Light Exposure Behavior Assessment (LEBA): Develop of a novel instrument to capture light exposure-related behaviours

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Abstract

One or two sentences providing a **basic introduction** to the field, comprehensible to a scientist in any discipline.

Two to three sentences of **more detailed background**, comprehensible to scientists in related disciplines.

One sentence clearly stating the **general problem** being addressed by this particular study.

One sentence summarizing the main result (with the words "**here we show**" or their equivalent).

Two or three sentences explaining what the **main result** reveals in direct comparison to what was thought to be the case previously, or how the main result adds to previous knowledge.

One or two sentences to put the results into a more **general context**.

Two or three sentences to provide a **broader perspective**, readily comprehensible to a scientist in any discipline.

Keywords: keywords

Word count: X

Light Exposure Behavior Assessment (LEBA): Develop of a novel instrument to capture light exposure-related behaviours

Introduction

Methods

Participants

This line is just a test for pushing in the github repo.

Material

Procedure

Our study had four objectives. First, to develop an instrument to assess individual's light exposure behavior . Second, to conduct an exploratory factor analysis(EFA) to understand the latent structure. Third to gather structural validity evidence for the latent structure obtained in EFA (Furr, 2014). Lastly, we gathered item information using Item response theory (IRT)(Baker, 2017)

Data Collection. Timeline of data collection, ethical approval, mode of data collection, how consent was recorded.

Item generation and Content Validity: Expert Panel Review. How we developed the 48 items?

Analytic Strategies

We used R (version 4.1.0), including several R-packages for our analyses. Necessary assumptions of EFA, including sample adequacy, normality assumptions, quality of correlation matrix were assessed. Our data violated both the univariate and multivariate normality assumptions. Due to these violations and the ordinal nature of our response data we used polychoric correlation matrix (Desjardins & Bulut, 2018) for the EFA. We employed principal axis (pa) a factor extraction method with varimax rotation. PA is apparently robust to the normality assumption violations (Watkins, 2020). The obtained latent structure was confirmed by minimum residuals extraction method as well. We used a combination factor indentification method including scree plot(Cattell, 1966), Horn's parallel analysis (Horn, 1965), minimum average partials method(Velicer, 1976), and hull method (Lorenzo-Seva, Timmerman, & Kiers, 2011) to identify factor numbers. Additionally, to identify the simple structure we followed the following guidelines recommended by psychometricians (i) no factors with fewer than three items (ii) no factors with a factor loading <0.3 (iii) no items with cross-loading greater than .3 across factors (Bandalos & Finney, 2018; Child, 2006; Mulaik, 2009; Watkins, 2020)

Results

Sampling adequacy was investigated by Kaiser-Meyer-Olkin (KMO) measures of sampling adequacy(Kaiser, 1974) . The overall KMO vale for 23 items was 0.63 which was above the cutoff value of .50 indicating a mediocre sample (Hutcheson, 1999).

Table1 summarizes the univariate descriptive statistics for the 48 items. some of the items were skewed with high Kurtosis values. The Shapiro-Wilk test of normality (Shapiro & Wilk, 1965) indicated all the items violated normality assumptions. Multivariate normality assumptions were investigated by Marida's test (Mardia, 1970). Multivariate skew = 583.80 ($p < 0.001$) and multivariate kurtosis = 2,749.15 ($p < 0.001$) indicated multivariate normality assumptions violation. Due to these violations and ordinal nature of the response data polychoric correlations over Pearson's correlations was chosen (Desjardins & Bulut, 2018). Bartlett's test of sphericity (Bartlett, 1954), χ^2 (1128) = 5042.86, $p < .001$] indicated the correlations between items are adequate for the EFA. However only 4.96% of the inter-item correlation coefficients were greater than .30 in the obtained matrix. The inter item correlation ranged between .44 to .91. The corrected item-total correlations ranged between .10 to .44.

