hsls_els_within

START

1 = strongly disagree 2 = disagree 3 = agree 4 = strongly agree

i1 = Teen (9th / 11th grader) confident can do excellent job on (fall 2009 / spring 2012) math tests

i2 = Teen (9th / 11th grader) certain can understand (fall 2009 / spring 2012) math textbook

i3 = Can understand difficult math class (ELS ONLY!)

i4 = Teen confident can do an excellent job on math assignments

i5 = Teen certain can master skills in math course

Can understand difficult math class

```
library(dplyr)
```

```
Attaching package: 'dplyr'

The following objects are masked from 'package:stats':

    filter, lag

The following objects are masked from 'package:base':

    intersect, setdiff, setequal, union
```

```
library(lavaan)
```

```
This is lavaan 0.6-19
lavaan is FREE software! Please report any bugs.
```

```
library(ltm)
```

```
Loading required package: MASS
```

```

Attaching package: 'MASS'
```

```
The following object is masked from 'package:dplyr':

    select
```

```
Loading required package: msm
```

```
Loading required package: polycor
```

```
library(sjlabelled)
```

```

Attaching package: 'sjlabelled'
```

```
The following object is masked from 'package:dplyr':

    as_label
```

```
library(kableExtra)
```

```

Attaching package: 'kableExtra'
```

```
The following object is masked from 'package:dplyr':

    group_rows
```

```
library(sirt)
```

```
- sirt 4.1-15 (2024-02-06 00:05:40)
```

```
library(mirt)
```

```
Loading required package: stats4
```

```
Loading required package: lattice
```

```

Attaching package: 'mirt'
```

```
The following object is masked from 'package:ltm':

    Science
```

```
library(parallel)
library(tidyr)
library(purrr)
library(semTools)
```

```


################################################################################
```

```
This is semTools 0.5-6
```

```
All users of R (or SEM) are invited to submit functions or ideas for functions.
```

```
################################################################################
```

```
#source("code/download_data.R")
source("F:/Users/alex/OneDrive/Documents/data/prepare_data.R")
```

```
here() starts at F:/Users/alex/OneDrive/Documents/data
```

```
Joining with `by = join_by(stu_id, sch_id, STRAT_ID, psu, sex, i1, i2, i4, i5,
i1_2, i2_2, i4_2, i5_2, sample)`
```

```
Warning in rm(dat_full, els, els_02_12_byf3pststu_v1_0, hsls,
hsls_17_student_pets_sr_v1_0, : object 'no_nas_hsls5' not found
```

```r
m_items <- paste0("i", 1:5)
m_items_2 <- paste0(m_items, "_2")
# get subset of relevant variables
dat <- dat[, c("stu_id", "sample", "sex", "dropout", m_items, m_items_2)]

dat$mean_score <- c(rowMeans(dat[dat$sample == "ELS", m_items], na.rm = TRUE),
                    rowMeans(dat[dat$sample == "HSLS", m_items[-3]], na.rm = TRUE))
dat$mean_score_2 <- c(rowMeans(dat[dat$sample == "ELS", m_items_2], na.rm = TRUE),
                    rowMeans(dat[dat$sample == "HSLS", m_items_2[-3]], na.rm = TRUE))
```

```r
# Creating only HSLS
hsls <- subset(dat, sample == "HSLS")

hsls_1 <- hsls[, c("i1", "i2", "i4", "i5")]
head(hsls_1)
```

```
      i1 i2 i4 i5
16198  4  3  4  3
16199  3  3  4  3
16200  4  2  4  3
16201  3  3  3  3
16202  3  3  3  3
16203  4  4  4  3
```

```r
hsls_2 <- hsls[, c("i1_2", "i2_2", "i4_2", "i5_2")]
head(hsls_2)
```

```
      i1_2 i2_2 i4_2 i5_2
16198    4    4    4    4
16199    2    2    3    2
16200    2    1    3    3
```

```
16201   NA   NA   NA   NA
16202   NA   NA   NA   NA
16203    3    3    3    3
```

```r
hsls_1_noNA <- na.omit(hsls_1)
hsls_2_noNA <- na.omit(hsls_2)


# Creating only ELS
els <- subset(dat, sample == "ELS")

els_1 <- els[, c("i1", "i2", "i3", "i4", "i5")]
head(els_1)
```

```
  i1 i2 i3 i4 i5
1  2  1  2  2  1
2  4  3  4  4  4
3  3  2  2  3  2
4  4  3  3  3  4
5  2  2  3  3  3
6  2  2  3  3 NA
```

```r
els_2 <- els[, c("i1_2", "i2_2", "i3_2", "i4_2", "i5_2")]
head(els_2)
```

```
  i1_2 i2_2 i3_2 i4_2 i5_2
1    3    2    2    2    3
2    3    3    3    3    3
3    2    3    3    2    2
4    3    2    2    3    4
5    3    3    3    4    4
6   NA   NA   NA   NA   NA
```

```r
els_1_noNA <- na.omit(els_1)
els_2_noNA <- na.omit(els_2)
```

```r
cfa_config <-  '
  group: ELS
  math =~ NA   * i1 +
```

```
        el2_1 * i2 +
        el3_1 * i3 +
        el4_1 * i4 +
        el5_1 * i5

# Naming the intercepts!
i1 ~ nu1_1 * 1
i2 ~ nu2_1 * 1
i3 ~ nu3_1 * 1
i4 ~ nu4_1 * 1
i5 ~ nu5_1 * 1

# Naming the residual variances!
i1 ~~ theta1_1 * i1
i2 ~~ theta2_1 * i2
i3 ~~ theta3_1 * i3
i4 ~~ theta4_1 * i4
i5 ~~ theta5_1 * i5

# Adding the covariances
i1 ~~ i2
i2 ~~ i3

# Fixing latent variance to 1, as we freed first factor loading
math ~~ 1 * math

# Fixing latent mean to 0 for identification?
math ~ 0 * 1


group: HSLS
math =~ NA   * i1 +
        hl2_2 * i2 +
        hl4_2 * i4 +
        hl5_2 * i5

# Naming the intercepts!
i1 ~ nu1_2 * 1
i2 ~ nu2_2 * 1
i4 ~ nu4_2 * 1
i5 ~ nu5_2 * 1
```

```
  # Naming the residual variances!
  i1 ~~ theta1_2 * i1
  i2 ~~ theta2_2 * i2
  i4 ~~ theta4_2 * i4
  i5 ~~ theta5_2 * i5

  # Adding the covariances
    #i1 ~~ i2
    i2 ~~ i4

  # Fixing latent variance to 1, as we freed first factor loading
  math ~~ 1 * math

  # Fixing latent mean to 0 for identification?
  math ~ 0 * 1
'

fit_config  <- cfa(cfa_config, data = dat, group = "sample",
                   estimator = "MLR", missing = "FIML", se = "robust.mlr")
```

```
Warning: lavaan->lav_data_full():
   some cases are empty and will be ignored: 24 32 33 34 35 36 37 38 39 40 44
   45 47 50 51 56 57 65 66 67 69 72 73 77 78 87 99 101 110 118 119 121 123
   124 125 130 132 139 140 149 152 164 166 173 175 176 177 185 191 201 208
   243 247 248 249 252 253 255 256 258 260 269 272 273 276 277 281 293 295
   297 298 300 311 312 313 315 316 318 321 331 339 358 378 379 380 385 389
   409 414 422 427 435 439 447 480 492 498 500 505 519 521 524 525 526 544
   550 558 561 563 570 572 573 580 582 584 587 602 607 610 616 617 622 624
   632 637 639 642 643 644 646 648 649 659 673 681 685 688 690 708 715 718
   723 730 732 733 740 741 742 744 767 785 790 791 792 793 794 795 808 810
   811 814 818 822 824 826 827 828 829 830 835 849 850 856 860 866 872 884
   888 897 898 899 900 901 917 918 931 935 942 946 949 952 955 956 963 966
   969 970 971 972 976 977 978 980 983 990 993 994 996 997 1001 1002 1006
   1007 1008 1022 1025 1027 1032 1034 1035 1036 1039 1041 1043 1045 1046 1050
   1051 1052 1053 1054 1055 1060 1065 1077 1078 1079 1084 1089 1091 1099 1106
   1127 1134 1136 1148 1153 1155 1156 1157 1159 1160 1165 1167 1173 1175 1176
   1185 1189 1190 1193 1200 1201 1204 1208 1217 1220 1237 1239 1244 1247 1254
   1261 1262 1263 1269 1270 1276 1279 1280 1285 1287 1291 1294 1297 1300 1301
   1305 1322 1328 1343 1348 1350 1388 1400 1409 1433 1434 1436 1437 1438 1439
   1442 1444 1452 1453 1454 1458 1463 1465 1469 1472 1473 1474 1476 1478 1479
   1480 1481 1483 1484 1485 1486 1488 1490 1493 1494 1495 1499 1501 1502 1504
   1507 1510 1511 1513 1522 1523 1529 1534 1537 1541 1543 1552 1553 1558 1561
```

1562 1566 1569 1571 1574 1576 1577 1581 1583 1588 1591 1598 1600 1601 1602
1603 1604 1605 1607 1610 1620 1624 1627 1631 1632 1637 1638 1655 1662 1666
1667 1673 1678 1679 1682 1683 1684 1686 1689 1690 1692 1693 1694 1698 1701
1704 1705 1707 1708 1711 1712 1719 1721 1722 1735 1736 1737 1744 1754 1758
1759 1764 1769 1770 1773 1774 1775 1777 1778 1779 1780 1783 1789 1790 1793
1795 1799 1801 1803 1804 1809 1813 1814 1815 1817 1819 1827 1830 1833 1835
1838 1840 1845 1853 1865 1879 1884 1887 1888 1906 1918 1933 1940 1941 1942
1944 1946 1948 1951 1953 1956 1962 1963 1964 1986 1992 1993 1998 1999 2005
2010 2011 2017 2019 2022 2026 2028 2058 2064 2068 2076 2077 2078 2083 2084
2086 2087 2101 2111 2114 2115 2128 2139 2140 2144 2146 2150 2154 2156 2186
2194 2219 2221 2223 2243 2248 2249 2250 2252 2253 2254 2255 2257 2261 2262
2268 2280 2290 2294 2295 2301 2303 2308 2309 2310 2313 2316 2317 2318 2320
2322 2328 2332 2339 2351 2358 2360 2361 2364 2365 2367 2368 2369 2371 2374
2376 2377 2380 2387 2389 2392 2394 2395 2400 2403 2405 2407 2410 2411 2412
2413 2414 2415 2416 2417 2418 2449 2458 2459 2460 2466 2472 2476 2477 2480
2489 2501 2520 2527 2557 2572 2574 2575 2582 2584 2589 2602 2607 2612 2625
2626 2630 2634 2643 2645 2648 2649 2651 2652 2659 2664 2667 2669 2678 2683
2688 2695 2707 2709 2712 2713 2723 2726 2727 2729 2732 2739 2742 2743 2750
2752 2753 2754 2755 2756 2757 2758 2759 2760 2761 2762 2763 2764 2765 2767
2769 2770 2776 2777 2783 2785 2787 2790 2800 2820 2834 2835 2841 2865 2874
2877 2885 2887 2888 2889 2890 2895 2896 2898 2901 2903 2904 2906 2907 2911
2915 2916 2917 2918 2920 2922 2923 2924 2926 2927 2928 2930 2932 2933 2934
2935 2939 2940 2941 2944 2948 2950 2952 2959 2963 2967 2968 2969 2973 2976
2978 2979 2980 2981 2982 2983 2984 2985 2987 2989 2996 3010 3012 3023 3024
3029 3038 3045 3056 3067 3068 3071 3076 3078 3079 3081 3082 3083 3089 3092
3094 3097 3103 3106 3112 3114 3119 3126 3127 3129 3132 3135 3136 3137 3139
3142 3144 3151 3164 3170 3173 3181 3182 3199 3203 3206 3209 3211 3212 3214
3217 3220 3221 3224 3227 3230 3231 3240 3246 3251 3261 3264 3265 3266 3282
3288 3289 3290 3293 3299 3305 3309 3315 3316 3317 3319 3320 3325 3329 3331
3332 3336 3339 3347 3348 3367 3368 3372 3379 3384 3393 3407 3428 3433 3435
3436 3442 3443 3444 3451 3456 3460 3462 3464 3469 3470 3471 3477 3485 3488
3491 3492 3518 3519 3520 3528 3529 3531 3532 3536 3553 3554 3555 3558 3559
3561 3566 3567 3572 3573 3577 3579 3580 3581 3583 3584 3585 3586 3588 3589
3591 3593 3594 3596 3600 3601 3610 3625 3627 3636 3637 3641 3645 3647 3649
3650 3653 3654 3655 3656 3657 3659 3661 3662 3668 3669 3672 3674 3676 3677
3678 3682 3683 3685 3686 3687 3688 3689 3690 3694 3698 3699 3700 3713 3717
3726 3730 3731 3732 3733 3741 3742 3744 3745 3755 3756 3760 3761 3763 3780
3781 3788 3789 3793 3794 3806 3810 3815 3818 3820 3824 3825 3832 3842 3846
3852 3871 3878 3880 3882 3901 3905 3906 3907 3908 3909 3913 3921 3933 3937
3940 3944 3945 3953 3954 3955 3956 3958 3963 3964 3965 3974 3983 3984 3989
3990 3992 3997 4006 4012 4025 4029 4035 4036 4043 4048 4058 4059 4061 4062
4063 4066 4067 4068 4071 4074 4075 4076 4077 4079 4080 4083 4086 4089 4090
4092 4093 4094 4096 4097 4099 4102 4104 4105 4107 4108 4110 4111 4112 4114

```
   4115 4118 4120 4123 4136 4137 4138 4142 4145 4154 4156 4158 4160 4163 4164
   4170 4178 4179 4180 4183 4185 4186 4189 4190 4192 4193 4196 4197 4202 4203
   4205 4206 4208 4209 4210 4211 4212 4213 4214 4215 4217 4218 4219 4224 4225
   4226 4227 4229 4230 4232 4235 4236 4239 4240 4243 4249 4254 4257 4263 4264
   4265 4268 4274 4276 4279 4280 4283 4284 4286 4290 4291 4292 4297 4298 4301
   4303 4307 4308 4309 4312 4314 4315 4317 4318 4319 4322 4323 4325 4337 4339
   4340 4347 4348 4354 4359 4362 4369 4374 4380 4387 4390 4393 4395 4399 4400
   4402 4404 4405 4413 4423 4440 4448 4449 4450 4456 4458 4463 4465 4467 4469
   4470 4471 4472 4474 4481 4487 4489 4491 4497 4500 4505 4510 4518 4521 4522
   4523 4526 4535 4546 4547 4554 4560 4573 4581 4582 4583 4584 4586 4589 4590
   4593 4594 4595 4597 4599 4601 4602 4603 4606 4612 4619 4621 4622 4623 4624
   4626 4627 4628 4629 4630 4631 4632 4633 4634 4635 4637 4638 4639 4640 4641
   4642 4643 4644 4645 4646 4647 4648 4649 4651 4657 4661 4662 4665 4666 4672
   4673 4675 4677 4678 4679 4681 4682 4683 4686 4687 4688 4690 4691 4692 4694
   4696 4698 4699 4700 4701 4702 4703 4704 4705 4706 4713 4714 4715 4718 4724
   4725 4726 4727 4732 4733 4734 4737 4738 4739 4742 4746 4748 4749 4751 4752
   4757 4758 4759 4761 4764 4765 4768 4769 4774 4787 4790 4796 4797 4798 4799
   4802 4803 4805 4806 4809 4810 4813 4814 4816 4817 4818 4820 4825 4826 4833
   4838 4840 4842 4843 4847 4849 4850 4856 4857 4858 4859 4863 4869 4873 4883
   4891 4897 4904 4910 4915 4916 4917 4920 4921 4922 4927 4928 4929 4930 4932
   4933 4935 4936 4939 4943 4944 4945 4946 4947 4950 4951 4952 4953 4956 4957
   4959 4961 4964 4967 4968 4969 4971 4974 4977 4978 4985 4986 4992 4996 5017
   5019 5020 5021 5024 5025 5027 5030 5033 5036 5040 5048 5074 5076 5077 5083
   5090 5097 5100 5105 5110 5112 5113 5140 5141 5142 5144 5145 5146 5147 5148
   5150 5151 5152 5153 5155 5156 5157 5158 5159 5160 5164 5165 5169 5176 5179
   5185 5186 5188 5191 5192 5193 5199 5201 5207 5210 5215 5216 5220 5221 5226
   5227 5228 5229 5231 5232 5236 5237 5244 5247 5250 5251 5254 5262 5263 5264
   5265 5273 5278 5281 5283 5284 5286 5300 5301 5302 5303 5304 5308 5310 5311
   5329 5343 5346 5351 5357 5363 5367 5391 5393 5399 5410 5414 5415 5426 5427
   5428 5429 5430 5431 5433 5435 5437 5439 5441 5443 5444 5445 5457 5466 5474
   5483 5487 5489 5490 5491 5493 5495 5496 5497 5498 5499 5500 5501 5502 5505
   5508 5510 5512 5514 5517 5520 5525 5528 5530 5533 5534 5541 5542 5545 5546
   5550 5558 5561 5565 5567 5568 5569 5577 5579 5581 5583 5593 5597 5598 5603
   5607 5610 5611 5616 5617 5618 5621 5625 5626 5628 5630 5637 5639 5640 5670
   5677 5694 5701 5707 5715 5718 5723 5724 5726 5733 5736 5738 5741 5746 5747
   5748 5750 5753 5754 5755 5756 5764 5765 5766 5768 5769 5770 5772 5776 5777
   5779 5781 5782 5783 5788 5790 5797 5798 5804 5809 5811 5813 5818 5824 5830
   5833 5834 5836 5843 5844 5847 5864 5867 5871 5875 5882 5883 5884 5885 5886
   5888 5922 5926 5928 5936 5937 5939 5940 5943 5944 5949 5950 5952 5953 5954
   5956 5960 5962 5963 5967 5969 5970 5972 5973 5974 5977 59

Warning: lavaan->lav_data_full():
```

