

Vaccine Confidence Index results

Jamie Griffith

03 February 2023

Notes on the code, analyses and results

If you, the reader, find any issues, mistakes, or otherwise have reason to comment, please contact Jamie Griffith at j-griffith@northwestern.edu. This research is funded by the National Institutes of Health (R01MD010440). Our clinicaltrials.gov number is NCT03584490.

Getting started

To begin the analyses, we first load the necessary packages to read in and analyse the data. Note that the `whatsthedif` package was developed by us in order to analyse data from this project. It contains scoring algorithms as well as some helpful functions. You can install and look at the package using the code below.

```
# Note to use: You may wish to ensure your packages are installed and up-to-date  
# before running this code  
  
if (!require("pacman")) install.packages("pacman")  
  
library(pacman)  
  
p_load(devtools,  
       ggplot2,  
       lavaan,  
       magrittr,  
       parallel,  
       tableone,  
       lubridate,  
       xlsx,  
       psych,  
       update = TRUE)  
  
if (!require("whatsthedif")) install_github("jameswgriffith/whatsthedif",  
      auth_token = "56a3f57ab6935c2610336a67db61357108aa2e15")  
  
library(whatsthedif)  
  
# Detach/unload devtools because it is no longer needed  
detach("package:devtools", unload = TRUE)
```

Reading in the data

The database for the project was maintained in REDCap. A .csv file was exported therefrom, read into R, and then reduced for the purposes of this paper. All data manipulation was done in R. The file below is the baseline assessment from the phone-based protocol (N = 304) merged with demographics and health literacy data from the parent study: phone_t1_screening_hl.rdata

There were 304 who completed a baseline assessment for the phone-based protocol.

VCI Completion

The rate of VCI completion was high, but only participants who completed 7 or more of the 8 items were retained in the analyses (i.e., 80% or more).

```
# How many valid VCI items?  
# On average  
mean(phone_t1_screening_hl$vci_valid)
```

```
## [1] 7.6
```

```
# Range  
range(phone_t1_screening_hl$vci_valid)
```

```
## [1] 3 8
```

Parallel analysis to check number of components

The result was one component.

```
vci_recoded <- paste0("vci", 1:8, "_rec")  
  
# Examine a parallel analysis using the method of Lubbe  
set.seed(010440)  
polyPA(vc_dat[, vci_recoded],  
       replications = 1000,  
       prc = .99)
```

```
## $sample_ev  
## [1] 3.62 1.47 0.83 0.65 0.50 0.37 0.32 0.24  
##  
## $reference_ev  
## [1] 2.18 1.48 1.29 1.15 1.03 0.94 0.83 0.68
```

Alpha overall, for English, and for Spanish

```
psych::alpha(vc_dat[, vci_recoded])  
  
##  
## Reliability analysis  
## Call: psych::alpha(x = vc_dat[, vci_recoded])  
##  
## raw_alpha std.alpha G6(smc) average_r S/N ase mean sd median_r
```

```

##      0.72      0.71      0.73      0.24 2.5 0.024  3.4 0.51      0.21
##
##      95% confidence boundaries
##          lower alpha upper
## Feldt      0.67 0.72 0.77
## Duhachek 0.67 0.72 0.77
##
## Reliability if an item is dropped:
##      raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
## vci1_rec      0.74      0.74      0.75      0.29 2.9  0.024 0.015 0.27
## vci2_rec      0.68      0.66      0.67      0.22 2.0  0.027 0.023 0.21
## vci3_rec      0.69      0.67      0.68      0.22 2.0  0.027 0.023 0.21
## vci4_rec      0.68      0.66      0.66      0.22 2.0  0.027 0.020 0.22
## vci5_rec      0.70      0.69      0.71      0.24 2.3  0.026 0.026 0.22
## vci6_rec      0.70      0.69      0.70      0.24 2.2  0.026 0.023 0.24
## vci7_rec      0.67      0.67      0.67      0.22 2.0  0.029 0.022 0.21
## vci8_rec      0.67      0.67      0.69      0.23 2.0  0.029 0.024 0.20
##
## Item statistics
##      n raw.r std.r r.cor r.drop mean  sd
## vci1_rec 273 0.19 0.32 0.13 0.09 3.9 0.41
## vci2_rec 264 0.63 0.65 0.60 0.47 3.2 0.93
## vci3_rec 272 0.58 0.64 0.58 0.46 3.7 0.69
## vci4_rec 271 0.60 0.65 0.61 0.47 3.6 0.75
## vci5_rec 267 0.56 0.54 0.43 0.37 3.6 0.88
## vci6_rec 265 0.61 0.54 0.45 0.40 2.5 1.10
## vci7_rec 261 0.67 0.64 0.58 0.52 3.4 0.92
## vci8_rec 271 0.69 0.63 0.55 0.50 3.4 1.08
##
## Non missing response frequency for each item
##      1 2 3 4 miss
## vci1_rec 0.01 0.00 0.03 0.95 0.00
## vci2_rec 0.09 0.08 0.36 0.47 0.03
## vci3_rec 0.04 0.03 0.09 0.85 0.00
## vci4_rec 0.04 0.05 0.14 0.77 0.01
## vci5_rec 0.08 0.04 0.05 0.84 0.02
## vci6_rec 0.26 0.25 0.28 0.22 0.03
## vci7_rec 0.06 0.12 0.15 0.67 0.04
## vci8_rec 0.12 0.10 0.07 0.71 0.01

