Sensitivity analyses — HPT (Czech data)

Robustness checks for scoring, ideology operationalisation, exclusions, and random-slopes

HPT and Extremism project

2025-12-09

Contents

1 Purpose and scope

This file documents **exploratory robustness checks** of our main results. We vary how HPT is scored, how ideology is operationalised, which observations are included, and whether class-level **random slopes** are needed. The goal is to see if substantive conclusions survive reasonable perturbations—**not** to hunt for significance.

HPT scoring follows the Hartmann–Hasselhorn / Huijgen instrument logic; note earlier reports that ROA items can behave inconsistently across samples, motivating ROA-free alternatives here. We also leverage the FR-LF dimensions RD and NS for ideology variants, aligned with the codebook of our dataset. These analyses correspond to the "contamination" checks pre-registered in the project snapshot.

1.1 Setup

```r
# Core packages
library(tidyverse)
library(lme4)
library(lmerTest)
library(broom)
library(broom.mixed)
library(performance)
library(gt)
library(glue)

# Nice printing
theme_set(theme_bw())
```

1.2 Data

```r
# Load the dataset created in 00_data-preparation
load("normalised_responses.RData")
stopifnot(exists("normalised_responses"))
dat_raw <- normalised_responses
```

How to read variables. Variable names and coding (KN, POP/ROA/CONT, RD/NS, KSA facets, SDR) are defined in the project codebook and used verbatim here.

HPT scoring variants —means (higher = better)

Score	Mean
9-item (POP+ROA+CONT)	2.51
8-item (drop ROA1)	2.47
6-item (drop all ROA)	2.36

2 1. Scoring variants for HPT

Why: In prior literature, POP and CONT often form one factor, while ROA can be unstable (e.g., ROA1 cross-loads in some samples). We therefore compare the **original 9-item average** with **ROA-free** and **problem-item-free** scores.

```r
dat <- dat_raw %>%
  mutate(
    # Per codebook, POP/ROA/CONT are coded 1-4 (higher = better fit). :contentReference[oaicite:5]{index=5}
    HPT_total_9  = rowMeans(across(c(POP1:POP3, ROA1:ROA3, CONT1:CONT3)), na.rm = TRUE),
    HPT_total_6  = rowMeans(across(c(POP1:POP3, CONT1:CONT3)), na.rm = TRUE),          # exclude all ROA
    HPT_total_8  = rowMeans(across(c(POP1:POP3, ROA2:ROA3, CONT1:CONT3)), na.rm = TRUE) # drop ROA1 only
  )
```

2.0.1 Descriptives

```r
hpt_desc <- dat %>%
  summarise(
    `9-item (POP+ROA+CONT)` = mean(HPT_total_9,  na.rm=TRUE),
    `8-item (drop ROA1)`    = mean(HPT_total_8,  na.rm=TRUE),
    `6-item (drop all ROA)` = mean(HPT_total_6,  na.rm=TRUE)
  ) %>% pivot_longer(everything(), names_to="Score", values_to="Mean")

gt(hpt_desc) %>%
  fmt_number(columns=Mean, decimals=2) %>%
  tab_header(title="HPT scoring variants - means (higher = better)")
```

Interpretation. If the **rankings of groups/effects** are stable across these scores, conclusions do not hinge on ROA behaviour. If results flip only when ROA is included, they are **fragile** and likely influenced by ROA idiosyncrasies noted in earlier work.

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3 2. Ideology operationalisations

Why: FR-LF defines six dimensions; we focus on **RD (right-authoritarian rule)** and **NS (Nazi relativisation)**. We test (a) **NS-only**, (b) **RD+NS combined** (FR-LF mini), and (c) **KSA-3** authoritarianism (total and facets).

```r
dat <- dat %>%
  mutate(
    KN_total   = rowSums(across(KN1:KN6), na.rm = TRUE),        # knowledge mini-test
    SDR_total  = rowSums(across(starts_with("SDR")), na.rm = TRUE),
    NS_sum     = rowSums(across(NS1:NS3), na.rm = TRUE),
    RD_sum     = rowSums(across(RD1:RD3), na.rm = TRUE),
    FRLF_mini  = NS_sum + RD_sum,                               # FR-LF logic (NS + RD)
    KSA_A      = rowSums(across(A1:A3), na.rm = TRUE),
    KSA_U      = rowSums(across(U1:U3), na.rm = TRUE),
    KSA_K      = rowSums(across(K1:K3), na.rm = TRUE),
    KSA_total  = KSA_A + KSA_U + KSA_K
  ) %>%
  # z-standardize predictors for comparability of
  mutate(across(c(NS_sum, FRLF_mini, KSA_total, KN_total, SDR_total), scale, .names="{.col}_z"))
```