some cases are empty and will be ignored: 16206 16211 16212 16222 16223
16226 16227 16229 16235 16241 16250 16252 16268 16273 16274 16280 16283
16293 16307 16313 16317 16331 16332 16338 16344 16345 16350 16355 16363
16365 16369 16370 16372 16379 16380 16384 16386 16393 16399 16401 16402
16406 16412 16418 16424 16438 16440 16444 16445 16448 16449 16451 16453
16461 16467 16472 16479 16481 16487 16488 16500 16508 16511 16521 16525
16533 16543 16549 16560 16563 16574 16577 16581 16583 16587 16588 16592
16598 16613 16614 16621 16626 16630 16643 16645 16647 16649 16650 16654
16662 16665 16673 16676 16678 16683 16686 16687 16692 16694 16697 16702
16703 16708 16710 16721 16730 16731 16737 16752 16753 16762 16773 16774
16775 16779 16782 16787 16791 16800 16807 16819 16827 16829 16832 16833
16836 16841 16844 16848 16849 16862 16866 16878 16884 16886 16904 16906
16907 16912 16916 16918 16921 16931 16933 16934 16938 16951 16952 16954
16968 16971 16973 16984 16987 16991 17003 17007 17027 17035 17039 17045
17048 17050 17052 17059 17070 17073 17076 17077 17078 17082 17086 17090
17109 17118 17134 17143 17145 17147 17155 17159 17160 17161 17170 17172
17176 17177 17180 17182 17183 17186 17193 17224 17225 17238 17247 17248
17249 17250 17264 17275 17283 17290 17297 17301 17303 17309 17312 17318
17320 17324 17334 17338 17345 17346 17351 17353 17357 17361 17365 17367
17373 17375 17379 17383 17388 17396 17397 17406 17409 17412 17419 17420
17422 17426 17432 17434 17438 17447 17450 17453 17457 17461 17477 17481
17485 17489 17494 17509 17511 17515 17537 17538 17543 17547 17551 17554
17572 17586 17589 17594 17600 17601 17603 17605 17608 17615 17616 17618
17619 17622 17627 17628 17630 17640 17641 17662 17672 17693 17694 17695
17696 17697 17702 17704 17705 17709 17710 17721 17727 17731 17732 17738
17739 17748 17750 17759 17761 17762 17763 17764 17774 17775 17776 17777
17786 17789 17792 17795 17802 17807 17811 17829 17832 17846 17850 17857
17858 17864 17865 17872 17893 17904 17905 17916 17917 17918 17919 17937
17944 17953 17958 17962 17965 17976 17979 17982 17988 17990 18002 18013
18023 18029 18031 18037 18039 18041 18043 18045 18049 18051 18053 18056
18065 18076 18079 18083 18084 18107 18114 18117 18122 18130 18134 18139
18143 18146 18152 18153 18162 18183 18201 18202 18203 18208 18209 18218
18221 18228 18232 18242 18245 18247 18251 18263 18265 18266 18273 18277
18280 18285 18291 18293 18298 18303 18304 18308 18321 18324 18325 18333
18340 18342 18343 18348 18357 18358 18370 18374 18379 18382 18386 18387
18396 18397 18401 18406 18408 18422 18426 18431 18451 18456 18462 18472
18476 18481 18482 18483 18484 18487 18491 18497 18499 18507 18517 18521
18526 18527 18533 18535 18536 18538 18541 18549 18555 18567 18573 18579
18580 18582 18585 18588 18592 18594 18597 18598 18601 18606 18607 18608
18609 18625 18638 18640 18641 18648 18663 18669 18671 18683 18688 18694
18698 18699 18700 18701 18703 18714 18715 18723 18726 18740 18749 18751
18765 18774 18780 18783 18790 18792 18793 18795 18801 18802 18825 18828
18831 18836 18854 18855 18867 18869 18874 18876 18883 18885 18890 18898

18903 18905 18911 18914 18915 18922 18928 18929 18932 18933 18935 18961
18967 18968 18977 18978 18985 18987 18995 18999 19002 19009 19015 19043
19044 19048 19049 19061 19063 19071 19075 19076 19077 19089 19097 19103
19110 19114 19115 19127 19131 19150 19155 19161 19165 19167 19168 19173
19177 19179 19193 19196 19200 19202 19209 19215 19216 19217 19218 19222
19223 19225 19231 19241 19243 19250 19251 19268 19269 19271 19272 19277
19278 19280 19286 19291 19292 19297 19299 19300 19302 19319 19323 19341
19346 19348 19353 19354 19355 19357 19359 19363 19368 19372 19374 19394
19402 19404 19406 19407 19409 19410 19411 19412 19416 19428 19429 19430
19431 19440 19444 19445 19448 19455 19461 19469 19471 19478 19482 19483
19487 19497 19498 19510 19514 19516 19520 19527 19539 19543 19549 19559
19560 19566 19583 19592 19593 19595 19597 19600 19602 19608 19609 19615
19616 19623 19624 19625 19631 19638 19646 19649 19661 19672 19682 19688
19694 19700 19701 19705 19707 19713 19725 19738 19741 19745 19746 19756
19757 19761 19764 19774 19779 19780 19783 19785 19797 19801 19807 19813
19816 19820 19823 19828 19837 19838 19844 19858 19870 19871 19874 19882
19922 19933 19935 19936 19940 19943 19951 19956 19957 19964 19971 19973
19979 19980 19986 19997 20012 20015 20017 20025 20031 20034 20046 20048
20050 20052 20058 20064 20069 20076 20078 20091 20098 20103 20104 20108
20110 20113 20116 20127 20129 20140 20144 20162 20164 20165 20168 20170
20179 20192 20196 20197 20207 20210 20218 20219 20222 20226 20227 20228
20234 20246 20258 20272 20275 20282 20283 20288 20292 20294 20296 20298
20300 20302 20306 20309 20314 20315 20320 20321 20322 20323 20324 20332
20340 20347 20348 20358 20362 20367 20378 20382 20385 20388 20390 20397
20398 20401 20402 20406 20410 20418 20420 20424 20429 20433 20436 20437
20440 20441 20449 20450 20454 20458 20459 20460 20463 20464 20468 20469
20472 20473 20476 20485 20492 20493 20495 20502 20507 20509 20514 20516
20521 20523 20532 20535 20537 20540 20542 20550 20556 20559 20560 20565
20571 20572 20576 20584 20587 20589 20591 20592 20604 20606 20607 20611
20612 20620 20621 20628 20631 20633 20638 20646 20660 20671 20685 20687
20688 20692 20693 20696 20699 20704 20706 20707 20713 20715 20720 20721
20737 20738 20741 20765 20767 20772 20775 20778 20779 20780 20782 20784
20789 20791 20794 20795 20798 20802 20805 20810 20813 20819 20827 20830
20832 20833 20838 20839 20841 20853 20860 20863 20865 20866 20870 20872
20881 20894 20895 20897 20904 20920 20923 20928 20932 20935 20936 20943
20963 20967 20973 20983 20986 20988 20991 20997 20999 21000 21001 21009
21017 21021 21022 21025 21033 21036 21037 21038 21043 21045 21055 21061
21077 21080 21082 21083 21084 21088 21106 21108 21116 21118 21124 21141
21148 21149 21150 21156 21168 21169 21179 21189 21190 21195 21200 21201
21205 21206 21208 21209 21212 21219 21223 21229 21237 21239 21247 21248
21258 21259 21274 21280 21296 21298 21301 21305 21312 21313 21314 21316
21322 21323 21324 21332 21348 21349 21350 21355 21360 21362 21371 21372
21374 21379 21382 21396 21398 21406 21411 21414 21419 21423 21429 21436

```
 21439 21443 21444 21447 21449 21451 21456 21459 21466 21473 21492 21501
 21515 21528 21540 21552 21556 21563 21566 21570 21571 21573 21575 21593
 21599 21602 21605 21619 21631 21635 21636 21638 21639 21654 21655 21657
 21663 21668 21673 21675 21686 21689 21692 21696 21699 21700 21702 21703
 21716 21718 21722 21725 21728 21731 21740 21743 21750 21752 21765 21767
 21769 21773 21774 21776 21791 21797 21798 21800 21813 21815 21817 21821
 21822 21823 21829 21831 21833 21839 21846 21851 21861 21865 21871 21878
 21880 21882 21884 21893 21894 21909 21910 21913 21915 21918 21921 21934
 21942 21946 21948 21954 21970 21981 21996 22004 22018 22026 22040 22041
 22043 22045 22047 22049 22055 22061 22063 22065 22073 22076 22078 22079
 22084 22100 22101 22110 22119 22126 22127 22128 22140 22142 22145 22146
 22154 22155 22170 22184 22200 22209 22210 22212 22213 22218 22221 22223
 22225 22232 22233 22237 22243 22246 22255 22274 22277 22283 22286 22289
 22295 22300 22302 22309 22319 22321 22329 22330 22341 22345 22358 22359
 22361 22365 22374 22380 22381 22400 22420 22431 22432 22436 22440 22447
 22448 22452 22453 22461 22462 22466 22477 22478 22484 22488 22489 22490
 22491 22499 22504 22508 22520 22523 22524 22527 22534 22557 22558 22587
 22599 22604 22606 22608 22613 22618 22621 22630 22634 22637 22639 22640
 22641 22643 22647 22656 22659 22671 22677 22691 22694 22707 22727 22729
 22730 22733 22739 22750 22755 22756 22760 22765 22769 22778 22779 22783
 22787 22821 22828 22830 22831 22832 22833 22840 22847 22849 22854 22856
 22873 22874 22880 22881 2288
```

```
s_config <- summary(fit_config, fit.measures = TRUE, standardized = TRUE)
s_config
```

```
lavaan 0.6-19 ended normally after 42 iterations

  Estimator                                         ML
  Optimization method                           NLMINB
  Number of model parameters                        30

  Number of observations per group:               Used       Total
    ELS                                          11663       16197
    HSLS                                         19086       23503
  Number of missing patterns per group:
    ELS                                             26
    HSLS                                            13

Model Test User Model:
                                                Standard      Scaled
```

```
  Test Statistic                                113.295      69.163
  Degrees of freedom                                  4           4
  P-value (Chi-square)                            0.000       0.000
  Scaling correction factor                                   1.638
    Yuan-Bentler correction (Mplus variant)
  Test statistic for each group:
    ELS                                          69.137      69.137
    HSLS                                          0.027       0.027

Model Test Baseline Model:

  Test statistic                             90186.603   48434.822
  Degrees of freedom                                 16          16
  P-value                                         0.000       0.000
  Scaling correction factor                                   1.862

User Model versus Baseline Model:

  Comparative Fit Index (CFI)                     0.999       0.999
  Tucker-Lewis Index (TLI)                        0.995       0.995

  Robust Comparative Fit Index (CFI)                          0.999
  Robust Tucker-Lewis Index (TLI)                             0.995

Loglikelihood and Information Criteria:

  Loglikelihood user model (H0)            -116489.266 -116489.266
  Scaling correction factor                                   1.301
      for the MLR correction
  Loglikelihood unrestricted model (H1)    -116432.619 -116432.619
  Scaling correction factor                                   1.340
      for the MLR correction

  Akaike (AIC)                              233038.533  233038.533
  Bayesian (BIC)                            233288.541  233288.541
  Sample-size adjusted Bayesian (SABIC)     233193.202  233193.202

Root Mean Square Error of Approximation:

  RMSEA                                           0.042       0.033
  90 Percent confidence interval - lower          0.036       0.027
  90 Percent confidence interval - upper          0.049       0.038
  P-value H_0: RMSEA <= 0.050                     0.970       1.000
```

```
  P-value H_0: RMSEA >= 0.080                    0.000       0.000

  Robust RMSEA                                               0.044
  90 Percent confidence interval - lower                     0.035
  90 Percent confidence interval - upper                     0.053
  P-value H_0: Robust RMSEA <= 0.050                         0.859
  P-value H_0: Robust RMSEA >= 0.080                         0.000

Standardized Root Mean Square Residual:

  SRMR                                           0.003       0.003

Parameter Estimates:

  Standard errors                             Sandwich
  Information bread                           Observed
  Observed information based on                Hessian


Group 1 [ELS]:

Latent Variables:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  math =~
    i1                0.739    0.007  111.616    0.000    0.739    0.796
    i2      (e2_1)    0.724    0.007  101.196    0.000    0.724    0.775
    i3      (e3_1)    0.830    0.006  131.882    0.000    0.830    0.860
    i4      (e4_1)    0.848    0.006  149.052    0.000    0.848    0.898
    i5      (e5_1)    0.840    0.006  144.001    0.000    0.840    0.892

Covariances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
 .i1 ~~
   .i2                0.128    0.005   25.380    0.000    0.128    0.387
 .i2 ~~
   .i3                0.074    0.004   17.800    0.000    0.074    0.253

Intercepts:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
   .i1      (n1_1)    2.541    0.009  294.240    0.000    2.541    2.735
   .i2      (n2_1)    2.359    0.009  271.389    0.000    2.359    2.527
   .i3      (n3_1)    2.462    0.009  272.528    0.000    2.462    2.550
   .i4      (n4_1)    2.623    0.009  295.510    0.000    2.623    2.780
```

```
   .i5      (n5_1)    2.651    0.009  298.195    0.000    2.651    2.815
    math              0.000                              0.000    0.000

Variances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
   .i1      (t1_1)    0.317    0.006   49.236    0.000    0.317    0.367
   .i2      (t2_1)    0.348    0.007   52.289    0.000    0.348    0.399
   .i3      (t3_1)    0.243    0.006   38.779    0.000    0.243    0.261
   .i4      (t4_1)    0.172    0.005   32.092    0.000    0.172    0.193
   .i5      (t5_1)    0.181    0.006   31.638    0.000    0.181    0.204
    math              1.000                              1.000    1.000


Group 2 [HSLS]:

Latent Variables:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  math =~
    i1                0.627    0.005  129.662    0.000    0.627    0.828
    i2      (h2_2)    0.666    0.005  130.363    0.000    0.666    0.814
    i4      (h4_2)    0.631    0.005  126.711    0.000    0.631    0.879
    i5      (h5_2)    0.600    0.005  121.580    0.000    0.600    0.823

Covariances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
 .i2 ~~
   .i4              -0.042    0.003  -15.086    0.000   -0.042   -0.261

Intercepts:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
   .i1      (n1_2)    2.977    0.005  542.813    0.000    2.977    3.931
   .i2      (n2_2)    2.723    0.006  459.954    0.000    2.723    3.332
   .i4      (n4_2)    3.069    0.005  589.042    0.000    3.069    4.270
   .i5      (n5_2)    2.983    0.005  564.394    0.000    2.983    4.090
    math              0.000                              0.000    0.000

Variances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
   .i1      (t1_2)    0.180    0.003   52.239    0.000    0.180    0.314
   .i2      (t2_2)    0.225    0.004   53.539    0.000    0.225    0.337
   .i4      (t4_2)    0.118    0.004   33.557    0.000    0.118    0.228
   .i5      (t5_2)    0.171    0.003   54.932    0.000    0.171    0.322
    math              1.000                              1.000    1.000
```

```r
mod_indices <- modindices(fit_config, sort. = TRUE, free.remove = FALSE)
head(mod_indices)
```

```
   lhs op rhs block group level     mi    epc sepc.lv sepc.all sepc.nox
35  i1 ~~  i3     1   ELS     1 81.621  0.033   0.033    0.119    0.119
42  i4 ~~  i5     1   ELS     1 81.621  0.038   0.038    0.218    0.218
37  i1 ~~  i5     1   ELS     1 76.182 -0.027  -0.027   -0.113   -0.113
40  i3 ~~  i4     1   ELS     1 27.064 -0.018  -0.018   -0.090   -0.090
39  i2 ~~  i5     1   ELS     1 12.584  0.011   0.011    0.043    0.043
38  i2 ~~  i4     1   ELS     1 12.584 -0.011  -0.011   -0.045   -0.045
```

```r
# Just for ELS
mod_indices_els <- mod_indices[mod_indices$group == "ELS", ]
head(mod_indices_els)
```

```
   lhs op rhs block group level     mi    epc sepc.lv sepc.all sepc.nox
35  i1 ~~  i3     1   ELS     1 81.621  0.033   0.033    0.119    0.119
42  i4 ~~  i5     1   ELS     1 81.621  0.038   0.038    0.218    0.218
37  i1 ~~  i5     1   ELS     1 76.182 -0.027  -0.027   -0.113   -0.113
40  i3 ~~  i4     1   ELS     1 27.064 -0.018  -0.018   -0.090   -0.090
39  i2 ~~  i5     1   ELS     1 12.584  0.011   0.011    0.043    0.043
38  i2 ~~  i4     1   ELS     1 12.584 -0.011  -0.011   -0.045   -0.045
```

```r
# Just for HSLS
mod_indices_hsls <- mod_indices[mod_indices$group == "HSLS", ]
head(mod_indices_hsls)
```

```
    lhs op rhs block group level    mi    epc sepc.lv sepc.all sepc.nox
47   i4 ~~  i5     2  HSLS     1 0.044 -0.001  -0.001   -0.004   -0.004
43   i1 ~~  i2     2  HSLS     1 0.044 -0.001  -0.001   -0.003   -0.003
46   i2 ~~  i5     2  HSLS     1 0.044  0.001   0.001    0.003    0.003
44   i1 ~~  i4     2  HSLS     1 0.044  0.001   0.001    0.004    0.004
25   i2 ~1         2  HSLS     1 0.000  0.000   0.000    0.000    0.000
23 math =~  i5     2  HSLS     1 0.000  0.000   0.000    0.000    0.000
```