```

```
psych::alpha(vc_dat[vc_dat$language == 1, vci_recoded])
```

```

##
## Reliability analysis
## Call: psych::alpha(x = vc_dat[vc_dat$language == 1, vci_recoded])
##
##      raw_alpha std.alpha G6(smc) average_r S/N ase mean sd median_r
##      0.73      0.73      0.74      0.25 2.7 0.027  3.5 0.5      0.23
##
##      95% confidence boundaries
##          lower alpha upper
## Feldt      0.67 0.73 0.78
## Duhachek 0.68 0.73 0.78
##
## Reliability if an item is dropped:
##      raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
## vci1_rec      0.74      0.74      0.75      0.29 2.9  0.027 0.018 0.26
## vci2_rec      0.69      0.68      0.69      0.23 2.1  0.030 0.023 0.23
## vci3_rec      0.69      0.68      0.69      0.23 2.1  0.030 0.022 0.23
## vci4_rec      0.70      0.69      0.69      0.24 2.2  0.029 0.018 0.23

```

```

## vci5_rec      0.71      0.71      0.73      0.26 2.5      0.028 0.025 0.23
## vci6_rec      0.71      0.71      0.72      0.26 2.4      0.029 0.022 0.24
## vci7_rec      0.67      0.68      0.69      0.24 2.2      0.033 0.021 0.23
## vci8_rec      0.69      0.69      0.71      0.24 2.3      0.031 0.024 0.23
##
## Item statistics
##           n raw.r std.r r.cor r.drop mean  sd
## vci1_rec 217 0.26 0.39 0.23 0.17 3.9 0.37
## vci2_rec 210 0.64 0.66 0.61 0.48 3.3 0.92
## vci3_rec 217 0.61 0.67 0.62 0.48 3.7 0.71
## vci4_rec 215 0.58 0.64 0.60 0.44 3.7 0.73
## vci5_rec 215 0.55 0.53 0.41 0.36 3.6 0.87
## vci6_rec 210 0.62 0.54 0.45 0.40 2.5 1.11
## vci7_rec 213 0.70 0.65 0.60 0.55 3.5 0.92
## vci8_rec 216 0.67 0.61 0.53 0.49 3.4 1.04
##
## Non missing response frequency for each item
##           1 2 3 4 miss
## vci1_rec 0.01 0.00 0.01 0.97 0.00
## vci2_rec 0.09 0.07 0.34 0.50 0.03
## vci3_rec 0.05 0.02 0.09 0.85 0.00
## vci4_rec 0.04 0.04 0.16 0.77 0.01
## vci5_rec 0.07 0.04 0.05 0.83 0.01
## vci6_rec 0.27 0.23 0.28 0.22 0.03
## vci7_rec 0.06 0.13 0.11 0.70 0.02
## vci8_rec 0.11 0.09 0.07 0.73 0.00

```

```
psych::alpha(vc_dat[vc_dat$language == 2, vci_recoded])
```

```

## Some items ( vci1_rec ) were negatively correlated with the total scale and
## probably should be reversed.
## To do this, run the function again with the 'check.keys=TRUE' option

