Analyse of response time in electronic PRO instrument: How could it be used to refine the analysis of health-related quality of life data?

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Background

Electronic patient-reported outcomes (PRO) measures can be used to assess health-related quality of life (HRQL) in clinical settings. They also provide auxiliary information such as time to complete a survey or time spent on each item of a questionnaire. This in turn allows to assess how well the questionnaire is functioning as a whole, and whether items are treated in the same way by respondents, depending on their linguistic characteristics (content, complexity or entropy, length).

Objective. The aim of this study was to evaluate response time in relation to item content and item severity on an electronic questionnaire assessing HRQL specific of HIV.

Methods

Data collection. Data were collected on N=80 HIV-positive patients during the validation of the ePROQOL-HIV questionnaire (8 dimensions, 43 Likert-type items in total) on internet using a cross-over design [1]. Sociodemographic data and individual timestamps were available for 54 electronic records. The sample of HIV+ patients had the following characteristics: 36% females, mean age 47 years, 72% of secondary or university education level. See **Table 1** for a full description of participants' characteristics.

Statistical methodology. Items were characterized by their length (number of characters), difficulty and spread of response category thresholds as estimated from an Item Response Model for polytomous items (Partial Credit Model, [2]). Analysis was carried out on two dimensions of the questionnaire: Physical Health and Symptoms (PHS, 9 items, Cronbach alpha = 0.885), and Emotional Distress (ED, 4 items, alpha = 0.869). Pearson correlations with associated 95% CIs were used to summarize linear associations between numerical variables; ANOVA F-tests were used to summarize the effect of a categorical predictor on a continuous outcome.

Statistical analyses were done using R software with the eRm package.

Results

Few items exhibited reversed thresholds for the extreme response categories ('rarely' was less likely to be endorsed than 'never'), although item fit statistics remained in the acceptable range (INFIT and OUTFIT indices between 0.7 and 1.3). Average standard errors for person location parameters were 0.44 (PHS) and 0.63 (ED) (**Figure 1**).

Average response time (RT, in seconds) for the PHS dimension (12.1s) was twice that observed for the ED dimension (6.5 s). It was positively correlated with item length (r = 0.600, [0.342;0.940]) and negatively correlated with item parameters (r = -0.595, [-0.880;0.008]), which means that more 'severe' items were associated with longer RTs (**Figure 2**). However, the spread of item thresholds did not correlate with item characteristics.

Average RT for each dimension did not correlate with person location on the latent trait, nor with study level of participants (ANOVA, p = 0.188 for PHS; p = 0.273 for ED).

However, a significant effect of gender was found for the ED dimension, with women showing higher RTs (9.2 ± 4.4 s) compared to men (6.3 ± 3.9 s, p = 0.016). No such effect was observed for the PHS dimension.

	N	Centre 1	Centre 2	Combined	
Age (years)	79	46.9 (11.2) [39.5–53.0]	44.4 (8.9) [37.0–51.0]	46.7 (10.9) [39.0–53.0]	P=0.580
Gender	79	63% (44)	89% (8)	66% (52)	P=0.120
No professional activity	78	21% (15)	75% (6)	27% (21)	P=0.005
Level of education (university)	78	41% (29)	50% (4)	42% (33)	P=0.931
Single	77	48% (33)	62% (5)	49% (38)	P=0.680
Living alone	78	44% (31)	100% (8)	50% (39)	P=0.009
Depression	78	13% (9)	38% (3)	15% (12)	P=0.067
Psychiatric disorder	78	1% (1)	0% (0)	1% (1)	P=0.730
Cardiovascular disease	78	13% (9)	38% (3)	15% (12)	P=0.067
Diabete	78	9% (6)	12% (1)	9% (7)	P=0.710
Other comorbidities	78	7% (5)	0% (0)	6% (5)	P=0.430
Lipodystrophy	79	21% (15)	22% (2)	22% (17)	P=0.960
Current treatment	78				
Tuberculosis		0% (0)	0% (0)	0% (0)	—
Prophylaxis		4% (3)	38% (3)	8% (6)	P<0.001
Antidepressant		11% (8)	38% (3)	14% (11)	P=0.045
Lipids		10% (7)	0% (0)	9% (7)	P=0.350
Year of diagnostic		1998 (8) [1990–2005]	2002 (7) [2000–2008]	1999 (8) [1991–2006]	P=0.190
CDC Stage	79				
A		59% (41)	22% (2)	54% (43)	P=0.074
B		19% (13)	22% (2)	19% (15)	
C		23% (16)	56% (5)	27% (21)	
Year of first HAART	66	2002 (6) [1996–2007]	2008 (3) [2007–2009]	2003 (6) [1997–2007]	P=0.024
Hepatitis C	79	20% (14)	0% (0)	18% (14)	P=0.310
Hepatitis B	79	6% (4)	10% (1)	6% (5)	P=1
CD4 counts (cell/mm^3)	79	623 (438) [441–700]	407 (191) [213–527]	598 (422) [424–694]	P=0.044
CD4 %	74	30.3 (10.2) [24–37]	20.2 (9.8) [19–24]	29.6 (10.4) [23–37]	—

