# Supplementary Material Online, belonging to

# Jović, Agarwal, Whitehouse, and van den Berg. Harmonized phenotypes for anxiety, depression, and attention-deficit hyperactivity disorder (ADHD).

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## Top-down approach - scales

# Supplementary Table I Original anxiety/depression scale consisting only of the CBCL items

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Item | Discrimination parameter | Threshold parameterCategory 1 | Threshold parameter Category 2 | Chi-square | Degrees of Freedom | Corrected p-value |
| CBCL lonely | 1.31 | -2.24 | -6.35 | 35.26 | 22 | 1.00 |
| CBCL cries a lot | 1.23 | -2.57 | -6.21 | 24.18 | 23 | 1.00 |
| CBCL fears might do bad | 1.27 | -2.82 | -7.96 | 16.01 | 23 | 1.00 |
| CBCL fears has to be perfect | 0.92 | -1.28 | -4.01 | 41.31 | 38 | 1.00 |
| CBCL feels unloved | 1.19 | -1.70 | -5.53 | 25.82 | 26 | 1.00 |
| CBCL feels others out to get | 1.71 | -2.88 | -7.82 | 21.23 | 21 | 1.00 |
| CBCL feels worthless | 1.91 | -2.81 | -8.27 | 33.91 | 21 | 1.00 |
| CBCL loner | 1.07 | -2.18 | -5.72 | 16.54 | 23 | 1.00 |
| CBCL nervous or tense | 1.54 | -2.13 | -6.14 | 32.05 | 29 | 1.00 |
| CBCL too fearful or anxious | 1.84 | -2.94 | -7.93 | 14.06 | 21 | 1.00 |
| CBCL feels dizzy | 1.32 | -3.70 | -9.10 | 33.12 | 22 | 1.00 |
| CBCL feels too guilty | 1.99 | -4.32 | -10.68 | 26.52 | 22 | 1.00 |
| CBCL overtired | 1.29 | -2.17 | -6.19 | 15.56 | 21 | 1.00 |
| CBCL no cause aches/pains | 0.85 | -1.31 | -4.60 | 24.50 | 33 | 1.00 |
| CBCL no cause headaches | 0.68 | -1.05 | -3.90 | 37.58 | 37 | 1.00 |
| CBCL no cause nausea | 1.13 | -2.11 | -6.39 | 28.43 | 22 | 1.00 |
| CBCL no cause eye problems | 0.57 | -3.81 | -5.67 | 30.95 | 17 | 0.63 |
| CBCL no cause skin problems | 0.64 | -2.25 | -5.07 | 18.11 | 22 | 1.00 |
| CBCL no cause stomachaches | 0.89 | -1.26 | -4.78 | 21.94 | 28 | 1.00 |
| CBCL no cause vomiting | 0.92 | -3.23 | -7.42 | 17.29 | 21 | 1.00 |
| CBCL refuses to talk | 1.39 | -3.28 | -7.85 | 20.90 | 23 | 1.00 |
| CBCL secretive | 1.32 | -1.81 | -6.22 | 21.14 | 21 | 1.00 |
| CBCL self-conscious | 1.35 | -0.29 | -3.74 | 25.47 | 36 | 1.00 |
| CBCL shy or timid | 0.95 | -0.94 | -4.18 | 37.24 | 35 | 1.00 |
| CBCL stares blankly | 1.44 | -3.28 | -8.60 | 19.72 | 23 | 1.00 |
| CBCL sulks a lot | 1.23 | -1.76 | -5.25 | 46.32 | 32 | 1.00 |
| CBCL suspicious | 1.71 | -4.05 | -9.72 | 25.13 | 23 | 1.00 |
| CBCL lacks energy/slow | 1.27 | -3.20 | -6.74 | 17.88 | 23 | 1.00 |
| CBCL unhappy depressed | 2.30 | -3.17 | -10.16 | 24.61 | 20 | 1.00 |
| CBCL withdrawn | 1.92 | -3.97 | -10.63 | 30.90 | 23 | 1.00 |
| CBCL worries | 1.95 | -1.27 | -6.23 | 36.64 | 30 | 1.00 |