```

```

##
## Reliability analysis
## Call: psych::alpha(x = vc_dat[vc_dat$language == 2, vci_recoded])
##
##   raw_alpha std.alpha G6(smc) average_r S/N ase mean sd median_r
##   0.69      0.66      0.7      0.19 1.9 0.057 3.4 0.51 0.24
##
##   95% confidence boundaries
##           lower alpha upper
## Feldt    0.55 0.69 0.8
## Duhachek 0.58 0.69 0.8
##
## Reliability if an item is dropped:
##   raw_alpha std.alpha G6(smc) average_r S/N alpha se var.r med.r
## vci1_rec    0.73      0.74      0.75      0.29 2.9 0.053 0.016 0.29
## vci2_rec    0.65      0.61      0.65      0.18 1.6 0.064 0.044 0.25
## vci3_rec    0.67      0.63      0.66      0.19 1.7 0.062 0.042 0.24
## vci4_rec    0.62      0.57      0.60      0.16 1.3 0.070 0.038 0.16
## vci5_rec    0.65      0.61      0.66      0.18 1.6 0.064 0.047 0.22
## vci6_rec    0.65      0.62      0.65      0.19 1.7 0.064 0.045 0.27
## vci7_rec    0.66      0.63      0.66      0.19 1.7 0.063 0.045 0.25
## vci8_rec    0.62      0.58      0.62      0.17 1.4 0.073 0.042 0.16
##
## Item statistics
##           n raw.r std.r r.cor r.drop mean  sd
## vci1_rec 56 0.0098 0.078 -0.17 -0.15 3.8 0.54

```

```

## vci2_rec 54 0.6002 0.598 0.53 0.42 3.1 0.93
## vci3_rec 55 0.4675 0.553 0.47 0.37 3.8 0.58
## vci4_rec 56 0.6930 0.728 0.72 0.57 3.6 0.82
## vci5_rec 52 0.6374 0.601 0.51 0.42 3.6 0.93
## vci6_rec 55 0.6133 0.558 0.48 0.41 2.5 1.07
## vci7_rec 48 0.5646 0.554 0.46 0.39 3.3 0.94
## vci8_rec 55 0.7494 0.678 0.64 0.54 3.1 1.19
##
## Non missing response frequency for each item
##      1      2      3      4 miss
## vci1_rec 0.02 0.02 0.09 0.88 0.00
## vci2_rec 0.09 0.11 0.43 0.37 0.04
## vci3_rec 0.00 0.07 0.09 0.84 0.02
## vci4_rec 0.04 0.11 0.07 0.79 0.00
## vci5_rec 0.10 0.02 0.04 0.85 0.07
## vci6_rec 0.22 0.29 0.27 0.22 0.02
## vci7_rec 0.08 0.08 0.31 0.52 0.14
## vci8_rec 0.16 0.15 0.07 0.62 0.02

```

Dates of phone-baseline completion and screening dates

For the sample of 273, the dates of completion for the baseline for the phone protocol are as follows:

```
## [1] "2020-11-06" "2021-03-11"
```

The range of dates for screening were as follows:

```
## [1] "2018-09-18" "2020-02-26"
```

Table 1 and demographics

	level	Overall	Hispanic	non-Hispanic Asian	non-Hispanic Black	non-Hispanic other/more than one	non-Hispanic White
n		273	67	10	109	6	81
Health LiTT T Score (mean (SD))		53.54 (8.62)	50.43 (8.73)	61.56 (3.24)	50.41 (7.81)	53.32 (13.15)	59.34 (5.63)
Age at screening (Years) (mean (SD))		49.32 (16.20)	47.15 (15.60)	30.60 (11.12)	52.52 (12.69)	39.75 (13.95)	49.83 (19.48)
VCI (mean (SD))		2.40 (0.97)	2.26 (0.94)	2.89 (0.69)	2.06 (0.91)	2.49 (1.44)	2.90 (0.85)
Gender (%)	male	100 (36.6)	20 (29.9)	5 (50.0)	37 (33.9)	3 (50.0)	35 (43.2)
	female	173 (63.4)	47 (70.1)	5 (50.0)	72 (66.1)	3 (50.0)	46 (56.8)
Language (%)	English	217 (79.5)	11 (16.4)	10 (100.0)	109 (100.0)	6 (100.0)	81 (100.0)
	Spanish	56 (20.5)	56 (83.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Education (%)	12th grade or less	105 (38.5)	31 (46.3)	0 (0.0)	59 (54.1)	2 (33.3)	13 (16.0)
	Some college/technical degree/AA	51 (18.7)	17 (25.4)	0 (0.0)	29 (26.6)	1 (16.7)	4 (4.9)

level	Overall	Hispanic	non-Hispanic Asian	non-Hispanic Black	non-Hispanic other/more than one	non-Hispanic White
College and above	117 (42.9)	19 (28.4)	10 (100.0)	21 (19.3)	3 (50.0)	64 (79.0)