HSLS Time Config

Make sure this matches hsls_els.qmd file for fit_config_comb. DOES

```
hsls_config <-  '
  math_T1 =~ NA  * i1 +
            l2_1 * i2 +
           #l3_1 * i3   i3 missing from HSLS
            l4_1 * i4 +
            l5_1 * i5


  # Fixing latent variance to 1, as we freed first factor loading
  math_T1 ~~ 1 * math_T1

  # Fixing latent mean to 0 for identification
  math_T1 ~ 0 * 1

  # Time Point 2
  math_T2 =~ NA  * i1_2 +
            l2_2 * i2_2 +
           #l3_2 * i3_2   i3 missing from HSLS
            l4_2 * i4_2 +
            l5_2 * i5_2



  ## Adding the covariances ##
  i1 ~~ i2
  i1_2 ~~ i2_2

  i1 ~~ i4
  i1_2 ~~ i4_2

  i2 ~~ i4
  i2_2 ~~ i4_2

  i1 ~~ i5
  i1_2 ~~ i5_2

  # Fixing latent variance to 1, as we freed first factor loading
  math_T2 ~~ 1 * math_T2

  # Fixing latent mean to 0
  math_T2 ~ 0 * 1
```

```
  # Correlations across time
  math_T1 ~~ math_T2
  i1 ~~ i1_2
  i2 ~~ i2_2
  i4 ~~ i4_2
  i5 ~~ i5_2
'

fit_hsls_config  <- cfa(hsls_config, data = hsls,
                        estimator = "MLR", missing = "FIML", se = "robust.mlr")
```

```
Warning: lavaan->lav_data_full():
   some cases are empty and will be ignored: 14 30 172 227 282 303 314 384
   391 416 450 452 465 489 500 513 540 555 556 582 630 652 707 810 848 873
   921 937 950 962 980 1041 1078 1115 1121 1160 1164 1229 1260 1389 1397 1406
   1418 1421 1422 1443 1498 1589 1610 1632 1696 1708 1761 1779 1785 1805 1882
   2006 2054 2128 2151 2177 2182 2189 2341 2344 2388 2391 2410 2412 2451 2472
   2491 2502 2503 2526 2586 2593 2605 2657 2717 2738 2770 2812 2874 2953 2958
   3126 3158 3160 3166 3234 3247 3248 3281 3319 3400 3403 3418 3434 3475 3516
   3544 3548 3604 3616 3677 3736 3738 3746 3782 3851 3853 3879 3930 3968 3971
   3973 4000 4030 4049 4097 4109 4181 4188 4193 4204 4240 4252 4253 4262 4312
   4324 4379 4395 4407 4415 4449 4496 4510 4541 4570 4578 4583 4668 4738 4739
   4766 4791 4836 4841 4864 4886 4909 4959 4971 5004 5022 5062 5077 5116 5119
   5126 5152 5182 5217 5254 5369 5373 5374 5402 5441 5442 5478 5506 5521 5577
   5618 5664 5687 5718 5745 5829 5852 5879 5943 6040 6080 6161 6164 6280 6307
   6311 6327 6433 6497 6558 6563 6582 6659 6698 6753 6770 6815 6852 6859 6879
   6911 7092 7114 7175 7184 7186 7195 7337 7349 7366 7369 7372 7400 7434 7471
   7487 7520 7523 7586 7629 7635 7637 7713 7754 7759 7776 7777 7812 7962 8021
   8028 8050 8077 8244 8329 8384 8385 8386 8455 8660 8703 8705 8790 8828 8868
   8891 8947 8948 8949 8956 9002 9042 9043 9049 9050 9067 9087 9112 9133 9184
   9193 9295 9312 9392 9428 9435 9447 9521 9537 9562 9624 9691 9713 9766 9869
   9879 9922 9932 9960 9981 9986 10016 10024 10074 10102 10130 10141 10147
   10188 10201 10207 10259 10320 10371 10378 10390 10437 10473 10513 10522
   10539 10667 10671 10714 10721 10724 10759 10820 10840 10913 10920 10957
   10983 11009 11034 11154 11211 11315 11375 11377 11381 11395 11402 11405
   11414 11456 11549 11554 11580 11624 11631 11668 11777 11818 11825 11854
   11884 11918 11922 11945 11960 11974 12028 12034 12067 12101 12181 12200
   12217 12302 12306 12317 12328 12418 12431 12453 12478 12482 12524 12563
   12585 12597 12698 12710 12743 12748 12824 12839 12912 12923 12925 13013
   13120 13142 13233 13268 13301 13306 13328 13337 13362 13408 13493 13521
   13550 13594 13595 13714 13760 13765 13773 13811 13848 13914 13970 14070
   14151 14178 14272 14282 14326 14399 14505 14528 14534 14578 14605 14657
```

```
  14733 14763 14779 14832 14838 14842 14847 14942 14992 15064 15209 15239
  15253 15281 15284 15332 15345 15347 15371 15398 15416 15420 15492 15508
  15541 15617 15633 15683 15702 15717 15735 15770 15776 15807 15843 15862
  15881 15947 15969 15988 16000 16045 16070 16076 16119 16132 16187 16250
  16275 16312 16353 16511 16515 16552 16638 16657 16684 16693 16702 16712
  16720 16765 16903 16918 16944 16953 16987 16992 17079 17133 17176 17191
  17359 17363 17364 17382 17396 17405 17466 17570 17589 17633 17772 17783
  17809 17825 17846 17861 17939 17963 18048 18072 18076 18114 18147 18182
  18190 18224 18247 18268 18287 18322 18397 18408 18454 18457 18570 18614
  18647 18704 18791 18799 18833 18856 18904 18925 18927 19031 19105 19124
  19131 19181 19185 19186 19293 19300 19307 19395 19404 19484 19485 19558
  19606 19652 19672 19693 19706 19719 19724 19773 19834 19835 19899 19911
  19963 19986 20034 20075 20086 20120 20133 20305 20310 20375 20389 20394
  20404 20419 20432 20435 20474 20604 20633 20637 20639 20693 20814 20869
  20880 20898 20901 20954 20960 20970 20975 20995 21005 21051 21056 21064
  21093 21111 21153 21268 21325 21328 21348 21383 21563 21574 21661 21683
  21771 21796 21822 21831 21846 21867 21877 21892 21895 21896 21917 21921
  21972 22000 22022 22041 22081 22201 22230 22282 22312 22322 22364 22368
  22383 22390 22393 22504 22586 22618 22621 22623 22624 22626 22671 22675
  22767 22821 22842 22881 22978 22985 23000 23002 23054 23112 23121 23123
  23173 23194 23333 23336 23370 23407 23420 23467 23485.
```

```
fit_hsls_config
```

```
lavaan 0.6-19 ended normally after 76 iterations

  Estimator                                         ML
  Optimization method                           NLMINB
  Number of model parameters                        37

                                                  Used       Total
  Number of observations                         22839       23503
  Number of missing patterns                        50

Model Test User Model:
                                              Standard      Scaled
  Test Statistic                                56.158      49.626
  Degrees of freedom                                 7           7
  P-value (Chi-square)                           0.000       0.000
  Scaling correction factor                                  1.132
    Yuan-Bentler correction (Mplus variant)
```

```r
head(modindices(fit_hsls_config, sort. = TRUE, free.remove = FALSE))
```

```
      lhs op  rhs     mi    epc sepc.lv sepc.all sepc.nox
55     i2 ~~ i4_2 14.891 -0.009  -0.009   -0.044   -0.044
53     i2 ~~   i5 14.583 -0.032  -0.032   -0.168   -0.168
57     i4 ~~   i5 14.583  0.030   0.030    0.209    0.209
47 math_T2 =~   i2 14.583  0.025   0.025    0.030    0.030
48 math_T2 =~   i4 14.583 -0.024  -0.024   -0.033   -0.033
54     i2 ~~ i1_2 14.196  0.009   0.009    0.036    0.036
```

```r
s_hsls_config <- summary(fit_hsls_config, fit.measures = TRUE)
```

HSLS Time Metric

```r
# Latent variance and mean set to 1 and 0 in ELS time 1,
# free variance, mean set to 0 everywhere else

hsls_time_metric <- '

  ######################
  # Time Point 1
  ######################
  math_t1 =~ l1 * i1 +
             l2 * i2 +   # Same label as ELS
             # no i3 in HSLS
             l4 * i4 +   # Same label as ELS
             l5 * i5     # Same label as ELS

  # Intercepts
  i1 ~ 0 * 1
  i2 ~ hnu2_1 * 1
  # i3 ~ hnu3_1 * 1 (item not in HSLS)
  i4 ~ hnu4_1 * 1
  i5 ~ hnu5_1 * 1

  # Residual variances
  i1 ~~ htheta1_1 * i1
  i2 ~~ htheta2_1 * i2
  # i3 ~~ htheta3_1 * i3 (item not in HSLS)
```

```
i4 ~~ htheta4_1 * i4
i5 ~~ htheta5_1 * i5

# Free both
math_t1 ~~ var_hsls_t1 * math_t1
math_t1 ~ mean_hsls_t1 * 1


#####################
# Time Point 2
#####################
math_t2 =~ l1 * i1_2 +
           l2 * i2_2 +   # Same label as ELS
           # no i3_2 in HSLS at Time 2
           l4 * i4_2 +   # Same label as ELS
           l5 * i5_2     # Same label as ELS

# Intercepts
i1_2 ~ 0 * 1
i2_2 ~ hnu2_2 * 1
# i3_2 ~ hnu3_2 * 1 (item not in HSLS)
i4_2 ~ hnu4_2 * 1
i5_2 ~ hnu5_2 * 1

# Residual variances
i1_2 ~~ htheta1_2 * i1_2
i2_2 ~~ htheta2_2 * i2_2
# i3_2 ~~ htheta3_2 * i3_2 (item not in HSLS)
i4_2 ~~ htheta4_2 * i4_2
i5_2 ~~ htheta5_2 * i5_2

# Covariances among items


i1 ~~ i5
i1_2 ~~ i5_2

# i1 ~~ i3
# i1_2 ~~ i3_2

i1 ~~ i4
```

```
  i1_2 ~~ i4_2

  i4 ~~ i5
  i4_2 ~~ i5_2

  # Free latent variance and free latent mean
  math_t2 ~~ var_hsls_t2 * math_t2
  math_t2 ~ mean_hsls_t2 * 1

  # Correlations across time
  math_t1 ~~ math_t2
  i1 ~~ i1_2
  i2 ~~ i2_2
  # i3 ~~ i3_2 (item not in HSLS)
  i4 ~~ i4_2
  i5 ~~ i5_2
'

fit_hsls_time_metric  <- sem(hsls_time_metric, data = dat,
                             estimator = "MLR",
                             missing = "FIML", se = "robust.mlr")
```

```
Warning: lavaan->lav_data_full():
   some cases are empty and will be ignored: 24 33 38 44 47 50 56 65 66 67 77
   87 99 101 110 119 123 124 130 139 140 164 166 173 177 185 201 208 243 248
   269 272 276 295 358 378 380 385 422 427 439 492 498 500 521 524 525 526
   544 550 561 563 570 572 584 587 607 617 622 624 637 639 643 646 648 649
   659 673 685 690 715 723 730 785 790 791 792 793 794 795 808 810 811 814
   818 822 824 826 827 828 829 830 835 849 850 856 866 884 888 918 935 949
   955 956 963 969 971 977 990 1001 1002 1006 1007 1032 1036 1041 1043 1052
   1078 1079 1084 1099 1173 1175 1176 1190 1217 1220 1237 1239 1244 1247 1254
   1263 1269 1270 1276 1287 1297 1305 1322 1400 1433 1434 1436 1438 1442 1444
   1452 1458 1460 1463 1465 1469 1472 1473 1474 1476 1478 1480 1481 1483 1486
   1488 1490 1493 1494 1499 1504 1507 1511 1522 1523 1529 1537 1541 1543 1553
   1576 1588 1591 1598 1601 1603 1604 1605 1610 1620 1624 1627 1631 1637 1638
   1655 1662 1667 1673 1678 1679 1683 1689 1690 1692 1694 1698 1701 1704 1707
   1711 1712 1721 1735 1737 1754 1758 1759 1764 1769 1770 1773 1774 1775 1776
   1777 1778 1779 1780 1783 1790 1793 1799 1801 1804 1809 1819 1827 1835 1838
   1879 1918 1933 1941 1942 1944 1948 1953 1956 1962 1963 1964 1986 1992 1993
   1998 1999 2005 2017 2022 2026 2068 2077 2083 2086 2087 2101 2111 2114 2115
   2140 2144 2146 2150 2154 2156 2186 2221 2223 2249 2250 2252 2257 2261 2262
   2268 2280 2290 2295 2301 2303 2308 2309 2316 2320 2328 2339 2360 2368 2369
```

2376 2392 2400 2403 2411 2412 2413 2415 2449 2458 2459 2460 2466 2472 2480
2489 2501 2520 2527 2572 2607 2612 2625 2626 2630 2634 2643 2645 2648 2649
2651 2667 2688 2695 2709 2712 2713 2726 2729 2732 2743 2752 2753 2757 2760
2761 2762 2764 2765 2767 2769 2770 2776 2777 2783 2785 2787 2790 2800 2835
2841 2865 2874 2877 2885 2887 2888 2889 2890 2895 2896 2898 2901 2903 2904
2906 2911 2915 2917 2918 2923 2927 2932 2940 2944 2959 2968 2973 2978 2980
3010 3012 3024 3029 3045 3056 3071 3079 3083 3092 3094 3103 3119 3126 3129
3135 3136 3139 3142 3151 3173 3220 3221 3240 3261 3265 3290 3293 3299 3309
3317 3319 3325 3331 3336 3348 3384 3393 3428 3435 3442 3451 3456 3460 3462
3464 3466 3470 3485 3488 3491 3492 3519 3553 3558 3566 3572 3573 3579 3581
3584 3585 3594 3600 3601 3610 3641 3654 3668 3676 3682 3683 3685 3687 3690
3694 3699 3700 3713 3717 3726 3760 3761 3763 3780 3781 3794 3806 3815 3820
3824 3832 3846 3852 3878 3908 3909 3945 3955 3964 3965 3974 3983 3984 3992
3997 4029 4036 4048 4061 4066 4067 4071 4076 4077 4079 4080 4089 4092 4093
4094 4096 4102 4104 4105 4111 4115 4120 4160 4163 4164 4170 4178 4179 4180
4183 4185 4186 4189 4190 4192 4193 4196 4197 4202 4203 4209 4210 4212 4217
4224 4225 4226 4232 4240 4254 4264 4268 4274 4276 4279 4280 4283 4284 4286
4290 4291 4292 4297 4298 4301 4303 4307 4308 4309 4312 4314 4315 4317 4318
4319 4322 4323 4325 4339 4340 4347 4348 4354 4362 4369 4387 4393 4402 4404
4405 4450 4472 4489 4491 4500 4510 4518 4522 4523 4526 4535 4546 4547 4582
4583 4589 4590 4594 4622 4623 4624 4628 4631 4632 4633 4635 4637 4638 4640
4643 4644 4645 4648 4651 4657 4662 4665 4666 4672 4673 4678 4692 4698 4702
4705 4714 4715 4718 4724 4725 4726 4732 4737 4738 4742 4746 4749 4758 4759
4765 4768 4787 4790 4797 4798 4799 4802 4803 4805 4809 4810 4814 4816 4825
4842 4843 4849 4850 4856 4857 4858 4859 4863 4883 4897 4935 4936 4943 4945
4946 4952 4953 4967 4971 5019 5021 5025 5027 5040 5074 5083 5097 5100 5110
5113 5145 5150 5155 5157 5159 5165 5169 5185 5188 5228 5231 5247 5251 5264
5278 5281 5284 5286 5304 5308 5310 5311 5329 5351 5357 5391 5393 5410 5428
5429 5430 5439 5466 5490 5491 5500 5505 5510 5528 5533 5542 5561 5565 5567
5568 5581 5593 5610 5611 5617 5621 5625 5626 5628 5630 5637 5639 5640 5677
5701 5741 5746 5747 5772 5776 5777 5779 5781 5788 5790 5798 5804 5818 5824
5830 5833 5836 5844 5847 5867 5882 5888 5926 5940 5949 5950 5953 5954 5956
5960 5973 5993 6050 6056 6059 6072 6073 6075 6083 6087 6094 6100 6101 6109
6115 6124 6127 6128 6148 6149 6153 6158 6161 6162 6167 6172 6173 6206 6211
6212 6223 6227 6238 6253 6258 6259 6264 6266 6283 6284 6288 6290 6291 6308
6309 6324 6326 6354 6358 6362 6372 6376 6393 6402 6403 6407 6408 6410 6412
6413 6414 6417 6423 6426 6441 6449 6461 6464 6476 6491 6503 6517 6526 6545
6546 6554 6557 6561 6580 6585 6592 6594 6600 6602 6605 6623 6631 6643 6644
6645 6646 6648 6650 6653 6654 6656 6658 6659 6661 6662 6679 6683 6687 6690
6691 6692 6693 6694 6698 6700 6703 6705 6714 6727 6731 6743 6764 6773 6775
6777 6778 6780 6781 6785 6786 6787 6788 6789 6793 6805 6816 6819 6822 6840
6863 6885 6886 6900 6902 6905 6908 6911 6918 6920 6930 6931 6936 6949 6972
6994 6995 6997 7001 7002 7004 7005 7007 7011 7013 7015 7017 7019 7048 7050