Scree plot (Fig@ref(fig:fac.id)) suggested a six-factor solution.Horn's parallel analysis (Horn, 1965), like the Monte Carlo study, draws several sets of random data with the same number of participants as the original data set and compares the mean eigenvalues among the simulated and original data sets to retain optimal factors.This extraction method also supported a five-factor model. In our data set parallel analysis with 500 iterations indicated six-factor solution. However, In MAP method (Velicer, 1976) and Hull method (Lorenzo-Seva, Timmerman, & Kiers, 2011) suggested a five-factor solution. As a result, we tested both five factor and six factor solutions.

The initial five-factor solution with all 48 items showed the presence of cross-loading items (item 42, 16, & 1) and poor factor loading (<.30) items (item 20,3 ,15, 17, 40, 4, 11, 39, 18, 45, 29, 25, 8 , & 46). At first we discard the items with poor factor loading and ran another EFA on the remaining 34 items. This iteration of EFA also appeared as a misfit in terms of poor factor loading (Item 12, 22, 38, 6) and cross-loading (items 23, 31, 37, 48) . Another two rounds of EFA were conducted with gradually identifying problematic items and discarding them from the model. Finally, a five-factor EFA solution with 23 items was accepted with low RMSR = 0.04, no loading smaller than .30 and no cross-loading greater than .30. The latent construct was also confirmed by using minimum residual extraction method (see the supplementary). Table**??** displays the structural coefficients and commonality of the items. The absolute value of the structural coefficients ranged from .47 to .99 indicating strong coefficients. The commonalities ranged between .10 to .99. However, the histogram of the absolute values of non-redundant residual-correlations showed 26.09% correlations greater than the absolute value of .05, indicating under factoring. (**desjardinsHandbookEducationalMeasurement2018a?**).

Confirmatory Factor Analysis

Discussion

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Table 1

Descriptive Statistics

	Mean	SD	Skew	Kurtosis	Shapiro-Wilk Statistics	p	Item-Total Correlation
Item1	1.12	0.49	5.02	27.80	0.25	.00	.16
Item2	2.16	1.19	0.71	-0.54	0.84	.00	.14
Item3	4.14	0.99	-1.23	1.14	0.79	.00	.19
Item4	2.87	1.59	0.08	-1.60	0.83	.00	.19
Item5	1.76	1.23	1.35	0.44	0.66	.00	.38
Item6	2.73	1.46	0.20	-1.36	0.87	.00	.33
Item7	3.86	1.67	-0.99	-0.85	0.65	.00	.23
Item8	3.76	1.14	-0.68	-0.45	0.86	.00	.00
Item9	3.42	1.83	-0.45	-1.69	0.69	.00	.33
Item10	2.74	1.04	0.09	-0.74	0.91	.00	.28
Item11	2.60	1.25	0.29	-0.86	0.89	.00	.35
Item12	2.11	1.17	0.77	-0.39	0.83	.00	.32
Item13	2.94	1.03	-0.12	-0.40	0.91	.00	.10
Item14	3.62	1.64	-0.68	-1.25	0.74	.00	.32
Item15	1.64	1.18	1.79	2.02	0.60	.00	.15
Item16	3.51	1.30	-0.70	-0.59	0.85	.00	.39
Item17	1.96	0.98	1.02	0.69	0.82	.00	.05
Item18	2.44	1.31	0.38	-1.14	0.86	.00	.11
Item19	3.80	1.29	-0.87	-0.42	0.82	.00	.17
Item20	4.01	1.40	-1.22	0.07	0.70	.00	.13
Item21	1.33	0.91	3.03	8.43	0.41	.00	.01
Item22	2.59	1.41	0.27	-1.27	0.86	.00	.19
Item23	1.31	0.81	2.75	6.92	0.43	.00	.21
Item24	1.47	1.18	2.38	4.00	0.43	.00	.28
Item25	2.56	1.27	0.33	-1.00	0.89	.00	.11
Item26	1.54	1.25	2.13	2.86	0.46	.00	.36