Interpretation. If **NS-only** predicts HPT similarly to (or more strongly than) broad authoritarianism (KSA-3), the HPT score may be **ideologically contaminated** by Nazi-congruent attitudes, consistent with our preregistered concern.

---

4 3. Exclusions: knowledge outliers & extreme SDR

Rules (predefined here for sensitivity only):

- **Knowledge outliers:** drop KN totals outside the Tukey fence ($[Q_1-1.5\,IQR,; Q_3+1.5\,IQR]$).
- **Extreme SDR:** drop the **top 10%** of SDR totals (possible "faking good"). Codebook notes SDR2–SDR4 are reversed already.

```r
# Compute fences
kn_q <- quantile(dat$KN_total, probs = c(.25, .75), na.rm = TRUE)
kn_iqr <- kn_q[2]-kn_q[1]
kn_low <- kn_q[1] - 1.5*kn_iqr
kn_high<- kn_q[2] + 1.5*kn_iqr

sdr_p90 <- quantile(dat$SDR_total, probs = .90, na.rm = TRUE)
```

Exclusion counts (for sensitivity runs)

Criterion	N
Total N	156
Drop KN outliers	0
Drop top-10% SDR	21
Kept (both rules)	135

```r
dat <- dat %>%
  mutate(
    excl_KN  = KN_total < kn_low | KN_total > kn_high,
    excl_SDR = SDR_total >= sdr_p90,
    keep_all = TRUE,
    keep_excl= !(excl_KN | excl_SDR)
  )

table_excl <- tibble(
  Criterion = c("Total N", "Drop KN outliers", "Drop top-10% SDR", "Kept (both rules)"),
  N = c(nrow(dat),
        sum(dat$excl_KN, na.rm=TRUE),
        sum(dat$excl_SDR, na.rm=TRUE),
        sum(dat$keep_excl, na.rm=TRUE))
)

gt(table_excl) %>%
  tab_header(title="Exclusion counts (for sensitivity runs)")
```

Interpretation. If effects persist after dropping **low-knowledge** and **high-SDR** respondents, results are less likely to be artefacts of misunderstanding or impression management.

---

5   4. Mixed models with class clustering & random slopes

We estimate multilevel models (students nested in classes), starting with random intercepts and then allowing the **ideology effect to vary by class**. We fit the models for each **HPT scoring** and **ideology** variant.

```r
fit_models <- function(data, hpt_var, ideol_var){
  form0 <- as.formula(glue("{hpt_var} ~ {ideol_var} + KN_total_z + SDR_total_z + (1 | class_label)"))
  form1 <- as.formula(glue("{hpt_var} ~ {ideol_var} + KN_total_z + SDR_total_z + (1 + {ideol_var} | class_label)"))
  m0 <- lmer(form0, data = data)
  # Try random slope; if singular, fall back to intercept-only
  m1 <- try(lmer(form1, data = data), silent = TRUE)
  if(inherits(m1,"try-error") || isTRUE(isSingular(m1))) m1 <- NULL
  list(m0=m0, m1=m1)
}


tidy_model <- function(m){
  tibble(
    term     = broom.mixed::tidy(m, effects="fixed")$term,
    estimate = broom.mixed::tidy(m, effects="fixed")$estimate,
    conf.low = confint(m, method="Wald")[names(fixef(m)),1],
    conf.high= confint(m, method="Wald")[names(fixef(m)),2],
    p.value  = broom.mixed::tidy(m, effects="fixed")$p.value,
    R2_marg  = performance::r2_nakagawa(m)$R2_marginal,
    R2_cond  = performance::r2_nakagawa(m)$R2_conditional
  )
}
```