Mediation analyses in lavaan

The results are saved to a multisheet Excel file for ease of review. Please see VCI_results_revision.xlsx

Other statistics for the abstract can be found in Table 1.

Histograms

Histograms are saved as .png files.

Package and R Session information

```
sessionInfo()
```

```
## R version 4.2.2 (2022-10-31 ucrt)
## Platform: x86_64-w64-mingw32/x64 (64-bit)
## Running under: Windows 10 x64 (build 19045)
##
## Matrix products: default
##
## locale:
## [1] LC_COLLATE=English_United Kingdom.utf8
## [2] LC_CTYPE=English_United Kingdom.utf8
## [3] LC_MONETARY=English_United Kingdom.utf8
## [4] LC_NUMERIC=C
## [5] LC_TIME=English_United Kingdom.utf8
##
## attached base packages:
## [1] parallel stats graphics grDevices utils datasets methods
## [8] base
##
## other attached packages:
## [1] whatsthe dif_0.3.2 psych_2.2.9 xlsx_0.6.5 lubridate_1.9.1
## [5] tableone_0.13.2 magrittr_2.0.3 lavaan_0.6-13 ggplot2_3.4.0
## [9] usethis_2.1.6 pacman_0.5.1
##
## loaded via a namespace (and not attached):
## [1] nlme_3.1-162 fs_1.6.0 tools_4.2.2 profvis_0.3.7
## [5] utf8_1.2.3 R6_2.5.1 DBI_1.1.3 colorspace_2.1-0
## [9] urlchecker_1.0.1 withr_2.5.0 tidyselect_1.2.0 prettyunits_1.1.1
## [13] mnormt_2.1.1 processx_3.8.0 compiler_4.2.2 textshaping_0.3.6
## [17] cli_3.6.0 labeling_0.4.2 scales_1.2.1 callr_3.7.3
## [21] proxy_0.4-27 systemfonts_1.0.4 stringr_1.5.0 digest_0.6.31
## [25] pbivnorm_0.6.0 rmarkdown_2.20 pkgconfig_2.0.3 htmltools_0.5.4
## [29] sessioninfo_1.2.2 labelled_2.10.0 fastmap_1.1.0 htmlwidgets_1.6.1
## [33] rlang_1.0.6 rstudioapi_0.14 shiny_1.7.4 farver_2.1.1
## [37] generics_0.1.3 zoo_1.8-11 dplyr_1.1.0 Matrix_1.5-3
```

## [41]	Rcpp_1.0.10	munsell_0.5.0	fansi_1.0.4	lifecycle_1.0.3
## [45]	stringi_1.7.12	yaml_2.3.7	MASS_7.3-58.2	pkgbuild_1.4.0
## [49]	grid_4.2.2	promises_1.2.0.1	forcats_1.0.0	crayon_1.5.2
## [53]	miniUI_0.1.1.1	lattice_0.20-45	haven_2.5.1	splines_4.2.2
## [57]	xlsxjars_0.6.1	hms_1.1.2	knitr_1.42	ps_1.7.2
## [61]	pillar_1.8.1	stats4_4.2.2	pkgload_1.3.2	glue_1.6.2
## [65]	evaluate_0.20	mitools_2.4	remotes_2.4.2	vctrs_0.5.2
## [69]	httpuv_1.6.8	gtable_0.3.1	purrr_1.0.1	cachem_1.0.6
## [73]	xfun_0.36	mime_0.12	xtable_1.8-4	survey_4.1-1
## [77]	e1071_1.7-13	later_1.3.0	ragg_1.2.5	class_7.3-21
## [81]	survival_3.5-0	tibble_3.1.8	rJava_1.0-6	memoise_2.0.1
## [85]	timechange_0.2.0	ellipsis_0.3.2		