09	-1.35	-.81	-.94	-.83
	10. Just met	-1.09	.10	-1.16	-1.09	-1.32 ^a	-.68 ^a
	5. Insertive anal sex with a condom	-1.15	.10	-1.28	-1.11	-1.14	-.93
	4. Receive oral sex without a condom	-1.22	.10	-1.29	-1.22	-1.12	-1.15
	11. Casual sex partners	-1.35	.11	-1.63	-1.22	-1.42 ^a	-1.00 ^a
	8. Receptive anal sex without a condom	-1.44	.11	-1.52	-1.44	-1.53 ^a	-1.00 ^a
	13. HIV positive partner	-1.58	.12	-1.76	-1.51	-1.49	-1.47
Easiest/most endorsement	6. Insertive anal sex without a condom	-1.73	.13	-1.76	-1.77	-1.88 ^a	-1.21 ^a
	12. HIV negative partner	-1.83	.12	-2.09	-1.74	-1.81	-1.39

b = item difficulty, *b_{se}* = standard error of item locations, DIF = differential item functioning

^a indicates significant likelihood ratio χ^2 for DIF test: Item 1 ($\chi^2 = 4.21, p = .04$), Item 2 ($\chi^2 = 1.82, p < .001$), Item 3 ($\chi^2 = 27, p < .001$), Item 6 ($\chi^2 = 10.23, p = .001$), Item 8 ($\chi^2 = 19.49, p < .001$), Item 10 ($\chi^2 = 1.82, p < .001$), Item 11 ($\chi^2 = 6.91, p = .009$)