5.0.1 Run model grid

```r
hpt_vars   <- c("HPT_total_9","HPT_total_8","HPT_total_6")
ideol_vars <- c("NS_sum_z","FRLF_mini_z","KSA_total_z")

# Full sample
grid_full <- expand_grid(hpt=hpt_vars, ideol=ideol_vars) %>%
  mutate(fits = map2(hpt, ideol, ~fit_models(dat %>% filter(keep_all), .x, .y)),
         m0   = map(fits, "m0"),
         m1   = map(fits, "m1"))

# Exclusion sample (drop KN outliers & top-10% SDR)
grid_excl <- expand_grid(hpt=hpt_vars, ideol=ideol_vars) %>%
  mutate(fits = map2(hpt, ideol, ~fit_models(dat %>% filter(keep_excl), .x, .y)),
         m0   = map(fits, "m0"),
         m1   = map(fits, "m1"))
```

5.0.2 Summaries (key coefficient = ideology)

```r
summarise_grid <- function(grid, label){
  out0 <- grid %>%
    mutate(tidy0 = map(m0, tidy_model)) %>%
    unnest(tidy0) %>%
    filter(term == "(Intercept)" | str_detect(term, "NS_sum_z|FRLF_mini_z|KSA_total_z")) %>%
    select(hpt, ideol, term, estimate, conf.low, conf.high, p.value, R2_marg, R2_cond) %>%
    mutate(model = "RI") # random intercept

  out1 <- grid %>%
    filter(!map_lgl(m1, is.null)) %>%
    mutate(tidy1 = map(m1, tidy_model)) %>%
    unnest(tidy1) %>%
    filter(term == "(Intercept)" | str_detect(term, "NS_sum_z|FRLF_mini_z|KSA_total_z")) %>%
    select(hpt, ideol, term, estimate, conf.low, conf.high, p.value, R2_marg, R2_cond) %>%
    mutate(model = "RS") # random slope (ideology)

  bind_rows(out0, out1) %>% mutate(sample = label)
}

tab_full <- summarise_grid(grid_full, "Full")
tab_excl <- summarise_grid(grid_excl, "Exclusions applied")
```

```
## Random effect variances not available. Returned R2 does not account for random effects.
## Random effect variances not available. Returned R2 does not account for random effects.
## Random effect variances not available. Returned R2 does not account for random effects.
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## Random effect variances not available. Returned R2 does not account for random effects.
## Random effect variances not available. Returned R2 does not account for random effects.

## Warning: There were 14 warnings in `mutate()`.
## The first warning was:
```

```
## i In argument: `tidy0 = map(m0, tidy_model)`.
## Caused by warning:
## ! Can't compute random effect variances. Some variance components equal
##   zero. Your model may suffer from singularity (see `?lme4::isSingular`
##   and `?performance::check_singularity`).
##   Decrease the `tolerance` level to force the calculation of random effect
##   variances, or impose priors on your random effects parameters (using
##   packages like `brms` or `glmmTMB`).
## i Run `dplyr::last_dplyr_warnings()` to see the 13 remaining warnings.


## Random effect variances not available. Returned R2 does not account for random effects.
## Random effect variances not available. Returned R2 does not account for random effects.
## Random effect variances not available. Returned R2 does not account for random effects.
## Random effect variances not available. Returned R2 does not account for random effects.


## Warning: There were 4 warnings in `mutate()`.
## The first warning was:
## i In argument: `tidy1 = map(m1, tidy_model)`.
## Caused by warning:
## ! Can't compute random effect variances. Some variance components equal
##   zero. Your model may suffer from singularity (see `?lme4::isSingular`
##   and `?performance::check_singularity`).
##   Decrease the `tolerance` level to force the calculation of random effect
##   variances, or impose priors on your random effects parameters (using
##   packages like `brms` or `glmmTMB`).
## i Run `dplyr::last_dplyr_warnings()` to see the 3 remaining warnings.
```

```r
tab_models <- bind_rows(tab_full, tab_excl) %>%
  mutate(ideol = recode(ideol,
                        NS_sum_z="NS (z)", FRLF_mini_z="FR-LF: RD+NS (z)", KSA_total_z="KSA-3 total (z)"),
         hpt   = recode(hpt,
                        HPT_total_9="HPT 9-item", HPT_total_8="HPT 8-item (drop ROA1)",
                        HPT_total_6="HPT 6-item (no ROA)")) %>%
  arrange(sample, hpt, ideol, model)
```

```r
tab_models %>%
  mutate(across(c(estimate, conf.low, conf.high, R2_marg, R2_cond), ~round(., 3)),
         p.value = signif(p.value, 3)) %>%
  gt() %>%
  tab_header(title="Multilevel models: ideology → HPT (controls: KN, SDR; class clustered)") %>%
  tab_spanner(label = "Effect (  and 95% CI)", columns = c(estimate, conf.low, conf.high)) %>%
```

```
cols_label(sample="Sample", hpt="HPT score", ideol="Ideology", model="Model",
           estimate=" ", conf.low="CI low", conf.high="CI high",
           p.value="p", R2_marg="R² (marg.)", R2_cond="R² (cond.)")
```