7054 7055 7065 7069 7086 7095 7105 7107 7122 7129 7159 7162 7174 7177 7179
7185 7187 7190 7197 7204 7246 7258 7259 7270 7271 7274 7275 7283 7288 7302
7306 7315 7330 7343 7367 7419 7434 7444 7472 7484 7497 7507 7511 7520 7521
7526 7531 7538 7543 7554 7567 7568 7571 7574 7591 7595 7596 7607 7613 7630
7632 7633 7669 7671 7676 7686 7691 7694 7699 7709 7712 7717 7723 7728 7737
7740 7742 7749 7756 7759 7767 7769 7771 7774 7779 7806 7841 7846 7849 7850
7865 7871 7874 7880 7891 7900 7910 7928 7939 7945 7952 7954 7962 7964 7973
8005 8018 8022 8025 8026 8030 8031 8033 8034 8035 8036 8037 8038 8039 8040
8041 8042 8043 8044 8045 8046 8047 8048 8049 8052 8054 8057 8058 8060 8061
8072 8074 8083 8085 8088 8093 8096 8098 8100 8101 8106 8111 8112 8124 8126
8129 8131 8133 8134 8136 8137 8140 8141 8143 8144 8145 8148 8149 8150 8151
8152 8153 8154 8156 8159 8160 8161 8162 8164 8166 8167 8171 8172 8173 8174
8176 8179 8181 8184 8189 8191 8194 8196 8203 8208 8209 8211 8214 8223 8227
8236 8238 8246 8252 8253 8254 8257 8258 8259 8260 8261 8263 8265 8266 8267
8268 8269 8277 8281 8282 8287 8288 8302 8306 8309 8315 8317 8326 8330 8334
8342 8343 8346 8348 8350 8362 8370 8375 8383 8385 8387 8392 8397 8400 8404
8407 8408 8410 8411 8412 8413 8421 8429 8458 8459 8461 8463 8469 8477 8478
8488 8494 8509 8512 8513 8534 8543 8552 8555 8561 8570 8576 8588 8608 8623
8629 8635 8639 8650 8655 8662 8677 8690 8712 8716 8720 8723 8731 8733 8738
8740 8742 8743 8744 8751 8781 8789 8792 8796 8812 8813 8823 8829 8831 8836
8848 8854 8857 8860 8861 8871 8874 8880 8881 8893 8950 8952 8955 8959 8961
8964 8965 8967 8968 8971 8978 8991 8998 9017 9018 9020 9022 9024 9028 9033
9034 9035 9039 9072 9077 9088 9092 9096 9099 9132 9145 9147 9149 9155 9157
9162 9166 9168 9169 9175 9176 9180 9197 9202 9212 9222 9237 9246 9250 9251
9269 9274 9278 9305 9309 9310 9313 9315 9326 9332 9333 9338 9345 9346 9351
9354 9367 9368 9371 9372 9389 9393 9405 9409 9411 9422 9428 9435 9437 9438
9441 9446 9448 9453 9463 9465 9468 9475 9479 9482 9486 9487 9490 9502 9510
9514 9525 9530 9536 9537 9541 9559 9561 9572 9573 9586 9587 9589 9598 9601
9605 9608 9609 9618 9622 9625 9630 9633 9634 9636 9640 9643 9646 9650 9651
9653 9663 9666 9667 9669 9673 9674 9688 9691 9693 9701 9703 9710 9725 9743
9745 9746 9755 9759 9766 9771 9778 9782 9785 9788 9793 9796 9800 9801 9805
9807 9811 9816 9818 9830 9844 9889 9891 9894 9906 9941 9944 9959 9967 9969
9994 9995 9996 9997 9999 10000 10001 10004 10006 10009 10011 10015 10016
10020 10021 10023 10024 10026 10028 10031 10032 10037 10041 10043 10045
10047 10050 10053 10054 10057 10059 10061 10065 10078 10082 10099 10115
10119 10121 10124 10138 10139 10143 10144 10145 10148 10149 10152 10153
10154 10155 10158 10160 10163 10166 10168 10169 10191 10206 10207 10216
10218 10227 10228 10234 10240 10243 10246 10248 10252 10253 10269 10273
10278 10280 10288 10294 10295 10302 10304 10311 10322 10331 10354 10375
10379 10401 10412 10424 10427 10447 10473 10478 10479 10480 10482 10485
10487 10493 10517 10520 10533 10538 10539 10544 10548 10555 10558 10560
10561 10574 10575 10579 10643 10644 10664 10671 10673 10683 1068

```r
fitMeasures(fit_hsls_time_metric, c("rmsea", "chisq.scaled", "cfi", "tli", "df", "aic", "b
```

```
     rmsea chisq.scaled          cfi          tli           df          aic
     0.015       99.780        0.999        0.999       12.000   447601.039
       bic
447873.420
```

```r
#head(modindices(fit_hsls_time_metric, sort. = TRUE, free.remove = FALSE))

s_hsls_time_metric <- summary(fit_hsls_time_metric, fit.measures = TRUE, standardized = TR
s_hsls_time_metric
```

```
lavaan 0.6-19 ended normally after 77 iterations

  Estimator                                         ML
  Optimization method                           NLMINB
  Number of model parameters                        35
  Number of equality constraints                     3

                                                  Used       Total
  Number of observations                         36750       39700
  Number of missing patterns                        62

Model Test User Model:
                                              Standard      Scaled
  Test Statistic                               108.701      99.780
  Degrees of freedom                                12          12
  P-value (Chi-square)                           0.000       0.000
  Scaling correction factor                                  1.089
    Yuan-Bentler correction (Mplus variant)

Model Test Baseline Model:

  Test statistic                            156724.874  110950.001
  Degrees of freedom                                28          28
  P-value                                        0.000       0.000
  Scaling correction factor                                  1.413

User Model versus Baseline Model:
```

```
  Comparative Fit Index (CFI)                    0.999       0.999
  Tucker-Lewis Index (TLI)                       0.999       0.998

  Robust Comparative Fit Index (CFI)                         0.999
  Robust Tucker-Lewis Index (TLI)                            0.998

Loglikelihood and Information Criteria:

  Loglikelihood user model (H0)            -223768.520 -223768.520
  Scaling correction factor                                  1.153
      for the MLR correction
  Loglikelihood unrestricted model (H1)    -223714.169 -223714.169
  Scaling correction factor                                  1.214
      for the MLR correction

  Akaike (AIC)                              447601.039  447601.039
  Bayesian (BIC)                            447873.420  447873.420
  Sample-size adjusted Bayesian (SABIC)     447771.724  447771.724

Root Mean Square Error of Approximation:

  RMSEA                                          0.015       0.014
  90 Percent confidence interval - lower         0.012       0.012
  90 Percent confidence interval - upper         0.017       0.017
  P-value H_0: RMSEA <= 0.050                    1.000       1.000
  P-value H_0: RMSEA >= 0.080                    0.000       0.000

  Robust RMSEA                                               0.018
  90 Percent confidence interval - lower                     0.015
  90 Percent confidence interval - upper                     0.021
  P-value H_0: Robust RMSEA <= 0.050                         1.000
  P-value H_0: Robust RMSEA >= 0.080                         0.000

Standardized Root Mean Square Residual:

  SRMR                                           0.008       0.008

Parameter Estimates:

  Standard errors                             Sandwich
  Information bread                           Observed
  Observed information based on                Hessian
```

Latent Variables:

		Estimate	Std.Err	z-value	P(>|z|)	Std.lv	Std.all
math_t1 =~							
i1	(l1)	1.000				0.741	0.870
i2	(l2)	0.997	0.009	108.334	0.000	0.739	0.838
i4	(l4)	0.899	0.004	224.701	0.000	0.666	0.804
i5	(l5)	0.927	0.004	220.848	0.000	0.687	0.828
math_t2 =~							
i1_2	(l1)	1.000				0.714	0.841
i2_2	(l2)	0.997	0.009	108.334	0.000	0.712	0.796
i4_2	(l4)	0.899	0.004	224.701	0.000	0.642	0.789
i5_2	(l5)	0.927	0.004	220.848	0.000	0.662	0.798

Covariances:

	Estimate	Std.Err	z-value	P(>|z|)	Std.lv	Std.all
.i1 ~~						
.i5	-0.012	0.005	-2.513	0.012	-0.012	-0.062
.i1_2 ~~						
.i5_2	0.033	0.005	6.991	0.000	0.033	0.144
.i1 ~~						
.i4	0.026	0.005	5.385	0.000	0.026	0.126
.i1_2 ~~						
.i4_2	0.046	0.005	9.670	0.000	0.046	0.199
.i4 ~~						
.i5	0.074	0.005	15.409	0.000	0.074	0.323
.i4_2 ~~						
.i5_2	0.050	0.005	11.057	0.000	0.050	0.201
math_t1 ~~						
math_t2	0.257	0.004	58.969	0.000	0.487	0.487
.i1 ~~						
.i1_2	0.006	0.002	3.138	0.002	0.006	0.030
.i2 ~~						
.i2_2	0.029	0.003	11.466	0.000	0.029	0.112
.i4 ~~						
.i4_2	0.008	0.002	4.093	0.000	0.008	0.031
.i5 ~~						
.i5_2	0.013	0.002	6.773	0.000	0.013	0.055

Intercepts:

		Estimate	Std.Err	z-value	P(>|z|)	Std.lv	Std.all
.i1		0.000				0.000	0.000
.i2	(h2_1)	-0.219	0.026	-8.358	0.000	-0.219	-0.249
.i4	(h4_1)	0.374	0.012	30.303	0.000	0.374	0.451

```
   .i5      (h5_1)    0.250    0.013   19.246    0.000    0.250    0.301
    math_t1 (m__1)    2.811    0.005  584.561    0.000    3.795    3.795
   .i1_2              0.000                              0.000    0.000
   .i2_2    (h2_2)   -0.209    0.025   -8.262    0.000   -0.209   -0.233
   .i4_2    (h4_2)    0.464    0.012   39.388    0.000    0.464    0.570
   .i5_2    (h5_2)    0.309    0.012   25.013    0.000    0.309    0.373
    math_t2 (m__2)    2.693    0.005  558.395    0.000    3.772    3.772

Variances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
   .i1      (h1_1)    0.176    0.005   32.053    0.000    0.176    0.243
   .i2      (h2_1)    0.232    0.005   43.071    0.000    0.232    0.298
   .i4      (h4_1)    0.243    0.005   45.759    0.000    0.243    0.354
   .i5      (h5_1)    0.216    0.005   41.448    0.000    0.216    0.315
    math_t1 (v__1)    0.549    0.007   80.866    0.000    1.000    1.000
   .i1_2    (h1_2)    0.212    0.005   38.917    0.000    0.212    0.294
   .i2_2    (h2_2)    0.292    0.006   53.105    0.000    0.292    0.366
   .i4_2    (h4_2)    0.250    0.005   50.082    0.000    0.250    0.378
   .i5_2    (h5_2)    0.250    0.005   48.566    0.000    0.250    0.364
    math_t2 (v__2)    0.510    0.006   78.489    0.000    1.000    1.000
```

```
#s_both_weak_comb
```

HSLS Time Scalar

```
# Latent variance and mean set to 1 and 0 in HSLS time 1,
# free variance, mean set to 0 everywhere else

hsls_time_scalar <- '

  ######################
  # Time Point 1
  ######################
  math_t1 =~ l1 * i1 +
             l2 * i2 +   # Same label as ELS
             # no i3 in HSLS
             l4 * i4 +   # Same label as ELS
             l5 * i5     # Same label as ELS

  # Intercepts
```

```
i1 ~ 0 * 1
i2 ~ hnu2_1 * 1
# i3 ~ hnu3_1 * 1 (item not in HSLS)
i4 ~ hnu4_1 * 1
i5 ~ hnu5_1 * 1

# Residual variances
i1 ~~ htheta1_1 * i1
i2 ~~ htheta2_1 * i2
# i3 ~~ htheta3_1 * i3 (item not in HSLS)
i4 ~~ htheta4_1 * i4
i5 ~~ htheta5_1 * i5

# Free both
math_t1 ~~ var_hsls_t1 * math_t1
math_t1 ~ mean_hsls_t1 * 1


######################
# Time Point 2
######################
math_t2 =~ l1 * i1_2 +
           l2 * i2_2 +   # Same label as ELS
           # no i3_2 in HSLS at Time 2
           l4 * i4_2 +   # Same label as ELS
           l5 * i5_2     # Same label as ELS

# Intercepts
i1_2 ~ 0 * 1
i2_2 ~ hnu2_1 * 1
# i3_2 ~ hnu3_2 * 1 (item not in HSLS)
i4_2 ~ hnu4_1 * 1
i5_2 ~ hnu5_1 * 1

# Residual variances
i1_2 ~~ htheta1_2 * i1_2
i2_2 ~~ htheta2_2 * i2_2
# i3_2 ~~ htheta3_2 * i3_2 (item not in HSLS)
i4_2 ~~ htheta4_2 * i4_2
i5_2 ~~ htheta5_2 * i5_2
```

```
  # Covariances among items


  i1 ~~ i5
  i1_2 ~~ i5_2

  # i1 ~~ i3
  # i1_2 ~~ i3_2

  i1 ~~ i4
  i1_2 ~~ i4_2

  i4 ~~ i5
  i4_2 ~~ i5_2

  # Free latent variance and free latent mean
  math_t2 ~~ var_hsls_t2 * math_t2
  math_t2 ~ mean_hsls_t2 * 1

  # Correlations across time
  math_t1 ~~ math_t2
  i1 ~~ i1_2
  i2 ~~ i2_2
  # i3 ~~ i3_2 (item not in HSLS)
  i4 ~~ i4_2
  i5 ~~ i5_2
'


fit_hsls_time_scalar  <- sem(hsls_time_scalar, data = dat,
                             estimator = "MLR",
                             missing = "FIML", se = "robust.mlr")
```

```
Warning: lavaan->lav_data_full():
   some cases are empty and will be ignored: 24 33 38 44 47 50 56 65 66 67 77
   87 99 101 110 119 123 124 130 139 140 164 166 173 177 185 201 208 243 248
   269 272 276 295 358 378 380 385 422 427 439 492 498 500 521 524 525 526
   544 550 561 563 570 572 584 587 607 617 622 624 637 639 643 646 648 649
   659 673 685 690 715 723 730 785 790 791 792 793 794 795 808 810 811 814
   818 822 824 826 827 828 829 830 835 849 850 856 866 884 888 918 935 949
   955 956 963 969 971 977 990 1001 1002 1006 1007 1032 1036 1041 1043 1052
   1078 1079 1084 1099 1173 1175 1176 1190 1217 1220 1237 1239 1244 1247 1254
```

1263 1269 1270 1276 1287 1297 1305 1322 1400 1433 1434 1436 1438 1442 1444
1452 1458 1460 1463 1465 1469 1472 1473 1474 1476 1478 1480 1481 1483 1486
1488 1490 1493 1494 1499 1504 1507 1511 1522 1523 1529 1537 1541 1543 1553
1576 1588 1591 1598 1601 1603 1604 1605 1610 1620 1624 1627 1631 1637 1638
1655 1662 1667 1673 1678 1679 1683 1689 1690 1692 1694 1698 1701 1704 1707
1711 1712 1721 1735 1737 1754 1758 1759 1764 1769 1770 1773 1774 1775 1776
1777 1778 1779 1780 1783 1790 1793 1799 1801 1804 1809 1819 1827 1835 1838
1879 1918 1933 1941 1942 1944 1948 1953 1956 1962 1963 1964 1986 1992 1993
1998 1999 2005 2017 2022 2026 2068 2077 2083 2086 2087 2101 2111 2114 2115
2140 2144 2146 2150 2154 2156 2186 2221 2223 2249 2250 2252 2257 2261 2262
2268 2280 2290 2295 2301 2303 2308 2309 2316 2320 2328 2339 2360 2368 2369
2376 2392 2400 2403 2411 2412 2413 2415 2449 2458 2459 2460 2466 2472 2480
2489 2501 2520 2527 2572 2607 2612 2625 2626 2630 2634 2643 2645 2648 2649
2651 2667 2688 2695 2709 2712 2713 2726 2729 2732 2743 2752 2753 2757 2760
2761 2762 2764 2765 2767 2769 2770 2776 2777 2783 2785 2787 2790 2800 2835
2841 2865 2874 2877 2885 2887 2888 2889 2890 2895 2896 2898 2901 2903 2904
2906 2911 2915 2917 2918 2923 2927 2932 2940 2944 2959 2968 2973 2978 2980
3010 3012 3024 3029 3045 3056 3071 3079 3083 3092 3094 3103 3119 3126 3129
3135 3136 3139 3142 3151 3173 3220 3221 3240 3261 3265 3290 3293 3299 3309
3317 3319 3325 3331 3336 3348 3384 3393 3428 3435 3442 3451 3456 3460 3462
3464 3466 3470 3485 3488 3491 3492 3519 3553 3558 3566 3572 3573 3579 3581
3584 3585 3594 3600 3601 3610 3641 3654 3668 3676 3682 3683 3685 3687 3690
3694 3699 3700 3713 3717 3726 3760 3761 3763 3780 3781 3794 3806 3815 3820
3824 3832 3846 3852 3878 3908 3909 3945 3955 3964 3965 3974 3983 3984 3992
3997 4029 4036 4048 4061 4066 4067 4071 4076 4077 4079 4080 4089 4092 4093
4094 4096 4102 4104 4105 4111 4115 4120 4160 4163 4164 4170 4178 4179 4180
4183 4185 4186 4189 4190 4192 4193 4196 4197 4202 4203 4209 4210 4212 4217
4224 4225 4226 4232 4240 4254 4264 4268 4274 4276 4279 4280 4283 4284 4286
4290 4291 4292 4297 4298 4301 4303 4307 4308 4309 4312 4314 4315 4317 4318
4319 4322 4323 4325 4339 4340 4347 4348 4354 4362 4369 4387 4393 4402 4404
4405 4450 4472 4489 4491 4500 4510 4518 4522 4523 4526 4535 4546 4547 4582
4583 4589 4590 4594 4622 4623 4624 4628 4631 4632 4633 4635 4637 4638 4640
4643 4644 4645 4648 4651 4657 4662 4665 4666 4672 4673 4678 4692 4698 4702
4705 4714 4715 4718 4724 4725 4726 4732 4737 4738 4742 4746 4749 4758 4759
4765 4768 4787 4790 4797 4798 4799 4802 4803 4805 4809 4810 4814 4816 4825
4842 4843 4849 4850 4856 4857 4858 4859 4863 4883 4897 4935 4936 4943 4945
4946 4952 4953 4967 4971 5019 5021 5025 5027 5040 5074 5083 5097 5100 5110
5113 5145 5150 5155 5157 5159 5165 5169 5185 5188 5228 5231 5247 5251 5264
5278 5281 5284 5286 5304 5308 5310 5311 5329 5351 5357 5391 5393 5410 5428
5429 5430 5439 5466 5490 5491 5500 5505 5510 5528 5533 5542 5561 5565 5567
5568 5581 5593 5610 5611 5617 5621 5625 5626 5628 5630 5637 5639 5640 5677
5701 5741 5746 5747 5772 5776 5777 5779 5781 5788 5790 5798 5804 5818 5824
5830 5833 5836 5844 5847 5867 5882 5888 5926 5940 5949 5950 5953 5954 5956