Table 2

	F1	F2	F3	F4	F5	Communalities
item1	0.06	-0.03	0.01	0.03	0.35	0.13
item2	0.12	-0.10	-0.11	0.69	-0.03	0.51
item5	0.01	0.16	0.09	0.01	0.69	0.52
item7	0.06	-0.09	0.66	-0.01	-0.03	0.45
item10	-0.01	0.82	0.07	0.02	0.02	0.68
item13	-0.06	0.34	-0.03	0.10	0.00	0.13
item14	0.00	0.05	0.89	-0.08	-0.08	0.81
item16	0.10	0.05	0.29	-0.11	0.31	0.21
item19	0.02	-0.06	0.00	0.80	0.03	0.64
item21	-0.05	-0.02	-0.34	0.03	-0.06	0.12
item24	-0.03	0.10	0.10	0.11	0.54	0.33
item26	0.93	0.00	0.13	-0.01	0.13	0.90
item27	-0.01	0.07	0.38	-0.12	0.21	0.21
item28	0.02	0.00	-0.05	0.01	0.31	0.10
item30	0.06	0.01	0.11	-0.04	0.52	0.29
item32	0.80	0.00	0.05	0.13	0.10	0.67
item34	-0.01	-0.14	0.02	0.84	0.12	0.74
item35	-0.04	0.46	0.04	-0.17	0.04	0.25
item36	0.09	0.63	0.10	-0.15	0.11	0.45
item41	0.05	0.07	0.70	0.30	0.14	0.60
item43	0.99	0.00	0.06	0.01	0.03	0.99
item44	-0.03	-0.47	-0.01	0.10	0.01	0.24
item47	0.02	0.82	-0.05	-0.06	0.16	0.70

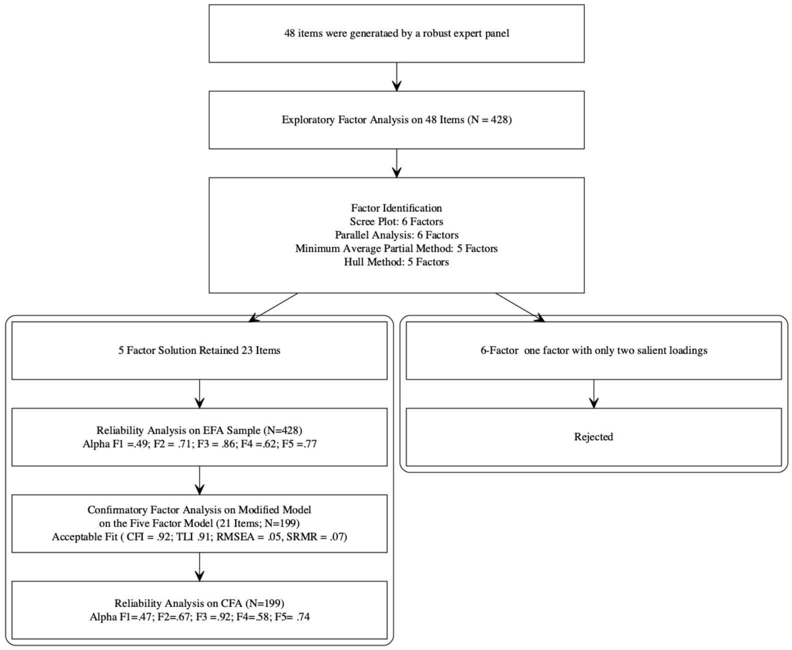
48 items were generataed by a robust expert panel
Exploratory Factor Analysis on 48 Items (N = 428)
Factor Identification
Scree Plot: 6 Factors
Parallel Analysis: 6 Factors
Minimum Average Partial Method: 5 Factors
Hull Method: 5 Factors
5 Factor Solution Retained 23 Items
Reliability Analysis on EFA Sample (N=428)
Alpha F1 =.49; F2 = .71; F3 = .86; F4 =.62; F5 =.77
Confirmatory Factor Analysis on Modified Model
on the Five Factor Model (21 Items; N=199)
Acceptable Fit (CFI = .92; TLI .91; RMSEA = .05, SRMR = .07)
Reliability Analysis on CFA (N=199)
Alpha F1=.47; F2=.67; F3 =.92; F4=.58; F5= .74
6-Factor one factor with only two salient loadings
Rejected