How to read the table.

- **Rows** = combinations of HPT scoring (9/8/6 items), ideology metric (NS only; FR-LF RD+NS; KSA-3), and model type: **RI** = random-intercept by class; **RS** = also random **slope** of ideology by class (shown only when not singular).
- **Key cell** = the **for ideology** (standardised), with **95% CI**.
- **R² (marg./cond.)** give variance explained by fixed effects and by full model.

Interpretation guide.

- If **NS (z)** predicts HPT strongly while KSA-3 does not, HPT may be **aligned with Nazi-congruent content** rather than general authoritarianism—i.e., content **congruence** instead of better historical reasoning. This is the contamination mechanism we flagged.
- If effects are **stable across 9/8/6-item** HPT scores, conclusions are **robust** to ROA decisions. If they require ROA to appear, caution is warranted given prior ROA instability.
- If **random slopes** improve fit (higher R²_cond; non-singular), the ideology–HPT link **varies by class**. That suggests classroom climate/teaching may moderate how ideology maps onto HPT.

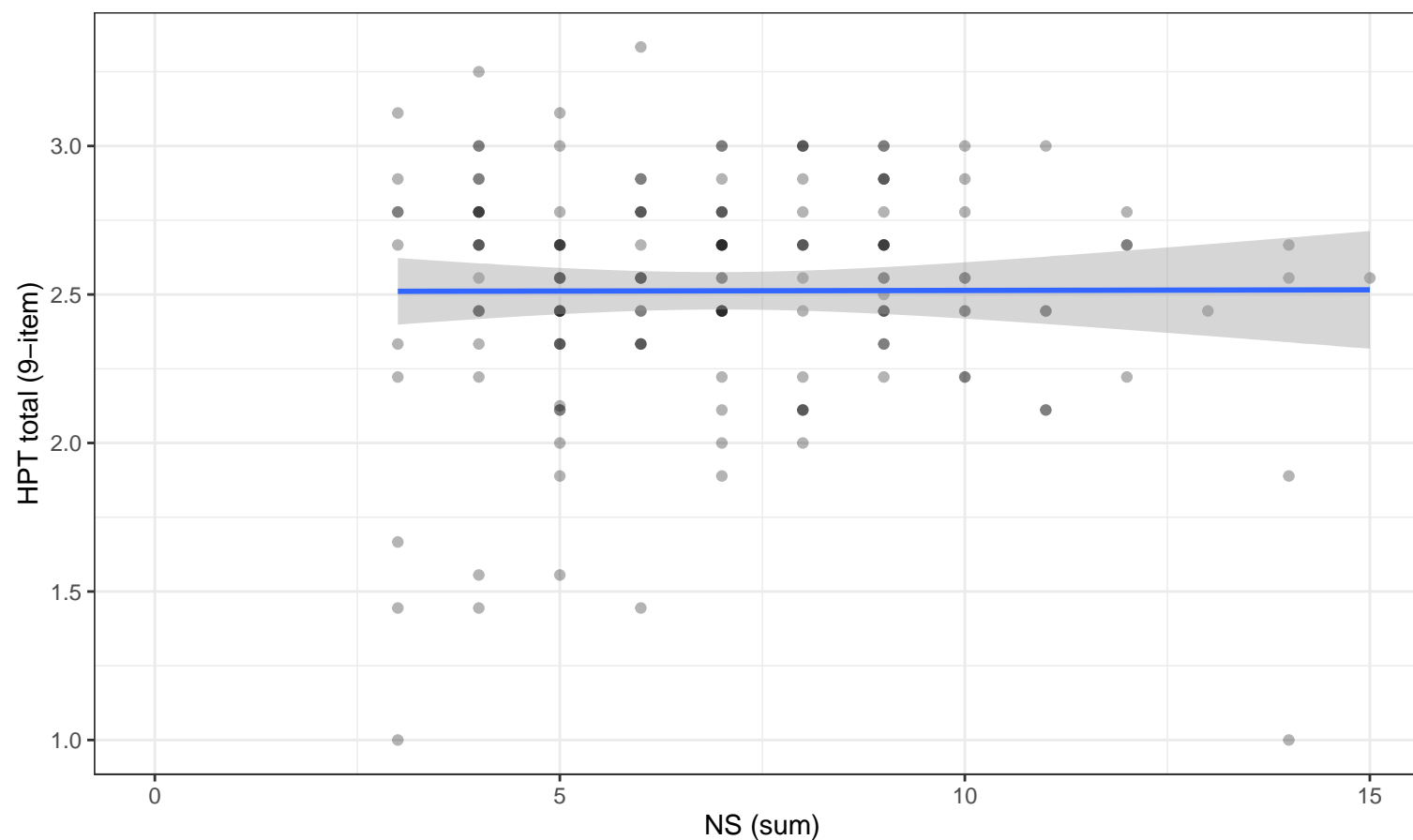# 6   5. Sanity checks & clarity plots (optional quick look)

```
dat %>%
  ggplot(aes(NS_sum, HPT_total_9)) +
  geom_point(alpha=.3) + geom_smooth(method="lm", se=TRUE) +
  labs(x="NS (sum)", y="HPT total (9-item)",
       title="Bivariate check (unadjusted): NS vs. HPT") +
  theme(plot.title.position="plot")
```

```
## `geom_smooth()` using formula = 'y ~ x'
```

```
## Warning: Removed 4 rows containing non-finite outside the scale range
## (`stat_smooth()`).
```

```
## Warning: Removed 4 rows containing missing values or values outside the scale
## range (`geom_point()`).
```

Bivariate check (unadjusted): NS vs. HPT

Interpretation. These quick plots are only to **visualise direction**; final inferences come from the multilevel models with controls.

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7 6. Read-outs you can cite in prose

- **Stable conclusions** across HPT **9/8/6** scoring → results **do not depend** on ROA items. (ROA instability has been noted previously.)
- **NS-only** predicting as much/more than **KSA-3** → supports the **ideological contamination** concern in our PCI RR snapshot.
- Survives **knowledge/SDR exclusions** → less likely driven by misunderstanding or impression management; SDR handling follows our codebook.

- **Random slopes needed** → ideology effects differ **by class**, implying a pedagogical moderation worth exploring (teaching of context vs. presentism etc.), in line with the HPT literature's emphasis on contextual frames.