5960 5973 5993 6050 6056 6059 6072 6073 6075 6083 6087 6094 6100 6101 6109
6115 6124 6127 6128 6148 6149 6153 6158 6161 6162 6167 6172 6173 6206 6211
6212 6223 6227 6238 6253 6258 6259 6264 6266 6283 6284 6288 6290 6291 6308
6309 6324 6326 6354 6358 6362 6372 6376 6393 6402 6403 6407 6408 6410 6412
6413 6414 6417 6423 6426 6441 6449 6461 6464 6476 6491 6503 6517 6526 6545
6546 6554 6557 6561 6580 6585 6592 6594 6600 6602 6605 6623 6631 6643 6644
6645 6646 6648 6650 6653 6654 6656 6658 6659 6661 6662 6679 6683 6687 6690
6691 6692 6693 6694 6698 6700 6703 6705 6714 6727 6731 6743 6764 6773 6775
6777 6778 6780 6781 6785 6786 6787 6788 6789 6793 6805 6816 6819 6822 6840
6863 6885 6886 6900 6902 6905 6908 6911 6918 6920 6930 6931 6936 6949 6972
6994 6995 6997 7001 7002 7004 7005 7007 7011 7013 7015 7017 7019 7048 7050
7054 7055 7065 7069 7086 7095 7105 7107 7122 7129 7159 7162 7174 7177 7179
7185 7187 7190 7197 7204 7246 7258 7259 7270 7271 7274 7275 7283 7288 7302
7306 7315 7330 7343 7367 7419 7434 7444 7472 7484 7497 7507 7511 7520 7521
7526 7531 7538 7543 7554 7567 7568 7571 7574 7591 7595 7596 7607 7613 7630
7632 7633 7669 7671 7676 7686 7691 7694 7699 7709 7712 7717 7723 7728 7737
7740 7742 7749 7756 7759 7767 7769 7771 7774 7779 7806 7841 7846 7849 7850
7865 7871 7874 7880 7891 7900 7910 7928 7939 7945 7952 7954 7962 7964 7973
8005 8018 8022 8025 8026 8030 8031 8033 8034 8035 8036 8037 8038 8039 8040
8041 8042 8043 8044 8045 8046 8047 8048 8049 8052 8054 8057 8058 8060 8061
8072 8074 8083 8085 8088 8093 8096 8098 8100 8101 8106 8111 8112 8124 8126
8129 8131 8133 8134 8136 8137 8140 8141 8143 8144 8145 8148 8149 8150 8151
8152 8153 8154 8156 8159 8160 8161 8162 8164 8166 8167 8171 8172 8173 8174
8176 8179 8181 8184 8189 8191 8194 8196 8203 8208 8209 8211 8214 8223 8227
8236 8238 8246 8252 8253 8254 8257 8258 8259 8260 8261 8263 8265 8266 8267
8268 8269 8277 8281 8282 8287 8288 8302 8306 8309 8315 8317 8326 8330 8334
8342 8343 8346 8348 8350 8362 8370 8375 8383 8385 8387 8392 8397 8400 8404
8407 8408 8410 8411 8412 8413 8421 8429 8458 8459 8461 8463 8469 8477 8478
8488 8494 8509 8512 8513 8534 8543 8552 8555 8561 8570 8576 8588 8608 8623
8629 8635 8639 8650 8655 8662 8677 8690 8712 8716 8720 8723 8731 8733 8738
8740 8742 8743 8744 8751 8781 8789 8792 8796 8812 8813 8823 8829 8831 8836
8848 8854 8857 8860 8861 8871 8874 8880 8881 8893 8950 8952 8955 8959 8961
8964 8965 8967 8968 8971 8978 8991 8998 9017 9018 9020 9022 9024 9028 9033
9034 9035 9039 9072 9077 9088 9092 9096 9099 9132 9145 9147 9149 9155 9157
9162 9166 9168 9169 9175 9176 9180 9197 9202 9212 9222 9237 9246 9250 9251
9269 9274 9278 9305 9309 9310 9313 9315 9326 9332 9333 9338 9345 9346 9351
9354 9367 9368 9371 9372 9389 9393 9405 9409 9411 9422 9428 9435 9437 9438
9441 9446 9448 9453 9463 9465 9468 9475 9479 9482 9486 9487 9490 9502 9510
9514 9525 9530 9536 9537 9541 9559 9561 9572 9573 9586 9587 9589 9598 9601
9605 9608 9609 9618 9622 9625 9630 9633 9634 9636 9640 9643 9646 9650 9651
9653 9663 9666 9667 9669 9673 9674 9688 9691 9693 9701 9703 9710 9725 9743
9745 9746 9755 9759 9766 9771 9778 9782 9785 9788 9793 9796 9800 9801 9805
9807 9811 9816 9818 9830 9844 9889 9891 9894 9906 9941 9944 9959 9967 9969

```
 9994 9995 9996 9997 9999 10000 10001 10004 10006 10009 10011 10015 10016
 10020 10021 10023 10024 10026 10028 10031 10032 10037 10041 10043 10045
 10047 10050 10053 10054 10057 10059 10061 10065 10078 10082 10099 10115
 10119 10121 10124 10138 10139 10143 10144 10145 10148 10149 10152 10153
 10154 10155 10158 10160 10163 10166 10168 10169 10191 10206 10207 10216
 10218 10227 10228 10234 10240 10243 10246 10248 10252 10253 10269 10273
 10278 10280 10288 10294 10295 10302 10304 10311 10322 10331 10354 10375
 10379 10401 10412 10424 10427 10447 10473 10478 10479 10480 10482 10485
 10487 10493 10517 10520 10533 10538 10539 10544 10548 10555 10558 10560
 10561 10574 10575 10579 10643 10644 10664 10671 10673 10683 1068
```

```
#fit_hsls_time_scalar

fitMeasures(fit_hsls_time_metric, c("rmsea", "chisq.scaled", "cfi", "tli", "df", "aic", "b
```

```
     rmsea chisq.scaled          cfi          tli           df          aic
     0.015       99.780        0.999        0.999       12.000   447601.039
       bic         srmr
447873.420        0.008
```

```
fitMeasures(fit_hsls_time_scalar, c("rmsea", "chisq.scaled", "cfi", "tli", "df", "aic", "b
```

```
     rmsea chisq.scaled          cfi          tli           df          aic
     0.030      486.690        0.997        0.994       15.000   448007.527
       bic         srmr
448254.372        0.013
```

```
#head(modindices(fit_hsls_time_scalar, sort. = TRUE, free.remove = FALSE))

s_hsls_time_scalar <- summary(fit_hsls_time_scalar, fit.measures = TRUE, standardized = TR
s_hsls_time_scalar
```

```
lavaan 0.6-19 ended normally after 68 iterations

  Estimator                                         ML
  Optimization method                           NLMINB
  Number of model parameters                        35
  Number of equality constraints                     6
```

```
                                                  Used       Total
  Number of observations                         36750       39700
  Number of missing patterns                        62

Model Test User Model:
                                               Standard      Scaled
  Test Statistic                                521.188     486.690
  Degrees of freedom                                 15          15
  P-value (Chi-square)                            0.000       0.000
  Scaling correction factor                                   1.071
    Yuan-Bentler correction (Mplus variant)

Model Test Baseline Model:

  Test statistic                             156724.874  110950.001
  Degrees of freedom                                 28          28
  P-value                                         0.000       0.000
  Scaling correction factor                                   1.413

User Model versus Baseline Model:

  Comparative Fit Index (CFI)                     0.997       0.996
  Tucker-Lewis Index (TLI)                        0.994       0.992

  Robust Comparative Fit Index (CFI)                          0.997
  Robust Tucker-Lewis Index (TLI)                             0.994

Loglikelihood and Information Criteria:

  Loglikelihood user model (H0)              -223974.763 -223974.763
  Scaling correction factor                                   1.067
      for the MLR correction
  Loglikelihood unrestricted model (H1)      -223714.169 -223714.169
  Scaling correction factor                                   1.214
      for the MLR correction

  Akaike (AIC)                                448007.527  448007.527
  Bayesian (BIC)                              448254.372  448254.372
  Sample-size adjusted Bayesian (SABIC)       448162.210  448162.210

Root Mean Square Error of Approximation:

  RMSEA                                           0.030       0.029
```

```
  90 Percent confidence interval - lower         0.028       0.027
  90 Percent confidence interval - upper         0.033       0.031
  P-value H_0: RMSEA <= 0.050                    1.000       1.000
  P-value H_0: RMSEA >= 0.080                    0.000       0.000

  Robust RMSEA                                               0.034
  90 Percent confidence interval - lower                     0.031
  90 Percent confidence interval - upper                     0.037
  P-value H_0: Robust RMSEA <= 0.050                         1.000
  P-value H_0: Robust RMSEA >= 0.080                         0.000

Standardized Root Mean Square Residual:

  SRMR                                           0.013       0.013

Parameter Estimates:

  Standard errors                             Sandwich
  Information bread                           Observed
  Observed information based on                Hessian

Latent Variables:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  math_t1 =~
    i1        (l1)    1.000                               0.740    0.869
    i2        (l2)    1.001    0.009  108.640    0.000    0.741    0.840
    i4        (l4)    0.893    0.004  223.632    0.000    0.661    0.799
    i5        (l5)    0.923    0.004  221.404    0.000    0.683    0.824
  math_t2 =~
    i1_2      (l1)    1.000                               0.714    0.839
    i2_2      (l2)    1.001    0.009  108.640    0.000    0.715    0.799
    i4_2      (l4)    0.893    0.004  223.632    0.000    0.637    0.784
    i5_2      (l5)    0.923    0.004  221.404    0.000    0.659    0.794

Covariances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
 .i1 ~~
   .i5              -0.010    0.005   -2.048    0.041   -0.010   -0.050
 .i1_2 ~~
   .i5_2             0.035    0.005    7.471    0.000    0.035    0.152
 .i1 ~~
   .i4               0.028    0.005    5.908    0.000    0.028    0.135
 .i1_2 ~~
```

```
   .i4_2             0.048    0.005   10.200    0.000    0.048    0.206
 .i4 ~~
   .i5               0.078    0.005   16.407    0.000    0.078    0.334
 .i4_2 ~~
   .i5_2             0.054    0.005   11.954    0.000    0.054    0.213
  math_t1 ~~
    math_t2          0.258    0.004   58.498    0.000    0.488    0.488
 .i1 ~~
   .i1_2             0.005    0.002    2.666    0.008    0.005    0.025
 .i2 ~~
   .i2_2             0.028    0.003   11.144    0.000    0.028    0.111
 .i4 ~~
   .i4_2             0.007    0.002    3.824    0.000    0.007    0.028
 .i5 ~~
   .i5_2             0.013    0.002    6.853    0.000    0.013    0.055

Intercepts:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
   .i1                0.000                              0.000    0.000
   .i2      (h2_1)   -0.224    0.026   -8.727    0.000   -0.224   -0.254
   .i4      (h4_1)    0.438    0.012   36.957    0.000    0.438    0.529
   .i5      (h5_1)    0.295    0.012   23.861    0.000    0.295    0.356
    math_t1 (m__1)    2.796    0.005  605.198    0.000    3.777    3.777
   .i1_2              0.000                              0.000    0.000
   .i2_2    (h2_1)   -0.224    0.026   -8.727    0.000   -0.224   -0.251
   .i4_2    (h4_1)    0.438    0.012   36.957    0.000    0.438    0.538
   .i5_2    (h5_1)    0.295    0.012   23.861    0.000    0.295    0.355
    math_t2 (m__2)    2.708    0.005  584.682    0.000    3.794    3.794

Variances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
   .i1      (h1_1)    0.178    0.005   32.395    0.000    0.178    0.245
   .i2      (h2_1)    0.229    0.005   42.069    0.000    0.229    0.294
   .i4      (h4_1)    0.248    0.005   47.078    0.000    0.248    0.362
   .i5      (h5_1)    0.220    0.005   42.552    0.000    0.220    0.320
    math_t1 (v__1)    0.548    0.007   80.871    0.000    1.000    1.000
   .i1_2    (h1_2)    0.214    0.005   39.183    0.000    0.214    0.295
   .i2_2    (h2_2)    0.289    0.006   52.628    0.000    0.289    0.362
   .i4_2    (h4_2)    0.255    0.005   51.049    0.000    0.255    0.386
   .i5_2    (h5_2)    0.254    0.005   49.271    0.000    0.254    0.369
    math_t2 (v__2)    0.509    0.007   78.109    0.000    1.000    1.000
```

##ELS Time Config

```
els_config <- '
  math_T1 =~  l1_1*NA * i1 +
              l2_1    * i2 +
              l3_1    * i3 +
              l4_1    * i4 +
              l5_1    * i5


  # Fixing latent variance to 1, as we freed first factor loading
  math_T1 ~~ 1 * math_T1

  # Fixing latent mean to 0 for identification?
  math_T1 ~ 0 * 1

  # Time Point 2
  math_T2 =~l1_2*NA * i1_2 +
            l2_2    * i2_2 +
            l3_2    * i3_2 +
            l4_2    * i4_2 +
            l5_2    * i5_2


  # Freeing latent variance to 1, as we freed first factor loading
  math_T2 ~~ 1 * math_T2

  # Fixing latent mean to 0 for identification
  math_T2 ~ 0 * math_T2

  # Correlations across time
  math_T1 ~~ math_T2
  i1 ~~ i1_2
  i2 ~~ i2_2
  i3 ~~ i3_2
  i4 ~~ i4_2
  i5 ~~ i5_2


  #i1 = Teen confident can do excellent job on math tests
  #i2 = Teen certain can understand math textbook
  i1   ~~ i2
  i1_2 ~~ i2_2
```

```
  #i2 = Teen certain can understand math textbook
  #i3 = Can understand difficult math class
  i2   ~~ i3
  i2_2 ~~ i3_2

  #i4 = Teen confident can do an excellent job on math assignments
  #i5 = Teen certain can master skills in math course
  i4   ~~ i5
  i4_2 ~~ i5_2
'

fit_els_time_config  <- sem(els_config, data = dat,
                            estimator = "MLR",
                            missing = "FIML", se = "robust.mlr")
```

```
Warning: lavaan->lav_data_full():
   some cases are empty and will be ignored: 24 33 38 44 47 50 56 65 66 67 77
   87 99 101 110 119 123 124 130 139 140 164 166 173 177 185 201 208 243 248
   269 272 276 295 358 378 380 385 422 427 439 492 498 500 521 524 525 526
   544 550 561 563 570 572 584 587 607 617 622 624 637 639 643 646 648 649
   659 673 685 690 715 723 730 785 790 791 792 793 794 795 808 810 811 814
   818 822 824 826 827 828 829 830 835 849 850 856 866 884 888 918 935 949
   955 956 963 969 971 977 990 1001 1002 1006 1007 1032 1036 1041 1043 1052
   1078 1079 1084 1099 1173 1175 1176 1190 1217 1220 1237 1239 1244 1247 1254
   1263 1269 1270 1276 1287 1297 1305 1322 1400 1433 1434 1436 1438 1442 1444
   1452 1458 1463 1465 1469 1472 1473 1474 1476 1478 1480 1481 1483 1486 1488
   1490 1493 1494 1499 1504 1507 1511 1522 1523 1529 1537 1541 1543 1553 1576
   1588 1591 1598 1601 1603 1604 1605 1610 1620 1624 1627 1631 1637 1638 1655
   1662 1667 1673 1678 1679 1683 1689 1690 1692 1694 1698 1701 1704 1707 1711
   1712 1721 1735 1737 1754 1758 1759 1764 1769 1770 1773 1774 1775 1777 1778
   1779 1780 1783 1790 1793 1799 1801 1804 1809 1819 1827 1835 1838 1879 1918
   1933 1941 1942 1944 1948 1953 1956 1962 1963 1964 1986 1992 1993 1998 1999
   2005 2017 2022 2026 2068 2077 2083 2086 2087 2101 2111 2114 2115 2140 2144
   2146 2150 2154 2156 2186 2221 2223 2249 2250 2252 2257 2261 2262 2268 2280
   2290 2295 2301 2303 2308 2309 2316 2320 2328 2339 2360 2368 2369 2376 2392
   2400 2403 2411 2412 2413 2415 2449 2458 2459 2460 2466 2472 2480 2489 2501
   2520 2527 2572 2607 2612 2625 2626 2630 2634 2643 2645 2648 2649 2651 2667
   2688 2695 2709 2712 2713 2726 2729 2732 2743 2752 2753 2757 2760 2761 2762
   2764 2765 2767 2769 2770 2776 2777 2783 2785 2787 2790 2800 2835 2841 2865
   2874 2877 2885 2887 2888 2889 2890 2895 2896 2898 2901 2903 2904 2906 2911
   2915 2917 2918 2923 2927 2932 2940 2944 2959 2968 2973 2978 2980 3010 3012
   3024 3029 3045 3056 3071 3079 3083 3092 3094 3103 3119 3126 3129 3135 3136
```