**Supplementary** **Table II** Originalanxiety/depression scale consisting only of the SDQ items

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Item | discrimination parameter | threshold parameter category 1 | threshold parameter category 2 | Chi-square | Degrees of freedom | Corrected p-value |
| SDQ complains of illness | 0.83 | -0.82 | -3.10 | 13.83 | 10 | 0.90 |
| SDQ often seems worried | 2.32 | -1.42 | -6.07 | 13.88 | 8 | 0.43 |
| SDQ often unhappy/tearful | 1.55 | -2.21 | -6.54 | 15.36 | 9 | 0.41 |
| SDQ nervous or clingy | 1.18 | -0.64 | -3.60 | 18.16 | 9 | 0.17 |
| SDQ easily scared | 1.71 | -1.96 | -6.05 | 18.43 | 8 | 0.09 |

# Supplementary Table III Original ADHD scale consisting of the CBCL items

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Item | Discrimination parameter | Threshold parameterCategory 1 | Threshold parameter Category 2 | Chi-square | Degrees of Freedom | Corrected p-value |
| CBCL acts too young | 1.42 | -1.89 | -5.67 | 16.59 | 22 | 1.00 |
| CBCL can’t concentrate | 3.28 | -1.92 | -7.42 | 17.32 | 14 | 1.00 |
| CBCL restless, hyperactive | 1.48 | -1.53 | -4.97 | 31.10 | 20 | 0.59 |
| CBCL confused | 2.07 | -3.96 | -9.79 | 10.84 | 14 | 1.00 |
| CBCL day dreams | 1.28 | -1.20 | -4.25 | 16.98 | 21 | 1.00 |
| CBCL impulsive | 1.73 | -0.92 | -4.71 | 31.33 | 19 | 0.41 |
| CBCL nervous or tense | 0.84 | -1.77 | -4.63 | 24.53 | 22 | 1.00 |
| CBCL nervous movements | 0.94 | -3.60 | -5.61 | 27.70 | 21 | 1.00 |
| CBCL poor school work | 1.96 | -2.58 | -6.81 | 20.11 | 19 | 1.00 |
| CBCL poorly coordinated | 1.37 | -2.89 | -6.72 | 38.78 | 18 | 0.03 |
| CBCL stares blankly | 1.59 | -3.43 | -9.31 | 16.86 | 11 | 1.00 |

# Supplementary Table IV Original ADHD scale consisting of the SDQ items

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Item | Discrimination parameter | Threshold parameterCategory 1 | Threshold parameter Category 2 | Chi-square | Degrees of Freedom | Corrected p-value |
| SDQ restless | 1.97 | -0.99 | -4.60 | 15.36 | 8 | 0.26 |
| SDQ constantly fidgeting | 1.74 | -1.26 | -4.58 | 20.23 | 8 | 0.05 |
| SDQ easily distracted | 2.99 | 0.11 | -3.74 | 12.78 | 7 | 0.39 |
| SDQ thinks before acting | 1.51 | 1.62 | -1.30 | 6.03 | 8 | 1.00 |
| SDQ good attention span | 2.04 | 0.71 | -2.39 | 24.22 | 8 | 0.01 |

## Top-down approach – figures



**Supplementary Figure 1** Item fit curve for item 10 (“CBCL poorly coordinated”) from the original ADHD scale consisting of the CBCL items



**Supplementary Figure 2** Item fit curve for item 5 (“SDQ good attention span”) from the original ADHD scale consisting of the SDQ items

**Supplementary Figure 3** Item fit curve for item 11 (“SDQ restless”) from ADHD scale consisting of both CBCL and SDQ items (top-down approach)