---

8 Reproducibility appendix

```r
sessionInfo()
```

```
## R version 4.4.2 (2024-10-31)
## Platform: x86_64-pc-linux-gnu
## Running under: Ubuntu 24.04.3 LTS
##
## Matrix products: default
## BLAS:   /usr/lib/x86_64-linux-gnu/blas/libblas.so.3.12.0
## LAPACK: /usr/lib/x86_64-linux-gnu/lapack/liblapack.so.3.12.0
##
## locale:
##  [1] LC_CTYPE=C.UTF-8           LC_NUMERIC=C
##  [3] LC_TIME=cs_CZ.UTF-8        LC_COLLATE=C.UTF-8
##  [5] LC_MONETARY=cs_CZ.UTF-8    LC_MESSAGES=C.UTF-8
##  [7] LC_PAPER=cs_CZ.UTF-8       LC_NAME=C
##  [9] LC_ADDRESS=C               LC_TELEPHONE=C
## [11] LC_MEASUREMENT=cs_CZ.UTF-8 LC_IDENTIFICATION=C
##
## time zone: Europe/Prague
## tzcode source: system (glibc)
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
##  [1] glue_1.8.0         gt_1.1.0             performance_0.15.1
##  [4] broom.mixed_0.2.9.6 broom_1.0.7         lmerTest_3.1-3
##  [7] lme4_1.1-38        Matrix_1.7-1         lubridate_1.9.4
## [10] forcats_1.0.0      stringr_1.5.1        dplyr_1.1.4
## [13] purrr_1.1.0        readr_2.1.5          tidyr_1.3.1
## [16] tibble_3.2.1       ggplot2_4.0.1        tidyverse_2.0.0
##
```

```
## loaded via a namespace (and not attached):
##  [1] gtable_0.3.6       xfun_0.54          insight_1.4.2
##  [4] lattice_0.22-5     tzdb_0.5.0         numDeriv_2016.8-1.1
##  [7] vctrs_0.6.5        tools_4.4.2        Rdpack_2.6.4
## [10] generics_0.1.3     parallel_4.4.2     pkgconfig_2.0.3
## [13] RColorBrewer_1.1-3 S7_0.2.1           lifecycle_1.0.4
## [16] compiler_4.4.2     farver_2.1.2       codetools_0.2-20
## [19] htmltools_0.5.8.1  yaml_2.3.10        pillar_1.10.0
## [22] furrr_0.3.1        nloptr_2.2.1       MASS_7.3-61
## [25] reformulas_0.4.1   boot_1.3-31        nlme_3.1-166
## [28] parallelly_1.45.1  tidyselect_1.2.1   digest_0.6.37
## [31] stringi_1.8.4      future_1.68.0      listenv_0.10.0
## [34] labeling_0.4.3     splines_4.4.2      fastmap_1.2.0
## [37] grid_4.4.2         cli_3.6.5          magrittr_2.0.3
## [40] withr_3.0.2        scales_1.4.0       backports_1.5.0
## [43] timechange_0.3.0   rmarkdown_2.29     globals_0.18.0
## [46] hms_1.1.3          evaluate_1.0.5     knitr_1.50
## [49] rbibutils_2.3      mgcv_1.9-1         rlang_1.1.6
## [52] Rcpp_1.0.13-1      xml2_1.3.6         minqa_1.2.8
## [55] R6_2.6.1           fs_1.6.5
```

Multilevel models: ideology →HPT (controls: KN, SDR; class clustered)