3139 3142 3151 3173 3220 3221 3240 3261 3265 3290 3293 3299 3309 3317 3319
3325 3331 3336 3348 3384 3393 3428 3435 3442 3451 3456 3460 3462 3464 3470
3485 3488 3491 3492 3519 3553 3558 3566 3572 3573 3579 3581 3584 3585 3594
3600 3601 3610 3641 3654 3668 3676 3682 3683 3685 3687 3690 3694 3699 3700
3713 3717 3726 3760 3761 3763 3780 3781 3794 3806 3815 3820 3824 3832 3846
3852 3878 3908 3909 3945 3955 3964 3965 3974 3983 3984 3992 3997 4029 4036
4048 4061 4066 4067 4071 4076 4077 4079 4080 4092 4093 4094 4096 4102 4104
4105 4111 4115 4120 4160 4163 4164 4170 4178 4179 4180 4183 4185 4186 4189
4190 4192 4193 4196 4197 4202 4203 4209 4210 4212 4217 4224 4225 4226 4232
4240 4254 4264 4268 4274 4276 4279 4280 4283 4284 4286 4290 4291 4292 4297
4298 4301 4303 4307 4308 4309 4312 4314 4315 4317 4318 4319 4322 4323 4325
4339 4340 4347 4348 4354 4362 4369 4387 4393 4402 4404 4405 4450 4472 4489
4491 4500 4510 4518 4522 4523 4526 4535 4546 4547 4582 4583 4589 4590 4594
4622 4623 4624 4628 4631 4632 4633 4635 4637 4638 4640 4643 4644 4645 4648
4651 4657 4662 4665 4666 4672 4673 4678 4692 4698 4702 4705 4714 4715 4718
4724 4725 4726 4732 4737 4738 4742 4746 4749 4758 4759 4765 4768 4787 4790
4797 4798 4799 4802 4803 4805 4809 4810 4814 4816 4825 4842 4843 4849 4850
4856 4857 4858 4859 4863 4883 4897 4935 4936 4943 4945 4946 4952 4953 4967
4971 5019 5021 5025 5027 5040 5074 5083 5097 5100 5110 5113 5145 5150 5155
5157 5159 5165 5169 5185 5188 5228 5231 5247 5251 5264 5278 5281 5284 5286
5304 5308 5310 5311 5329 5351 5357 5391 5393 5410 5428 5429 5430 5439 5466
5490 5491 5500 5505 5510 5528 5533 5542 5561 5565 5567 5568 5581 5593 5610
5611 5617 5621 5625 5626 5628 5630 5637 5639 5640 5677 5701 5741 5746 5747
5772 5776 5777 5779 5781 5788 5790 5798 5804 5818 5824 5830 5833 5836 5844
5847 5867 5882 5888 5926 5940 5949 5950 5953 5954 5956 5960 5973 5993 6050
6056 6059 6072 6073 6075 6083 6087 6094 6100 6101 6109 6115 6124 6127 6128
6148 6149 6153 6158 6161 6162 6167 6172 6173 6206 6211 6212 6223 6227 6238
6253 6258 6259 6264 6266 6283 6284 6288 6290 6291 6308 6309 6324 6326 6354
6358 6362 6372 6376 6393 6402 6403 6407 6408 6410 6412 6413 6414 6417 6423
6426 6441 6449 6461 6464 6476 6491 6503 6517 6526 6545 6546 6554 6557 6561
6580 6585 6592 6594 6600 6602 6605 6623 6631 6643 6644 6645 6646 6648 6650
6653 6654 6656 6658 6659 6661 6662 6679 6683 6687 6690 6691 6692 6693 6694
6698 6700 6703 6705 6714 6727 6731 6743 6764 6773 6775 6777 6778 6780 6781
6785 6786 6787 6788 6789 6793 6805 6816 6819 6822 6840 6863 6885 6886 6900
6902 6905 6908 6911 6918 6920 6930 6931 6936 6949 6972 6994 6995 6997 7001
7002 7004 7005 7007 7011 7013 7015 7017 7019 7048 7050 7054 7055 7065 7069
7086 7095 7105 7107 7122 7129 7159 7162 7174 7177 7179 7185 7187 7190 7197
7204 7246 7258 7259 7270 7271 7274 7275 7283 7288 7302 7306 7315 7330 7343
7367 7419 7434 7444 7472 7484 7497 7507 7511 7520 7521 7526 7531 7538 7543
7554 7567 7568 7571 7574 7591 7595 7596 7607 7613 7630 7632 7633 7669 7671
7676 7686 7691 7694 7699 7709 7712 7717 7723 7728 7737 7740 7742 7749 7756
7759 7767 7769 7771 7774 7779 7806 7841 7846 7849 7850 7865 7871 7874 7880
7891 7900 7910 7928 7939 7945 7952 7954 7962 7964 7973 8005 8018 8022 8025

```
 8026 8030 8031 8033 8034 8035 8036 8037 8038 8039 8040 8041 8042 8043 8044
 8045 8046 8047 8048 8049 8052 8054 8057 8058 8060 8061 8072 8074 8083 8085
 8088 8093 8096 8098 8100 8101 8106 8111 8112 8124 8126 8129 8131 8133 8134
 8136 8137 8140 8141 8143 8144 8145 8148 8149 8150 8151 8152 8153 8154 8156
 8159 8160 8161 8162 8164 8166 8167 8171 8172 8173 8174 8176 8179 8181 8184
 8189 8191 8194 8196 8203 8208 8209 8211 8214 8223 8227 8236 8238 8246 8252
 8253 8254 8257 8258 8259 8260 8261 8263 8265 8266 8267 8268 8269 8277 8281
 8282 8287 8288 8302 8306 8309 8315 8317 8326 8330 8334 8342 8343 8346 8348
 8350 8362 8370 8375 8383 8385 8387 8392 8397 8400 8404 8407 8408 8410 8411
 8412 8413 8421 8429 8458 8459 8461 8463 8469 8477 8478 8488 8494 8509 8512
 8513 8534 8543 8552 8555 8561 8570 8576 8588 8608 8623 8629 8635 8639 8650
 8655 8662 8677 8690 8712 8716 8720 8723 8731 8733 8738 8740 8742 8743 8744
 8751 8781 8789 8792 8796 8812 8813 8823 8829 8831 8836 8848 8854 8857 8860
 8861 8871 8874 8880 8881 8893 8950 8952 8955 8959 8961 8964 8965 8967 8968
 8971 8978 8991 8998 9017 9018 9020 9022 9024 9028 9033 9034 9035 9039 9072
 9077 9088 9092 9096 9099 9132 9145 9147 9149 9155 9157 9162 9166 9168 9169
 9175 9176 9180 9197 9202 9212 9222 9237 9246 9250 9251 9269 9274 9278 9305
 9309 9310 9313 9315 9326 9332 9333 9338 9345 9346 9351 9354 9367 9368 9371
 9372 9389 9393 9405 9409 9411 9422 9428 9435 9437 9438 9441 9446 9448 9453
 9463 9465 9468 9475 9479 9482 9486 9487 9490 9502 9510 9514 9525 9530 9536
 9537 9541 9559 9561 9572 9573 9586 9587 9589 9598 9601 9605 9608 9609 9618
 9622 9625 9630 9633 9634 9636 9640 9643 9646 9650 9651 9653 9663 9666 9667
 9669 9673 9674 9688 9691 9693 9701 9703 9710 9725 9743 9745 9746 9755 9759
 9766 9771 9778 9782 9785 9788 9793 9796 9800 9801 9805 9811 9816 9818 9830
 9844 9889 9891 9894 9906 9941 9944 9959 9967 9969 9994 9995 9996 9997 9999
10000 10001 10004 10006 10009 10011 10015 10016 10020 10021 10023 10024
10026 10028 10031 10032 10037 10041 10043 10045 10047 10050 10053 10054
10057 10059 10061 10065 10078 10082 10099 10115 10119 10121 10124 10138
10139 10143 10144 10145 10148 10149 10152 10153 10154 10155 10158 10160
10163 10166 10168 10169 10191 10206 10207 10216 10218 10227 10228 10234
10240 10243 10246 10248 10252 10253 10269 10273 10278 10280 10288 10294
10295 10302 10304 10311 10322 10331 10354 10375 10379 10401 10412 10424
10427 10447 10473 10478 10479 10480 10482 10485 10487 10493 10517 10520
10533 10538 10539 10544 10548 10555 10558 10560 10561 10574 10575 10579
10643 10644 10664 10671 10673 10683 10685 10691 10699 10702 10704
```

```
fitMeasures(fit_els_time_config, c("rmsea", "chisq.scaled", "cfi", "tli", "df", "aic", "bi
```

```
    rmsea chisq.scaled          cfi          tli           df          aic
    0.028      582.689        0.996        0.993       23.000   482264.489
      bic
482622.006
```

```r
head(modindices(fit_els_time_config, sort. = TRUE, free.remove = FALSE))
```

```
    lhs op  rhs      mi    epc sepc.lv sepc.all sepc.nox
59   i1 ~~   i4 316.314  0.034   0.034    0.181    0.181
60   i1 ~~   i5 254.917 -0.030  -0.030   -0.151   -0.151
65   i2 ~~   i4 221.167 -0.028  -0.028   -0.129   -0.129
66   i2 ~~   i5 165.375  0.024   0.024    0.104    0.104
86 i1_2 ~~ i4_2 101.025  0.024   0.024    0.126    0.126
58   i1 ~~   i3  99.291 -0.054  -0.054   -0.229   -0.229
```

```r
s_els_time_config <- summary(fit_els_time_config, fit.measures = TRUE, standardized = TRUE
s_els_time_config
```

```
lavaan 0.6-19 ended normally after 53 iterations

  Estimator                                         ML
  Optimization method                           NLMINB
  Number of model parameters                        42

                                                  Used       Total
  Number of observations                         36765       39700
  Number of missing patterns                       123

Model Test User Model:
                                              Standard      Scaled
  Test Statistic                               702.923     582.689
  Degrees of freedom                                23          23
  P-value (Chi-square)                           0.000       0.000
  Scaling correction factor                                  1.206
    Yuan-Bentler correction (Mplus variant)

Model Test Baseline Model:

  Test statistic                            180643.665  128474.530
  Degrees of freedom                                45          45
  P-value                                        0.000       0.000
  Scaling correction factor                                  1.406

User Model versus Baseline Model:
```

```
  Comparative Fit Index (CFI)                    0.996       0.996
  Tucker-Lewis Index (TLI)                       0.993       0.991

  Robust Comparative Fit Index (CFI)                         0.995
  Robust Tucker-Lewis Index (TLI)                            0.991

Loglikelihood and Information Criteria:

  Loglikelihood user model (H0)            -241090.244 -241090.244
  Scaling correction factor                                  1.251
      for the MLR correction
  Loglikelihood unrestricted model (H1)    -240738.783 -240738.783
  Scaling correction factor                                  1.235
      for the MLR correction

  Akaike (AIC)                              482264.489  482264.489
  Bayesian (BIC)                            482622.006  482622.006
  Sample-size adjusted Bayesian (SABIC)     482488.530  482488.530

Root Mean Square Error of Approximation:

  RMSEA                                          0.028       0.026
  90 Percent confidence interval - lower         0.027       0.024
  90 Percent confidence interval - upper         0.030       0.027
  P-value H_0: RMSEA <= 0.050                    1.000       1.000
  P-value H_0: RMSEA >= 0.080                    0.000       0.000

  Robust RMSEA                                               0.038
  90 Percent confidence interval - lower                     0.035
  90 Percent confidence interval - upper                     0.042
  P-value H_0: Robust RMSEA <= 0.050                         1.000
  P-value H_0: Robust RMSEA >= 0.080                         0.000

Standardized Root Mean Square Residual:

  SRMR                                           0.017       0.017

Parameter Estimates:

  Standard errors                             Sandwich
  Information bread                           Observed
  Observed information based on                Hessian
```

```
Latent Variables:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  math_T1 =~
    i1      (l1_1)    0.705    0.004  175.331    0.000    0.705    0.827
    i2      (l2_1)    0.690    0.004  156.505    0.000    0.690    0.784
    i3      (l3_1)    0.753    0.005  151.288    0.000    0.753    0.836
    i4      (l4_1)    0.736    0.004  177.450    0.000    0.736    0.880
    i5      (l5_1)    0.716    0.004  170.519    0.000    0.716    0.864
  math_T2 =~
    i1_2    (l1_2)    0.734    0.004  186.665    0.000    0.734    0.864
    i2_2    (l2_2)    0.677    0.005  147.693    0.000    0.677    0.757
    i3_2    (l3_2)    0.687    0.006  123.523    0.000    0.687    0.766
    i4_2    (l4_2)    0.672    0.004  160.713    0.000    0.672    0.833
    i5_2    (l5_2)    0.698    0.004  166.132    0.000    0.698    0.837

Regressions:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  math_T2 ~
    math_T2           0.000                              0.000    0.000

Covariances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  math_T1 ~~
   .math_T2           0.468    0.006   72.226    0.000    0.468    0.468
 .i1 ~~
   .i1_2              0.009    0.002    5.200    0.000    0.009    0.046
 .i2 ~~
   .i2_2              0.029    0.002   12.808    0.000    0.029    0.091
 .i3 ~~
   .i3_2              0.008    0.004    2.109    0.035    0.008    0.027
 .i4 ~~
   .i4_2              0.005    0.002    2.623    0.009    0.005    0.027
 .i5 ~~
   .i5_2              0.012    0.002    6.787    0.000    0.012    0.066
 .i1 ~~
   .i2                0.061    0.003   18.838    0.000    0.061    0.232
 .i1_2 ~~
   .i2_2              0.014    0.003    4.825    0.000    0.014    0.056
 .i2 ~~
   .i3                0.061    0.004   14.734    0.000    0.061    0.224
 .i2_2 ~~
   .i3_2              0.126    0.005   25.265    0.000    0.126    0.374
 .i4 ~~
```

```
   .i5                0.010    0.003    3.146    0.002    0.010    0.061
 .i4_2 ~~
   .i5_2              0.004    0.003    1.330    0.183    0.004    0.019

Intercepts:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
    math_T1           0.000                               0.000    0.000
   .i1                2.810    0.005  583.839    0.000    2.810    3.298
   .i2                2.583    0.005  519.127    0.000    2.583    2.936
   .i3                2.692    0.007  406.808    0.000    2.692    2.991
   .i4                2.900    0.005  609.303    0.000    2.900    3.467
   .i5                2.855    0.005  605.066    0.000    2.855    3.445
   .i1_2              2.692    0.005  558.378    0.000    2.692    3.170
   .i2_2              2.477    0.005  488.822    0.000    2.477    2.770
   .i3_2              2.536    0.007  376.505    0.000    2.536    2.829
   .i4_2              2.885    0.005  626.232    0.000    2.885    3.575
   .i5_2              2.805    0.005  590.890    0.000    2.805    3.364

Variances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
    math_T1           1.000                               1.000    1.000
   .math_T2           1.000                               1.000    1.000
   .i1                0.229    0.004   60.011    0.000    0.229    0.315
   .i2                0.298    0.004   70.173    0.000    0.298    0.385
   .i3                0.244    0.006   40.082    0.000    0.244    0.301
   .i4                0.158    0.004   40.008    0.000    0.158    0.225
   .i5                0.174    0.004   45.065    0.000    0.174    0.253
   .i1_2              0.183    0.004   50.236    0.000    0.183    0.254
   .i2_2              0.342    0.005   74.011    0.000    0.342    0.428
   .i3_2              0.332    0.006   55.326    0.000    0.332    0.413
   .i4_2              0.199    0.004   55.527    0.000    0.199    0.306
   .i5_2              0.208    0.004   54.818    0.000    0.208    0.300
```

ELS Time Metric

```
els_time_metric <- '
  math_T1 =~  l1*NA * i1 +
              l2*1    * i2 +
              l3    * i3 +
              l4    * i4 +
              l5  * i5
```

```
# Free both mean and variance
math_T1 ~~ var_els_1 * math_T1
math_T1 ~ mean_els_1 * 1

# Fix 2nd intercept to 0 (putnick bornstein 2016)
i2 ~ 0 * 1

# Time Point 2
math_T2 =~l1*NA * i1_2 +
          l2*1   * i2_2 +
          l3    * i3_2 +
          l4    * i4_2 +
          l5*NA  * i5_2


# Free both mean and variance
math_T2 ~~ var_els_2 * math_T2
math_T2 ~ mean_els_2 * 1

# Fix 2nd intercept to 0 (putnick bornstein 2016)
i2_2 ~ 0 * 1

# Correlations across time
math_T1 ~~ math_T2
i1 ~~ i1_2
i2 ~~ i2_2
i3 ~~ i3_2
i4 ~~ i4_2
i5 ~~ i5_2


#i1 = Teen confident can do excellent job on math tests
#i2 = Teen certain can understand math textbook
i1   ~~ i2
i1_2 ~~ i2_2

#i2 = Teen certain can understand math textbook
#i3 = Can understand difficult math class
i2   ~~ i3
i2_2 ~~ i3_2
```

```
  #i4 = Teen confident can do an excellent job on math assignments
  #i5 = Teen certain can master skills in math course
  i4   ~~ i5
  i4_2 ~~ i5_2

'
fit_els_time_metric  <- sem(els_time_metric, data = dat,
                            estimator = "MLR",
                            missing = "FIML", se = "robust.mlr")
```

```
Warning: lavaan->lav_data_full():
   some cases are empty and will be ignored: 24 33 38 44 47 50 56 65 66 67 77
   87 99 101 110 119 123 124 130 139 140 164 166 173 177 185 201 208 243 248
   269 272 276 295 358 378 380 385 422 427 439 492 498 500 521 524 525 526
   544 550 561 563 570 572 584 587 607 617 622 624 637 639 643 646 648 649
   659 673 685 690 715 723 730 785 790 791 792 793 794 795 808 810 811 814
   818 822 824 826 827 828 829 830 835 849 850 856 866 884 888 918 935 949
   955 956 963 969 971 977 990 1001 1002 1006 1007 1032 1036 1041 1043 1052
   1078 1079 1084 1099 1173 1175 1176 1190 1217 1220 1237 1239 1244 1247 1254
   1263 1269 1270 1276 1287 1297 1305 1322 1400 1433 1434 1436 1438 1442 1444
   1452 1458 1463 1465 1469 1472 1473 1474 1476 1478 1480 1481 1483 1486 1488
   1490 1493 1494 1499 1504 1507 1511 1522 1523 1529 1537 1541 1543 1553 1576
   1588 1591 1598 1601 1603 1604 1605 1610 1620 1624 1627 1631 1637 1638 1655
   1662 1667 1673 1678 1679 1683 1689 1690 1692 1694 1698 1701 1704 1707 1711
   1712 1721 1735 1737 1754 1758 1759 1764 1769 1770 1773 1774 1775 1777 1778
   1779 1780 1783 1790 1793 1799 1801 1804 1809 1819 1827 1835 1838 1879 1918
   1933 1941 1942 1944 1948 1953 1956 1962 1963 1964 1986 1992 1993 1998 1999
   2005 2017 2022 2026 2068 2077 2083 2086 2087 2101 2111 2114 2115 2140 2144
   2146 2150 2154 2156 2186 2221 2223 2249 2250 2252 2257 2261 2262 2268 2280
   2290 2295 2301 2303 2308 2309 2316 2320 2328 2339 2360 2368 2369 2376 2392
   2400 2403 2411 2412 2413 2415 2449 2458 2459 2460 2466 2472 2480 2489 2501
   2520 2527 2572 2607 2612 2625 2626 2630 2634 2643 2645 2648 2649 2651 2667
   2688 2695 2709 2712 2713 2726 2729 2732 2743 2752 2753 2757 2760 2761 2762
   2764 2765 2767 2769 2770 2776 2777 2783 2785 2787 2790 2800 2835 2841 2865
   2874 2877 2885 2887 2888 2889 2890 2895 2896 2898 2901 2903 2904 2906 2911
   2915 2917 2918 2923 2927 2932 2940 2944 2959 2968 2973 2978 2980 3010 3012
   3024 3029 3045 3056 3071 3079 3083 3092 3094 3103 3119 3126 3129 3135 3136
   3139 3142 3151 3173 3220 3221 3240 3261 3265 3290 3293 3299 3309 3317 3319
   3325 3331 3336 3348 3384 3393 3428 3435 3442 3451 3456 3460 3462 3464 3470
   3485 3488 3491 3492 3519 3553 3558 3566 3572 3573 3579 3581 3584 3585 3594
   3600 3601 3610 3641 3654 3668 3676 3682 3683 3685 3687 3690 3694 3699 3700
```