## Bottom-up approach – factor analyses

**Supplementary Table V** Factor analysis with two fixed factors and Promax rotation (factor loadings higher than .3 or lower than -.3)

|  |  |  |
| --- | --- | --- |
| Item | Factor 1 | Factor 2 |
| CBCL acts too young |  |  |
| CBCL allergy |  |  |
| CBCL argues a lot | 0.575 |  |
| CBCL asthma |  |  |
| CBCL behaves like opposite sex |  |  |
| CBCL bowels outside toilet |  |  |
| CBCL bragging | 0.478 |  |
| CBCL cant concentrate | 0.505  |  |
| CBCL obsessions |  | 0.410 |
| CBCL restless, hyperactive | 0.529  |  |
| CBCL too dependent |  | 0.537 |
| CBCL lonely |  | 0.389 |
| CBCL confused |  | 0.423 |
| CBCL cries a lot |  | 0.353 |
| CBCL cruel to animals | 0.440  |  |
| CBCL cruel, bully | 0.661  |  |
| CBCL day dreams |  | 0.336 |
| CBCL deliberate harm | 0.365  |  |
| CBCL demands attention | 0.432  |  |
| CBCL destroys own things | 0.621  |  |
| CBCL destroys other`s things | 0.622  |  |
| CBCL disobedient at home | 0.677  |  |
| CBCL disobedient at school | 0.693  |  |
| CBCL doesn't eat well |  |  |
| CBCL doesn't get along | 0.381  |  |
| CBCL doesn't feel guilty | 0.622  |  |
| CBCL easily jealous |  |  |
| CBCL eats or drinks pica |  |  |
| CBCL fears animals, situations |  | 0.427 |
| CBCL fears going to school |  | 0.392 |
| CBCL fears might do bad |  | 0.393 |
| CBCL fears has to be perfect |  | 0.479 |
| CBCL feels unloved | 0.362  |  |
| CBCL feels others out to get |  | 0.337 |
| CBCL feels worthless |  | 0.488 |
| CBCL accident prone |  |  |
| CBCL gets in fights | 0.576  |  |
| CBCL gets teased a lot | 0.352  |  |
| CBCL hangs out with trouble | 0.554  |  |
| CBCL hears voices not there |  |  |
| CBCL impulsive | 0.621  |  |
| CBCL loner |  | 0.391 |
| CBCL lying or cheating | 0.626  |  |
| CBCL bites fingernails |  |  |
| CBCL nervous or tense |  | 0.612 |
| CBCL nervous movements |  |  |
| CBCL nightmares |  | 0.386 |
| CBCL not liked by other kids | 0.333  |  |
| CBCL constipated |  |  |
| CBCL too fearful or anxious |  | 0.712 |
| CBCL feels dizzy |  | 0.345 |
| CBCL feels too guilty |  | 0.493 |
| CBCL overeating |  |  |
| CBCL overtired |  | 0.449 |
| CBCL overweight |  |  |
| CBCL no cause aches/pains |  | 0.317 |
| CBCL no cause headaches |  |  |
| CBCL no cause nausea |  | 0.391 |
| CBCL no cause eye problems |  |  |
| CBCL no cause skin problems |  |  |
| CBCL no cause stomachaches |  | 0.395 |
| CBCL no cause vomiting |  |  |
| CBCL no cause other symptoms |  |  |
| CBCL attacks people | 0.548  |  |
| CBCL picks nose, etc |  |  |
| CBCL plays sex parts in public |  |  |
| CBCL plays sex parts too much |  |  |
| CBCL poor school work | 0.431  |  |
| CBCL poorly coordinated |  | 0.322 |