HPT score	Ideology	term	Effect (β and 95% CI) β	CI low	CI high	p	R²(marg.)	R²(cond.)	Model	Samp
HPT 6-item (no ROA)	FR-LF: RD+NS (z)	(Intercept)	2.345	2.267	2.422	7.33e-13	0.004	0.019	RI	Exclu
HPT 6-item (no ROA)	FR-LF: RD+NS (z)	FRLF_mini_z	0.009	-0.067	0.086	8.09e-01	0.004	0.019	RI	Exclu
HPT 6-item (no ROA)	FR-LF: RD+NS (z)	(Intercept)	2.341	2.269	2.413	2.16e-80	0.006	NA	RS	Exclu
HPT 6-item (no ROA)	FR-LF: RD+NS (z)	FRLF_mini_z	0.014	-0.093	0.120	8.05e-01	0.006	NA	RS	Exclu
HPT 6-item (no ROA)	KSA-3 total (z)	(Intercept)	2.342	2.273	2.412	7.22e-101	0.046	NA	RI	Exclu
HPT 6-item (no ROA)	KSA-3 total (z)	KSA_total_z	0.093	0.017	0.168	1.77e-02	0.046	NA	RI	Exclu
HPT 6-item (no ROA)	NS (z)	(Intercept)	2.346	2.274	2.417	3.33e-13	0.017	0.020	RI	Exclu
HPT 6-item (no ROA)	NS (z)	NS_sum_z	0.051	-0.024	0.127	1.87e-01	0.017	0.020	RI	Exclu
HPT 6-item (no ROA)	NS (z)	(Intercept)	2.341	2.271	2.412	6.15e-65	0.016	NA	RS	Exclu
HPT 6-item (no ROA)	NS (z)	NS_sum_z	0.049	-0.043	0.140	3.21e-01	0.016	NA	RS	Exclu
HPT 8-item (drop ROA1)	FR-LF: RD+NS (z)	(Intercept)	2.463	2.395	2.532	1.42e-104	0.011	NA	RI	Exclu
HPT 8-item (drop ROA1)	FR-LF: RD+NS (z)	FRLF_mini_z	-0.003	-0.076	0.070	9.34e-01	0.011	NA	RI	Exclu
HPT 8-item (drop ROA1)	KSA-3 total (z)	(Intercept)	2.459	2.392	2.526	2.67e-105	0.041	NA	RI	Exclu
HPT 8-item (drop ROA1)	KSA-3 total (z)	KSA_total_z	0.075	0.002	0.148	4.54e-02	0.041	NA	RI	Exclu
HPT 8-item (drop ROA1)	NS (z)	(Intercept)	2.463	2.395	2.531	1.12e-104	0.013	NA	RI	Exclu
HPT 8-item (drop ROA1)	NS (z)	NS_sum_z	0.021	-0.052	0.094	5.67e-01	0.013	NA	RI	Exclu
HPT 9-item	FR-LF: RD+NS (z)	(Intercept)	2.499	2.429	2.569	8.93e-104	0.021	NA	RI	Exclu
HPT 9-item	FR-LF: RD+NS (z)	FRLF_mini_z	-0.009	-0.084	0.066	8.13e-01	0.021	NA	RI	Exclu
HPT 9-item	KSA-3 total (z)	(Intercept)	2.494	2.425	2.563	1.95e-104	0.049	NA	RI	Exclu
HPT 9-item	KSA-3 total (z)	KSA_total_z	0.075	0.000	0.151	5.18e-02	0.049	NA	RI	Exclu
HPT 9-item	NS (z)	(Intercept)	2.498	2.428	2.568	7.49e-104	0.023	NA	RI	Exclu
HPT 9-item	NS (z)	NS_sum_z	0.020	-0.055	0.095	6.00e-01	0.023	NA	RI	Exclu
HPT 6-item (no ROA)	FR-LF: RD+NS (z)	(Intercept)	2.349	2.266	2.432	1.55e-13	0.014	0.062	RI	Full
HPT 6-item (no ROA)	FR-LF: RD+NS (z)	FRLF_mini_z	-0.011	-0.081	0.059	7.52e-01	0.014	0.062	RI	Full
HPT 6-item (no ROA)	FR-LF: RD+NS (z)	(Intercept)	2.350	2.268	2.432	3.14e-13	0.013	0.079	RS	Full
HPT 6-item (no ROA)	FR-LF: RD+NS (z)	FRLF_mini_z	-0.006	-0.088	0.076	8.86e-01	0.013	0.079	RS	Full
HPT 6-item (no ROA)	KSA-3 total (z)	(Intercept)	2.346	2.271	2.421	1.72e-13	0.034	0.061	RI	Full
HPT 6-item (no ROA)	KSA-3 total (z)	KSA_total_z	0.061	-0.011	0.133	9.85e-02	0.034	0.061	RI	Full
HPT 6-item (no ROA)	KSA-3 total (z)	(Intercept)	2.347	2.277	2.418	8.38e-14	0.045	0.122	RS	Full
HPT 6-item (no ROA)	KSA-3 total (z)	KSA_total_z	0.076	-0.027	0.179	1.89e-01	0.045	0.122	RS	Full
HPT 6-item (no ROA)	NS (z)	(Intercept)	2.348	2.268	2.428	8.07e-14	0.016	0.055	RI	Full
HPT 6-item (no ROA)	NS (z)	NS_sum_z	0.018	-0.049	0.086	5.93e-01	0.016	0.055	RI	Full
HPT 6-item (no ROA)	NS (z)	(Intercept)	2.348	2.269	2.427	3.80e-13	0.017	0.060	RS	Full
HPT 6-item (no ROA)	NS (z)	NS_sum_z	13 0.019	-0.053	0.090	6.22e-01	0.017	0.060	RS	Full
HPT 8-item (drop ROA1)	FR-LF: RD+NS (z)	(Intercept)	2.466	2.395	2.537	1.34e-11	0.021	0.044	RI	Full