Figure 1. ABC

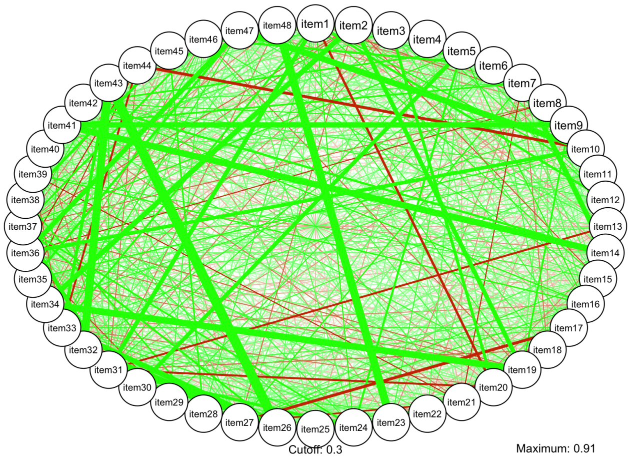

Figure 2. Iter-correlation of the items

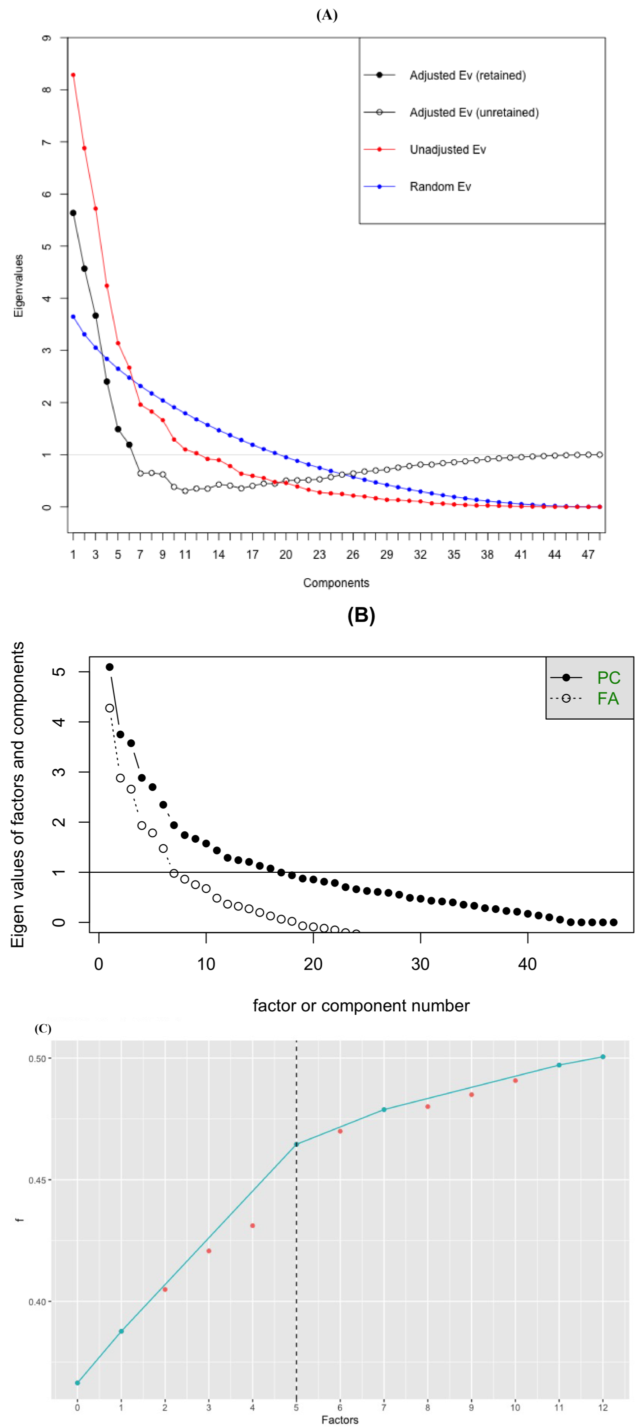