| CBCL likes older kids |  |  |
| CBCL likes younger kids |  |  |
| CBCL refuses to talk |  |  |
| CBCL compulsive behaviour |  |  |
| CBCL runs away from home | 0.425  |  |
| CBCL screams a lot | 0.475  |  |
| CBCL secretive |  | 0.347 |
| CBCL sees things not there |  |  |
| CBCL self-conscious |  | 0.544 |
| CBCL sets fires | 0.358  |  |
| CBCL sexual problems |  |  |
| CBCL showing off | 0.533  |  |
| CBCL shy or timid |  | 0.532 |
| CBCL sleeps less than most |  |  |
| CBCL sleeps more than most |  |  |
| CBCL plays with bowel motions |  |  |
| CBCL speech problem |  |  |
| CBCL stares blankly |  | 0.324 |
| CBCL steals at home | 0.425 |  |
| CBCL steals outside home | 0.313  |  |
| CBCL stores things up |  |  |
| CBCL strange behaviour |  |  |
| CBCL strange ideas |  |  |
| CBCL stubborn, sullen | 0.444 |  |
| CBCL sudden change in mood | 0.362  |  |
| CBCL sulks a lot |  | 0.312 |
| CBCL suspicious |  |  |
| CBCL obscene language | 0.533  |  |
| CBCL talks about killing self | 0.352  |  |
| CBCL talks/walks in sleep |  |  |
| CBCL talks too much |  |  |
| CBCL teases a lot | 0.507  |  |
| CBCL temper tantrums | 0.574  |  |
| CBCL thinks sex too much |  |  |
| CBCL threatens people | 0.501  |  |
| CBCL thumb-sucking |  |  |
| CBCL overly neat/clean |  |  |
| CBCL trouble sleeping |  | 0.325 |
| CBCL skips school |  |  |
| CBCL lacks energy/slow |  | 0.437 |
| CBCL unhappy/depressed |  | 0.464 |
| CBCL unusually loud | 0.502  |  |
| CBCL uses alcohol or drugs |  |  |
| CBCL vandalism | 0.488  |  |
| CBCL wets self during day |  |  |
| CBCL wets the bed |  |  |
| CBCL whining |  |  |
| CBCL wants to be other sex |  |  |
| CBCL withdrawn |  | 0.389 |
| CBCL worries |  | 0.689 |
| CBCL any other problems |  |  |
| SDQ considerate of others | -0.532  |  |
| SDQ restless | 0.488  |  |
| SDQ complains of illness |  | 0.417 |
| SDQ shares well | -0.353 |  |
| SDQ temper tantrums | 0.514  |  |
| SDQ solitary, plays alone |  | 0.316 |
| SDQ generally obedient | -0.561  |  |
| SDQ often seems worried |  | 0.632 |
| SDQ helpful of others in need | -0.315  |  |
| SDQ constantly fidgeting | 0.409  |  |
| SDQ at least one good friend |  |  |
| SDQ often fights/bullies | 0.613  |  |
| SDQ often unhappy/tearful |  | 0.395 |
| SDQ generally liked by kids | -0.373  |  |
| SDQ easily distracted | 0.438  |  |
| SDQ nervous or clingy |  | 0.547 |
| SDQ kind to younger kids | -0.332  |  |
| SDQ often lies/cheats | 0.592  |  |
| SDQ picked on/bullied |  |  |
| SDQ volunteers to help others |  |  |
| SDQ thinks before acting | -0.485  |  |
| SDQ steals | 0.386  |  |
| SDQ relates better to adults than kids |  |  |
| SDQ easily scared |  | 0.650 |
| SDQ good attention span | -0.478  |  |