Table 1. Participants' characteristics (From [1])

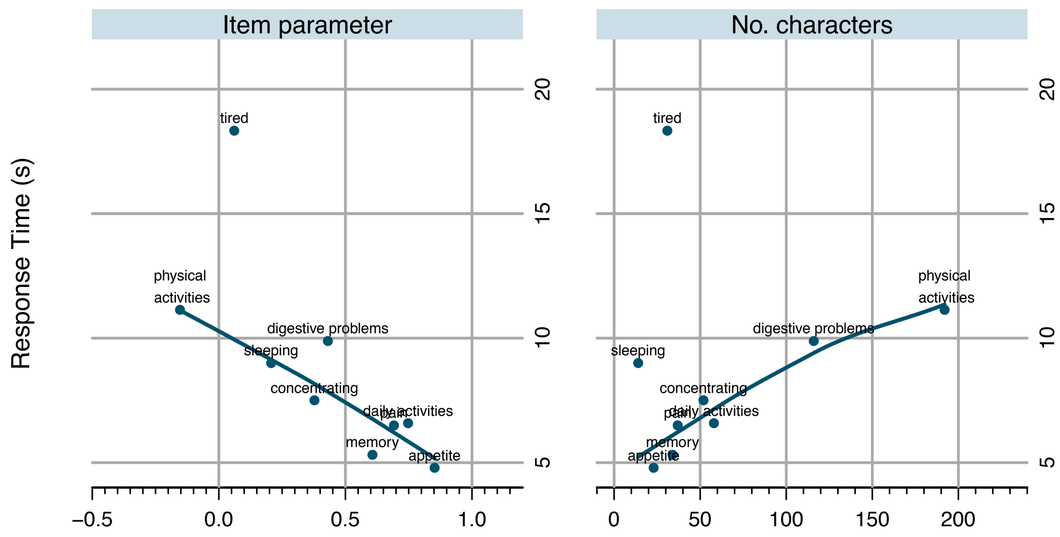

Figure 2. Average response time according to (left) item parameter ('severity') and (right) item length (total number of characters), for the 9 items of the PHS dimension.

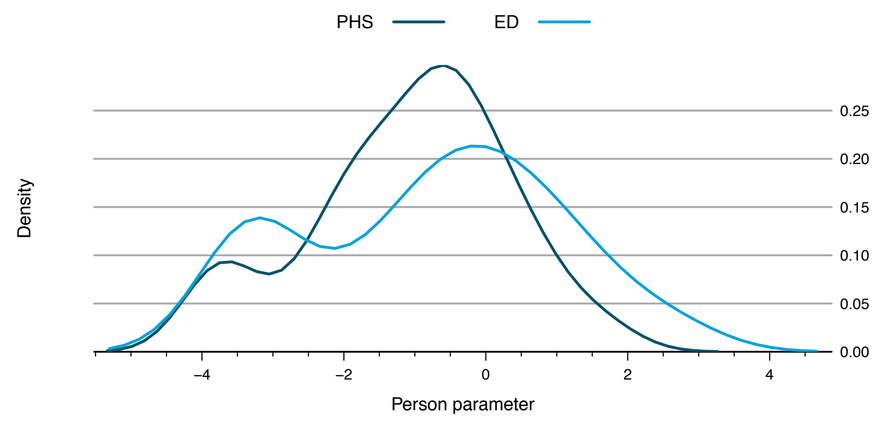

Figure 1. Distribution of person parameters on the latent traits (PHS and ED dimension)

Conclusion

The present findings suggest that items dealing with more severe impact of HIV can also affect processing time, besides item length. Interestingly, although the ED dimension was composed of shorter items, which implies faster reading, women did take more time to answer those questions. This suggests that they might pay more attention to their emotional state than men, which is in agreement with previous studies [3]. Such analysis could be useful when developing or validating HRQL questionnaires, or in field trials in association with cognitive debriefing.

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