Figure 3. Factor Identification (A) Parallel analysis (B) Scree Plot, (C) Hull method (#fig:fac.id)

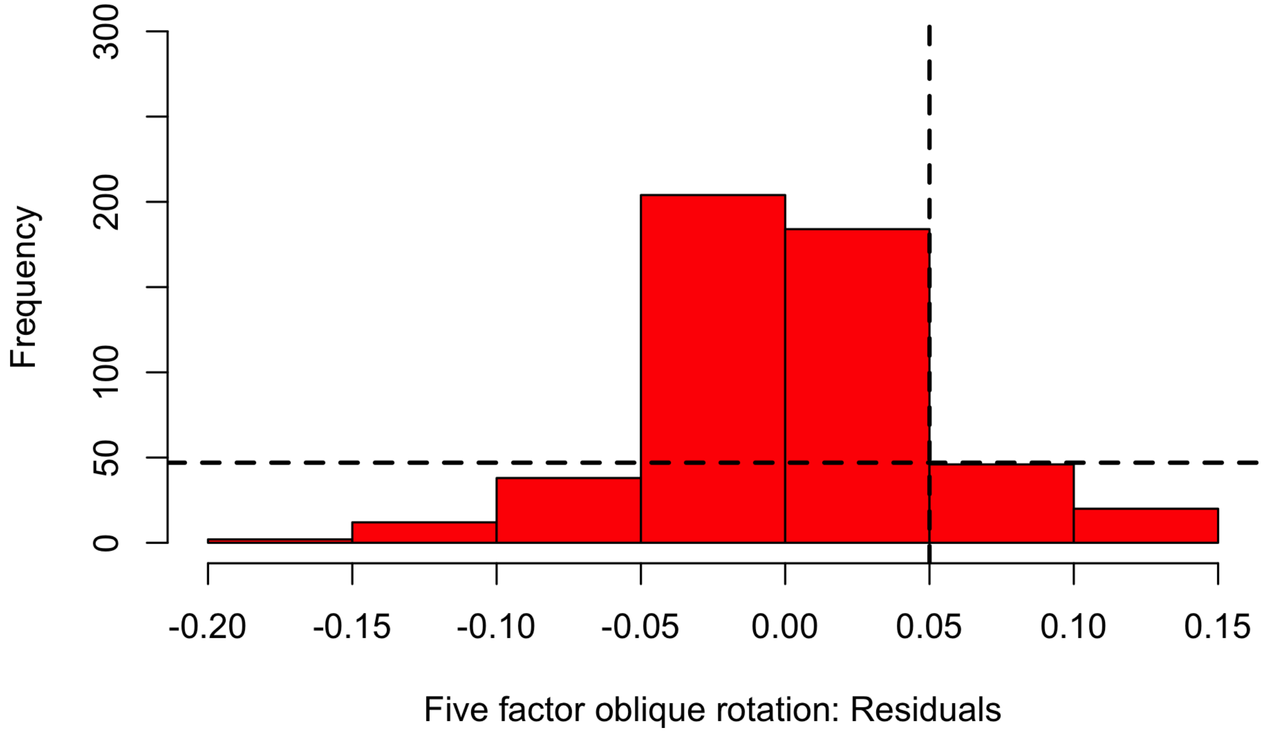

Figure 4. Residulas of five-dactor solution