3713 3717 3726 3760 3761 3763 3780 3781 3794 3806 3815 3820 3824 3832 3846
3852 3878 3908 3909 3945 3955 3964 3965 3974 3983 3984 3992 3997 4029 4036
4048 4061 4066 4067 4071 4076 4077 4079 4080 4092 4093 4094 4096 4102 4104
4105 4111 4115 4120 4160 4163 4164 4170 4178 4179 4180 4183 4185 4186 4189
4190 4192 4193 4196 4197 4202 4203 4209 4210 4212 4217 4224 4225 4226 4232
4240 4254 4264 4268 4274 4276 4279 4280 4283 4284 4286 4290 4291 4292 4297
4298 4301 4303 4307 4308 4309 4312 4314 4315 4317 4318 4319 4322 4323 4325
4339 4340 4347 4348 4354 4362 4369 4387 4393 4402 4404 4405 4450 4472 4489
4491 4500 4510 4518 4522 4523 4526 4535 4546 4547 4582 4583 4589 4590 4594
4622 4623 4624 4628 4631 4632 4633 4635 4637 4638 4640 4643 4644 4645 4648
4651 4657 4662 4665 4666 4672 4673 4678 4692 4698 4702 4705 4714 4715 4718
4724 4725 4726 4732 4737 4738 4742 4746 4749 4758 4759 4765 4768 4787 4790
4797 4798 4799 4802 4803 4805 4809 4810 4814 4816 4825 4842 4843 4849 4850
4856 4857 4858 4859 4863 4883 4897 4935 4936 4943 4945 4946 4952 4953 4967
4971 5019 5021 5025 5027 5040 5074 5083 5097 5100 5110 5113 5145 5150 5155
5157 5159 5165 5169 5185 5188 5228 5231 5247 5251 5264 5278 5281 5284 5286
5304 5308 5310 5311 5329 5351 5357 5391 5393 5410 5428 5429 5430 5439 5466
5490 5491 5500 5505 5510 5528 5533 5542 5561 5565 5567 5568 5581 5593 5610
5611 5617 5621 5625 5626 5628 5630 5637 5639 5640 5677 5701 5741 5746 5747
5772 5776 5777 5779 5781 5788 5790 5798 5804 5818 5824 5830 5833 5836 5844
5847 5867 5882 5888 5926 5940 5949 5950 5953 5954 5956 5960 5973 5993 6050
6056 6059 6072 6073 6075 6083 6087 6094 6100 6101 6109 6115 6124 6127 6128
6148 6149 6153 6158 6161 6162 6167 6172 6173 6206 6211 6212 6223 6227 6238
6253 6258 6259 6264 6266 6283 6284 6288 6290 6291 6308 6309 6324 6326 6354
6358 6362 6372 6376 6393 6402 6403 6407 6408 6410 6412 6413 6414 6417 6423
6426 6441 6449 6461 6464 6476 6491 6503 6517 6526 6545 6546 6554 6557 6561
6580 6585 6592 6594 6600 6602 6605 6623 6631 6643 6644 6645 6646 6648 6650
6653 6654 6656 6658 6659 6661 6662 6679 6683 6687 6690 6691 6692 6693 6694
6698 6700 6703 6705 6714 6727 6731 6743 6764 6773 6775 6777 6778 6780 6781
6785 6786 6787 6788 6789 6793 6805 6816 6819 6822 6840 6863 6885 6886 6900
6902 6905 6908 6911 6918 6920 6930 6931 6936 6949 6972 6994 6995 6997 7001
7002 7004 7005 7007 7011 7013 7015 7017 7019 7048 7050 7054 7055 7065 7069
7086 7095 7105 7107 7122 7129 7159 7162 7174 7177 7179 7185 7187 7190 7197
7204 7246 7258 7259 7270 7271 7274 7275 7283 7288 7302 7306 7315 7330 7343
7367 7419 7434 7444 7472 7484 7497 7507 7511 7520 7521 7526 7531 7538 7543
7554 7567 7568 7571 7574 7591 7595 7596 7607 7613 7630 7632 7633 7669 7671
7676 7686 7691 7694 7699 7709 7712 7717 7723 7728 7737 7740 7742 7749 7756
7759 7767 7769 7771 7774 7779 7806 7841 7846 7849 7850 7865 7871 7874 7880
7891 7900 7910 7928 7939 7945 7952 7954 7962 7964 7973 8005 8018 8022 8025
8026 8030 8031 8033 8034 8035 8036 8037 8038 8039 8040 8041 8042 8043 8044
8045 8046 8047 8048 8049 8052 8054 8057 8058 8060 8061 8072 8074 8083 8085
8088 8093 8096 8098 8100 8101 8106 8111 8112 8124 8126 8129 8131 8133 8134
8136 8137 8140 8141 8143 8144 8145 8148 8149 8150 8151 8152 8153 8154 8156

```
 8159 8160 8161 8162 8164 8166 8167 8171 8172 8173 8174 8176 8179 8181 8184
 8189 8191 8194 8196 8203 8208 8209 8211 8214 8223 8227 8236 8238 8246 8252
 8253 8254 8257 8258 8259 8260 8261 8263 8265 8266 8267 8268 8269 8277 8281
 8282 8287 8288 8302 8306 8309 8315 8317 8326 8330 8334 8342 8343 8346 8348
 8350 8362 8370 8375 8383 8385 8387 8392 8397 8400 8404 8407 8408 8410 8411
 8412 8413 8421 8429 8458 8459 8461 8463 8469 8477 8478 8488 8494 8509 8512
 8513 8534 8543 8552 8555 8561 8570 8576 8588 8608 8623 8629 8635 8639 8650
 8655 8662 8677 8690 8712 8716 8720 8723 8731 8733 8738 8740 8742 8743 8744
 8751 8781 8789 8792 8796 8812 8813 8823 8829 8831 8836 8848 8854 8857 8860
 8861 8871 8874 8880 8881 8893 8950 8952 8955 8959 8961 8964 8965 8967 8968
 8971 8978 8991 8998 9017 9018 9020 9022 9024 9028 9033 9034 9035 9039 9072
 9077 9088 9092 9096 9099 9132 9145 9147 9149 9155 9157 9162 9166 9168 9169
 9175 9176 9180 9197 9202 9212 9222 9237 9246 9250 9251 9269 9274 9278 9305
 9309 9310 9313 9315 9326 9332 9333 9338 9345 9346 9351 9354 9367 9368 9371
 9372 9389 9393 9405 9409 9411 9422 9428 9435 9437 9438 9441 9446 9448 9453
 9463 9465 9468 9475 9479 9482 9486 9487 9490 9502 9510 9514 9525 9530 9536
 9537 9541 9559 9561 9572 9573 9586 9587 9589 9598 9601 9605 9608 9609 9618
 9622 9625 9630 9633 9634 9636 9640 9643 9646 9650 9651 9653 9663 9666 9667
 9669 9673 9674 9688 9691 9693 9701 9703 9710 9725 9743 9745 9746 9755 9759
 9766 9771 9778 9782 9785 9788 9793 9796 9800 9801 9805 9811 9816 9818 9830
 9844 9889 9891 9894 9906 9941 9944 9959 9967 9969 9994 9995 9996 9997 9999
 10000 10001 10004 10006 10009 10011 10015 10016 10020 10021 10023 10024
 10026 10028 10031 10032 10037 10041 10043 10045 10047 10050 10053 10054
 10057 10059 10061 10065 10078 10082 10099 10115 10119 10121 10124 10138
 10139 10143 10144 10145 10148 10149 10152 10153 10154 10155 10158 10160
 10163 10166 10168 10169 10191 10206 10207 10216 10218 10227 10228 10234
 10240 10243 10246 10248 10252 10253 10269 10273 10278 10280 10288 10294
 10295 10302 10304 10311 10322 10331 10354 10375 10379 10401 10412 10424
 10427 10447 10473 10478 10479 10480 10482 10485 10487 10493 10517 10520
 10533 10538 10539 10544 10548 10555 10558 10560 10561 10574 10575 10579
 10643 10644 10664 10671 10673 10683 10685 10691 10699 10702 10704
```

```
fitMeasures(fit_els_time_metric, c("rmsea", "chisq.scaled", "cfi", "tli", "df", "aic", "bi
```

```
    rmsea chisq.scaled          cfi          tli           df          aic
    0.031      830.399        0.995        0.991       27.000   482523.661
      bic
482847.128
```

```r
#head(modindices(fit_els_time_metric, sort. = TRUE, free.remove = FALSE))

s_hsls_time_metric <- summary(fit_els_time_metric, fit.measures = TRUE, standardized = TRU
s_hsls_time_metric
```

```
lavaan 0.6-19 ended normally after 73 iterations

  Estimator                                         ML
  Optimization method                           NLMINB
  Number of model parameters                        42
  Number of equality constraints                     4

                                                  Used       Total
  Number of observations                         36765       39700
  Number of missing patterns                       123

Model Test User Model:
                                              Standard      Scaled
  Test Statistic                               970.095     830.399
  Degrees of freedom                                27          27
  P-value (Chi-square)                           0.000       0.000
  Scaling correction factor                                  1.168
    Yuan-Bentler correction (Mplus variant)

Model Test Baseline Model:

  Test statistic                            180643.665  128474.530
  Degrees of freedom                                45          45
  P-value                                        0.000       0.000
  Scaling correction factor                                  1.406

User Model versus Baseline Model:

  Comparative Fit Index (CFI)                    0.995       0.994
  Tucker-Lewis Index (TLI)                       0.991       0.990

  Robust Comparative Fit Index (CFI)                         0.994
  Robust Tucker-Lewis Index (TLI)                            0.990

Loglikelihood and Information Criteria:

  Loglikelihood user model (H0)            -241223.831 -241223.831
```

```
  Scaling correction factor                                  1.160
      for the MLR correction
  Loglikelihood unrestricted model (H1)    -240738.783 -240738.783
  Scaling correction factor                                  1.235
      for the MLR correction

  Akaike (AIC)                              482523.661  482523.661
  Bayesian (BIC)                            482847.128  482847.128
  Sample-size adjusted Bayesian (SABIC)     482726.364  482726.364

Root Mean Square Error of Approximation:

  RMSEA                                          0.031       0.028
  90 Percent confidence interval - lower         0.029       0.027
  90 Percent confidence interval - upper         0.033       0.030
  P-value H_0: RMSEA <= 0.050                    1.000       1.000
  P-value H_0: RMSEA >= 0.080                    0.000       0.000

  Robust RMSEA                                               0.041
  90 Percent confidence interval - lower                     0.039
  90 Percent confidence interval - upper                     0.044
  P-value H_0: Robust RMSEA <= 0.050                         1.000
  P-value H_0: Robust RMSEA >= 0.080                         0.000

Standardized Root Mean Square Residual:

  SRMR                                           0.022       0.022

Parameter Estimates:

  Standard errors                             Sandwich
  Information bread                           Observed
  Observed information based on                Hessian

Latent Variables:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  math_T1 =~
    i1        (l1)    1.048    0.004  236.347    0.000    0.729    0.841
    i2        (l2)    1.000                              0.695    0.790
    i3        (l3)    1.056    0.006  188.982    0.000    0.735    0.829
    i4        (l4)    1.030    0.006  166.979    0.000    0.716    0.868
    i5        (l5)    1.030    0.006  173.643    0.000    0.717    0.861
  math_T2 =~
```

```
    i1_2      (l1)    1.048    0.004  236.347    0.000    0.708    0.847
    i2_2      (l2)    1.000                              0.676    0.753
    i3_2      (l3)    1.056    0.006  188.982    0.000    0.714    0.778
    i4_2      (l4)    1.030    0.006  166.979    0.000    0.696    0.850
    i5_2      (l5)    1.030    0.006  173.643    0.000    0.696    0.841

Covariances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  math_T1 ~~
    math_T2           0.220    0.004   53.106    0.000    0.469    0.469
 .i1 ~~
   .i1_2              0.010    0.002    5.290    0.000    0.010    0.046
 .i2 ~~
   .i2_2              0.029    0.002   12.831    0.000    0.029    0.092
 .i3 ~~
   .i3_2              0.008    0.004    2.209    0.027    0.008    0.029
 .i4 ~~
   .i4_2              0.004    0.002    2.483    0.013    0.004    0.025
 .i5 ~~
   .i5_2              0.012    0.002    6.610    0.000    0.012    0.064
 .i1 ~~
   .i2                0.053    0.003   17.773    0.000    0.053    0.210
 .i1_2 ~~
   .i2_2              0.023    0.003    8.946    0.000    0.023    0.088
 .i2 ~~
   .i3                0.057    0.004   14.188    0.000    0.057    0.213
 .i2_2 ~~
   .i3_2              0.130    0.005   26.850    0.000    0.130    0.381
 .i4 ~~
   .i5                0.018    0.003    6.301    0.000    0.018    0.105
 .i4_2 ~~
   .i5_2             -0.006    0.003   -2.366    0.018   -0.006   -0.032

Intercepts:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
    math_T1 (m__1)    2.583    0.005  519.008    0.000    3.714    3.714
   .i2                0.000                              0.000    0.000
    math_T2 (m__2)    2.477    0.005  488.546    0.000    3.667    3.667
   .i2_2              0.000                              0.000    0.000
   .i1                0.103    0.012    8.548    0.000    0.103    0.119
   .i3               -0.042    0.015   -2.862    0.004   -0.042   -0.047
   .i4                0.239    0.017   14.351    0.000    0.239    0.289
   .i5                0.194    0.016   12.017    0.000    0.194    0.233
```

```
   .i1_2              0.096    0.012    8.248    0.000    0.096    0.115
   .i3_2             -0.082    0.015   -5.580    0.000   -0.082   -0.089
   .i4_2              0.332    0.016   20.673    0.000    0.332    0.405
   .i5_2              0.253    0.015   16.300    0.000    0.253    0.305

Variances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
    math_T1 (v__1)    0.484    0.005   91.095    0.000    1.000    1.000
    math_T2 (v__2)    0.456    0.005   86.998    0.000    1.000    1.000
   .i1                0.220    0.004   61.727    0.000    0.220    0.293
   .i2                0.291    0.004   74.025    0.000    0.291    0.376
   .i3                0.245    0.006   41.576    0.000    0.245    0.312
   .i4                0.168    0.004   47.450    0.000    0.168    0.247
   .i5                0.179    0.003   51.265    0.000    0.179    0.259
   .i1_2              0.197    0.003   60.588    0.000    0.197    0.282
   .i2_2              0.349    0.004   83.319    0.000    0.349    0.433
   .i3_2              0.331    0.006   55.870    0.000    0.331    0.394
   .i4_2              0.187    0.003   57.062    0.000    0.187    0.278
   .i5_2              0.201    0.003   59.447    0.000    0.201    0.293
```

```
#s_both_weak_comb
```

ELS Time Scalar

```
els_time_scalar <- '
  math_T1 =~  l1*NA * i1 +
              l2*1    * i2 +
              l3    * i3 +
              l4    * i4 +
              l5    * i5


  # Free both mean and variance
  math_T1 ~~ var_els_1 * math_T1
  math_T1 ~ mean_els_1 * 1

  # Fix 2nd intercept to 0 (putnick bornstein 2016)
  i1 ~ int1*1
  i2 ~    0*1
  i3 ~ int3*1
```

```
i4 ~ int4*1
i5 ~ int5*1

# Time Point 2
math_T2 =~l1*NA * i1_2 +
          l2*1    * i2_2 +
          l3    * i3_2 +
          l4    * i4_2 +
          l5  * i5_2


# Free both mean and variance
math_T2 ~~ var_els_2 * math_T2
math_T2 ~ mean_els_2 * 1

# Fix fifth intercept to 0 (putnick bornstein 2016)
i1_2 ~ int1*1
i2_2 ~    0*1
i3_2 ~ int3*1
i4_2 ~ int4*1
i5_2 ~ int5*1

# Correlations across time
math_T1 ~~ math_T2
i1 ~~ i1_2
i2 ~~ i2_2
i3 ~~ i3_2
i4 ~~ i4_2
i5 ~~ i5_2


#i1 = Teen confident can do excellent job on math tests
#i2 = Teen certain can understand math textbook
i1   ~~ i2
i1_2 ~~ i2_2

#i2 = Teen certain can understand math textbook
#i3 = Can understand difficult math class
i2   ~~ i3
i2_2 ~~ i3_2
```

```
  #i4 = Teen confident can do an excellent job on math assignments
  #i5 = Teen certain can master skills in math course
  i4   ~~ i5
  i4_2 ~~ i5_2
  '



fit_els_time_scalar  <- sem(els_time_scalar, data = dat,
                            estimator = "MLR",
                            missing = "FIML", se = "robust.mlr")
```

```
Warning: lavaan->lav_data_full():
   some cases are empty and will be ignored: 24 33 38 44 47 50 56 65 66 67 77
   87 99 101 110 119 123 124 130 139 140 164 166 173 177 185 201 208 243 248
   269 272 276 295 358 378 380 385 422 427 439 492 498 500 521 524 525 526
   544 550 561 563 570 572 584 587 607 617 622 624 637 639 643 646 648 649
   659 673 685 690 715 723 730 785 790 791 792 793 794 795 808 810 811 814
   818 822 824 826 827 828 829 830 835 849 850 856 866 884 888 918 935 949
   955 956 963 969 971 977 990 1001 1002 1006 1007 1032 1036 1041 1043 1052
   1078 1079 1084 1099 1173 1175 1176 1190 1217 1220 1237 1239 1244 1247 1254
   1263 1269 1270 1276 1287 1297 1305 1322 1400 1433 1434 1436 1438 1442 1444
   1452 1458 1463 1465 1469 1472 1473 1474 1476 1478 1480 1481 1483 1486 1488
   1490 1493 1494 1499 1504 1507 1511 1522 1523 1529 1537 1541 1543 1553 1576
   1588 1591 1598 1601 1603 1604 1605 1610 1620 1624 1627 1631 1637 1638 1655
   1662 1667 1673 1678 1679 1683 1689 1690 1692 1694 1698 1701 1704 1707 1711
   1712 1721 1735 1737 1754 1758 1759 1764 1769 1770 1773 1774 1775 1777 1778
   1779 1780 1783 1790 1793 1799 1801 1804 1809 1819 1827 1835 1838 1879 1918
   1933 1941 1942 1944 1948 1953 1956 1962 1963 1964 1986 1992 1993 1998 1999
   2005 2017 2022 2026 2068 2077 2083 2086 2087 2101 2111 2114 2115 2140 2144
   2146 2150 2154 2156 2186 2221 2223 2249 2250 2252 2257 2261 2262 2268 2280
   2290 2295 2301 2303 2308 2309 2316 2320 2328 2339 2360 2368 2369 2376 2392
   2400 2403 2411 2412 2413 2415 2449 2458 2459 2460 2466 2472 2480 2489 2501
   2520 2527 2572 2607 2612 2625 2626 2630 2634 2643 2645 2648 2649 2651 2667
   2688 2695 2709 2712 2713 2726 2729 2732 2743 2752 2753 2757 2760 2761 2762
   2764 2765 2767 2769 2770 2776 2777 2783 2785 2787 2790 2800 2835 2841 2865
   2874 2877 2885 2887 2888 2889 2890 2895 2896 2898 2901 2903 2904 2906 2911
   2915 2917 2918 2923 2927 2932 2940 2944 2959 2968 2973 2978 2980 3010 3012
   3024 3029 3045 3056 3071 3079 3083 3092 3094 3103 3119 3126 3129 3135 3136
   3139 3142 3151 3173 3220 3221 3240 3261 3265 3290 3293 3299 3309 3317 3319
   3325 3331 3336 3348 3384 3393 3428 3435 3442 3451 3456 3460 3462 3464 3470
   3485 3488 3491 3492 3519 3553 3558 3566 3572 3573 3579 3581 3584 3585 3594
```

3600 3601 3610 3641 3654 3668 3676 3682 3683 3685 3687 3690 3694 3699 3700
3713 3717 3726 3760 3761 3763 3780 3781 3794 3806 3815 3820 3824 3832 3846
3852 3878 3908 3909 3945 3955 3964 3965 3974 3983 3984 3992 3997 4029 4036
4048 4061 4066 4067 4071 4076 4077 4079 4080 4092 4093 4094 4096 4102 4104
4105 4111 4115 4120 4160 4163 4164 4170 4178 4179 4180 4183 4185 4186 4189
4190 4192 4193 4196 4197 4202 4203 4209 4210 4212 4217 4224 4225 4226 4232
4240 4254 4264 4268 4274 4276 4279 4280 4283 4284 4286 4290 4291 4292 4297
4298 4301 4303 4307 4308 4309 4312 4314 4315 4317 4318 4319 4322 4323 4325
4339 4340 4347 4348 4354 4362 4369 4387 4393 4402 4404 4405 4450 4472 4489
4491 4500 4510 4518 4522 4523 4526 4535 4546 4547 4582 4583 4589 4590 4594
4622 4623 4624 4628 4631 4632 4633 4635 4637 4638 4640 4643 4644 4645 4648
4651 4657 4662 4665 4666 4672 4673 4678 4692 4698 4702 4705 4714 4715 4718
4724 4725 4726 4732 4737 4738 4742 4746 4749 4758 4759 4765 4768 4787 4790
4797 4798 4799 4802 4803 4805 4809 4810 4814 4816 4825 4842 4843 4849 4850
4856 4857 4858 4859 4863 4883 4897 4935 4936 4943 4945 4946 4952 4953 4967
4971 5019 5021 5025 5027 5040 5074 5083 5097 5100 5110 5113 5145 5150 5155
5157 5159 5165 5169 5185 5188 5228 5231 5247 5251 5264 5278 5281 5284 5286
5304 5308 5310 5311 5329 5351 5357 5391 5393 5410 5428 5429 5430 5439 5466
5490 5491 5500 5505 5510 5528 5533 5542 5561 5565 5567 5568 5581 5593 5610
5611 5617 5621 5625 5626 5628 5630 5637 5639 5640 5677 5701 5741 5746 5747
5772 5776 5777 5779 5781 5788 5790 5798 5804 5818 5824 5830 5833 5836 5844
5847 5867 5882 5888 5926 5940 5949 5950 5953 5954 5956 5960 5973 5993 6050
6056 6059 6072 6073 6075 6083 6087 6094 6100 6101 6109 6115 6124 6127 6128
6148 6149 6153 6158 6161 6162 6167 6172 6173 6206 6211 6212 6223 6227 6238
6253 6258 6259 6264 6266 6283 6284 6288 6290 6291 6308 6309 6324 6326 6354
6358 6362 6372 6376 6393 6402 6403 6407 6408 6410 6412 6413 6414 6417 6423
6426 6441 6449 6461 6464 6476 6491 6503 6517 6526 6545 6546 6554 6557 6561
6580 6585 6592 6594 6600 6602 6605 6623 6631 6643 6644 6645 6646 6648 6650
6653 6654 6656 6658 6659 6661 6662 6679 6683 6687 6690 6691 6692 6693 6694
6698 6700 6703 6705 6714 6727 6731 6743 6764 6773 6775 6777 6778 6780 6781
6785 6786 6787 6788 6789 6793 6805 6816 6819 6822 6840 6863 6885 6886 6900
6902 6905 6908 6911 6918 6920 6930 6931 6936 6949 6972 6994 6995 6997 7001
7002 7004 7005 7007 7011 7013 7015 7017 7019 7048 7050 7054 7055 7065 7069
7086 7095 7105 7107 7122 7129 7159 7162 7174 7177 7179 7185 7187 7190 7197
7204 7246 7258 7259 7270 7271 7274 7275 7283 7288 7302 7306 7315 7330 7343
7367 7419 7434 7444 7472 7484 7497 7507 7511 7520 7521 7526 7531 7538 7543
7554 7567 7568 7571 7574 7591 7595 7596 7607 7613 7630 7632 7633 7669 7671
7676 7686 7691 7694 7699 7709 7712 7717 7723 7728 7737 7740 7742 7749 7756
7759 7767 7769 7771 7774 7779 7806 7841 7846 7849 7850 7865 7871 7874 7880
7891 7900 7910 7928 7939 7945 7952 7954 7962 7964 7973 8005 8018 8022 8025
8026 8030 8031 8033 8034 8035 8036 8037 8038 8039 8040 8041 8042 8043 8044
8045 8046 8047 8048 8049 8052 8054 8057 8058 8060 8061 8072 8074 8083 8085
8088 8093 8096 8098 8100 8101 8106 8111 8112 8124 8126 8129 8131 8133 8134

```
 8136 8137 8140 8141 8143 8144 8145 8148 8149 8150 8151 8152 8153 8154 8156
 8159 8160 8161 8162 8164 8166 8167 8171 8172 8173 8174 8176 8179 8181 8184
 8189 8191 8194 8196 8203 8208 8209 8211 8214 8223 8227 8236 8238 8246 8252
 8253 8254 8257 8258 8259 8260 8261 8263 8265 8266 8267 8268 8269 8277 8281
 8282 8287 8288 8302 8306 8309 8315 8317 8326 8330 8334 8342 8343 8346 8348
 8350 8362 8370 8375 8383 8385 8387 8392 8397 8400 8404 8407 8408 8410 8411
 8412 8413 8421 8429 8458 8459 8461 8463 8469 8477 8478 8488 8494 8509 8512
 8513 8534 8543 8552 8555 8561 8570 8576 8588 8608 8623 8629 8635 8639 8650
 8655 8662 8677 8690 8712 8716 8720 8723 8731 8733 8738 8740 8742 8743 8744
 8751 8781 8789 8792 8796 8812 8813 8823 8829 8831 8836 8848 8854 8857 8860
 8861 8871 8874 8880 8881 8893 8950 8952 8955 8959 8961 8964 8965 8967 8968
 8971 8978 8991 8998 9017 9018 9020 9022 9024 9028 9033 9034 9035 9039 9072
 9077 9088 9092 9096 9099 9132 9145 9147 9149 9155 9157 9162 9166 9168 9169
 9175 9176 9180 9197 9202 9212 9222 9237 9246 9250 9251 9269 9274 9278 9305
 9309 9310 9313 9315 9326 9332 9333 9338 9345 9346 9351 9354 9367 9368 9371
 9372 9389 9393 9405 9409 9411 9422 9428 9435 9437 9438 9441 9446 9448 9453
 9463 9465 9468 9475 9479 9482 9486 9487 9490 9502 9510 9514 9525 9530 9536
 9537 9541 9559 9561 9572 9573 9586 9587 9589 9598 9601 9605 9608 9609 9618
 9622 9625 9630 9633 9634 9636 9640 9643 9646 9650 9651 9653 9663 9666 9667
 9669 9673 9674 9688 9691 9693 9701 9703 9710 9725 9743 9745 9746 9755 9759
 9766 9771 9778 9782 9785 9788 9793 9796 9800 9801 9805 9811 9816 9818 9830
 9844 9889 9891 9894 9906 9941 9944 9959 9967 9969 9994 9995 9996 9997 9999
10000 10001 10004 10006 10009 10011 10015 10016 10020 10021 10023 10024
10026 10028 10031 10032 10037 10041 10043 10045 10047 10050 10053 10054
10057 10059 10061 10065 10078 10082 10099 10115 10119 10121 10124 10138
10139 10143 10144 10145 10148 10149 10152 10153 10154 10155 10158 10160
10163 10166 10168 10169 10191 10206 10207 10216 10218 10227 10228 10234
10240 10243 10246 10248 10252 10253 10269 10273 10278 10280 10288 10294
10295 10302 10304 10311 10322 10331 10354 10375 10379 10401 10412 10424
10427 10447 10473 10478 10479 10480 10482 10485 10487 10493 10517 10520
10533 10538 10539 10544 10548 10555 10558 10560 10561 10574 10575 10579
10643 10644 10664 10671 10673 10683 10685 10691 10699 10702 10704
```

```
#fit_hsls_time_scalar

fitMeasures(fit_els_time_scalar, c("rmsea", "chisq.scaled", "cfi", "tli", "df", "aic", "bi
```

```
    rmsea chisq.scaled          cfi          tli           df          aic
    0.036     1340.690        0.992        0.988       31.000   483084.247
      bic         srmr
483373.666        0.025
```

```r
#head(modindices(fit_els_time_scalar, sort. = TRUE, free.remove = FALSE))

s_els_time_scalar <- summary(fit_els_time_scalar, fit.measures = TRUE, standardized = TRUE
s_els_time_scalar
```

```
lavaan 0.6-19 ended normally after 59 iterations

  Estimator                                         ML
  Optimization method                           NLMINB
  Number of model parameters                        42
  Number of equality constraints                     8

                                                  Used       Total
  Number of observations                         36765       39700
  Number of missing patterns                       123

Model Test User Model:
                                              Standard      Scaled
  Test Statistic                              1538.681    1340.690
  Degrees of freedom                                31          31
  P-value (Chi-square)                           0.000       0.000
  Scaling correction factor                                  1.148
    Yuan-Bentler correction (Mplus variant)

Model Test Baseline Model:

  Test statistic                            180643.665  128474.530
  Degrees of freedom                                45          45
  P-value                                        0.000       0.000
  Scaling correction factor                                  1.406

User Model versus Baseline Model:

  Comparative Fit Index (CFI)                    0.992       0.990
  Tucker-Lewis Index (TLI)                       0.988       0.985

  Robust Comparative Fit Index (CFI)                         0.990
  Robust Tucker-Lewis Index (TLI)                            0.986

Loglikelihood and Information Criteria:

  Loglikelihood user model (H0)            -241508.124 -241508.124
```

```
  Scaling correction factor                                  1.064
      for the MLR correction
  Loglikelihood unrestricted model (H1)    -240738.783 -240738.783
  Scaling correction factor                                  1.235
      for the MLR correction

  Akaike (AIC)                              483084.247  483084.247
  Bayesian (BIC)                            483373.666  483373.666
  Sample-size adjusted Bayesian (SABIC)     483265.614  483265.614

Root Mean Square Error of Approximation:

  RMSEA                                          0.036       0.034
  90 Percent confidence interval - lower         0.035       0.032
  90 Percent confidence interval - upper         0.038       0.035
  P-value H_0: RMSEA <= 0.050                    1.000       1.000
  P-value H_0: RMSEA >= 0.080                    0.000       0.000

  Robust RMSEA                                               0.049
  90 Percent confidence interval - lower                     0.046
  90 Percent confidence interval - upper                     0.051
  P-value H_0: Robust RMSEA <= 0.050                         0.797
  P-value H_0: Robust RMSEA >= 0.080                         0.000

Standardized Root Mean Square Residual:

  SRMR                                           0.025       0.025

Parameter Estimates:

  Standard errors                             Sandwich
  Information bread                           Observed
  Observed information based on                Hessian

Latent Variables:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  math_T1 =~
    i1        (l1)    1.048    0.004  236.835    0.000    0.731    0.842
    i2        (l2)    1.000                              0.697    0.792
    i3        (l3)    1.051    0.006  188.909    0.000    0.733    0.828
    i4        (l4)    1.020    0.006  166.658    0.000    0.711    0.863
    i5        (l5)    1.022    0.006  173.473    0.000    0.713    0.858
  math_T2 =~
```

```
    i1_2      (l1)    1.048    0.004  236.835    0.000    0.712    0.850
    i2_2      (l2)    1.000                              0.679    0.756
    i3_2      (l3)    1.051    0.006  188.909    0.000    0.714    0.778
    i4_2      (l4)    1.020    0.006  166.658    0.000    0.693    0.845
    i5_2      (l5)    1.022    0.006  173.473    0.000    0.694    0.838

Covariances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  math_T1 ~~
    math_T2           0.223    0.004   53.896    0.000    0.472    0.472
 .i1 ~~
   .i1_2              0.008    0.002    4.637    0.000    0.008    0.041
 .i2 ~~
   .i2_2              0.029    0.002   12.783    0.000    0.029    0.092
 .i3 ~~
   .i3_2              0.007    0.004    1.846    0.065    0.007    0.024
 .i4 ~~
   .i4_2              0.004    0.002    2.046    0.041    0.004    0.020
 .i5 ~~
   .i5_2              0.012    0.002    6.722    0.000    0.012    0.064
 .i1 ~~
   .i2                0.052    0.003   17.213    0.000    0.052    0.206
 .i1_2 ~~
   .i2_2              0.020    0.003    7.806    0.000    0.020    0.078
 .i2 ~~
   .i3                0.056    0.004   13.888    0.000    0.056    0.210
 .i2_2 ~~
   .i3_2              0.130    0.005   26.662    0.000    0.130    0.381
 .i4 ~~
   .i5                0.022    0.003    7.620    0.000    0.022    0.123
 .i4_2 ~~
   .i5_2             -0.002    0.003   -0.808    0.419   -0.002   -0.011

Intercepts:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
    math_T1 (m__1)    2.565    0.005  538.662    0.000    3.678    3.678
   .i1      (int1)    0.097    0.012    8.440    0.000    0.097    0.112
   .i2                0.000                              0.000    0.000
   .i3      (int3)   -0.043    0.014   -3.110    0.002   -0.043   -0.049
   .i4      (int4)    0.311    0.016   19.427    0.000    0.311    0.378
   .i5      (int5)    0.244    0.015   15.779    0.000    0.244    0.294
    math_T2 (m__2)    2.497    0.005  534.059    0.000    3.676    3.676
   .i1_2    (int1)    0.097    0.012    8.440    0.000    0.097    0.116
```

```
   .i2_2              0.000                                  0.000    0.000
   .i3_2    (int3)   -0.043    0.014   -3.110    0.002   -0.043   -0.047
   .i4_2    (int4)    0.311    0.016   19.427    0.000    0.311    0.380
   .i5_2    (int5)    0.244    0.015   15.779    0.000    0.244    0.295

Variances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
    math_T1 (v__1)    0.486    0.005   91.636    0.000    1.000    1.000
    math_T2 (v__2)    0.461    0.005   87.683    0.000    1.000    1.000
   .i1                0.219    0.004   61.083    0.000    0.219    0.291
   .i2                0.290    0.004   73.182    0.000    0.290    0.373
   .i3                0.246    0.006   41.490    0.000    0.246    0.314
   .i4                0.173    0.004   49.054    0.000    0.173    0.255
   .i5                0.182    0.003   52.285    0.000    0.182    0.263
   .i1_2              0.194    0.003   59.319    0.000    0.194    0.277
   .i2_2              0.346    0.004   81.941    0.000    0.346    0.429
   .i3_2              0.333    0.006   55.573    0.000    0.333    0.395
   .i4_2              0.192    0.003   57.834    0.000    0.192    0.286
   .i5_2              0.205    0.003   60.084    0.000    0.205    0.298
```