**Supplementary Table VI** Factor analysis with four fixed factors and Promax rotation (factor loadings higher than .3 or lower than -.3)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item | Factor 1 | Factor 2 | Factor 3 | Factor 4 |
| CBCL acts too young |  |  |  | 0.446 |
| CBCL allergy |  |  |  |  |
| CBCL argues a lot |  |  | 0.632 |  |
| CBCL asthma |  |  |  |  |
| CBCL behaves like opposite sex |  |  |  |  |
| CBCL bowels outside toilet |  |  |  |  |
| CBCL bragging |  |  | 0.399 |  |
| CBCL cant concentrate |  |  |  | 0.741 |
| CBCL obsessions | 0.351 |  |  |  |
| CBCL restless, hyperactive |  |  | 0.335 | 0.523 |
| CBCL too dependent | 0.507 |  |  |  |
| CBCL lonely | 0.387 |  |  |  |
| CBCL confused | 0.353 |  |  |  |
| CBCL cries a lot | 0.358 |  |  |  |
| CBCL cruel to animals |  | 0.487 |  |  |
| CBCL cruel, bully |  | 0.508 | 0.317 |  |
| CBCL day dreams |  |  |  | 0.401 |
| CBCL deliberate harm |  | 0.501 |  |  |
| CBCL demands attention |  |  | 0.412 |  |
| CBCL destroys own things |  | 0.646 |  |  |
| CBCL destroys other`s things |  | 0.602 |  |  |
| CBCL disobedient at home |  |  | 0.649 |  |
| CBCL disobedient at school |  | 0.410 |  |  |
| CBCL doesn't eat well |  |  |  |  |
| CBCL doesn't get along |  |  |  |  |
| CBCL doesn't feel guilty |  | 0.308 | 0.412 |  |
| CBCL easily jealous | 0.330 |  | 0.414 |  |
| CBCL eats or drinks pica |  |  |  |  |
| CBCL fears animals, situations | 0.403 |  |  |  |
| CBCL fears going to school | 0.372 |  |  |  |
| CBCL fears might do bad | 0.376 |  |  |  |
| CBCL fears has to be perfect | 0.518 |  |  |  |
| CBCL feels unloved |  |  |  |  |
| CBCL feels others out to get | 0.336 |  |  |  |
| CBCL feels worthless | 0.460 |  |  |  |
| CBCL accident prone |  |  |  |  |
| CBCL gets in fights |  | 0.581 |  |  |
| CBCL gets teased a lot |  |  |  |  |
| CBCL hangs out with trouble |  | 0.368 |  |  |
| CBCL hears voices not there |  |  |  |  |
| CBCL impulsive |  |  | 0.381 | 0.425 |
| CBCL loner | 0.362 |  |  |  |
| CBCL lying or cheating |  |  | 0.422 |  |
| CBCL bites fingernails |  |  |  |  |
| CBCL nervous or tense | 0.585 |  |  |  |
| CBCL nervous movements |  |  |  |  |
| CBCL nightmares | 0.393 |  |  |  |
| CBCL not liked by other kids |  |  |  |  |
| CBCL constipated | 0.305 |  |  |  |
| CBCL too fearful or anxious | 0.676 |  |  |  |
| CBCL feels dizzy | 0.338 |  |  |  |
| CBCL feels too guilty | 0.473 |  |  |  |
| CBCL overeating |  |  |  |  |
| CBCL overtired | 0.438 |  |  |  |
| CBCL overweight |  |  |  |  |
| CBCL no cause aches/pains | 0.343 |  |  |  |
| CBCL no cause headaches |  |  |  |  |
| CBCL no cause nausea | 0.400 |  |  |  |
| CBCL no cause eye problems |  |  |  |  |
| CBCL no cause skin problems |  |  |  |  |
| CBCL no cause stomachaches | 0.410 |  |  |  |
| CBCL no cause vomiting |  |  |  |  |
| CBCL no cause other symptoms |  |  |  |  |
| CBCL attacks people |  | 0.562 |  |  |
| CBCL picks nose, etc |  |  |  |  |
| CBCL plays sex parts in public |  | 0.373 |  |  |
| CBCL plays sex parts too much |  |  |  |  |
| CBCL poor school work |  |  |  | 0.477 |
| CBCL poorly coordinated |  |  |  | 0.363 |
| CBCL likes older kids |  |  |  |  |
| CBCL likes younger kids |  |  |  |  |
| CBCL refuses to talk |  | 0.372 |  |  |
| CBCL compulsive behaviour |  |  |  |  |
| CBCL runs away from home |  | 0.573 |  |  |
| CBCL screams a lot |  |  | 0.356 |  |
| CBCL secretive | 0.361 |  |  |  |
| CBCL sees things not there |  |  |  |  |
| CBCL self-conscious | 0.556 |  |  |  |
| CBCL sets fires |  | 0.472 |  |  |
| CBCL sexual problems |  | 0.338 |  |  |
| CBCL showing off |  |  | 0.451 |  |
| CBCL shy or timid | 0.531 |  |  |  |
| CBCL sleeps less than most |  |  |  |  |
| CBCL sleeps more than most |  |  |  |  |
| CBCL plays with bowel motions |  |  |  |  |
| CBCL speech problem |  |  |  | 0.308 |
| CBCL stares blankly |  |  |  |  |
| CBCL steals at home |  | 0.512 |  |  |
| CBCL steals outside home |  | 0.420 |  |  |
| CBCL stores things up |  |  |  |  |
| CBCL strange behaviour |  | 0.309 |  |  |
| CBCL strange ideas |  |  |  |  |
| CBCL stubborn, sullen |  |  | 0.510 |  |
| CBCL sudden change in mood | 0.317 |  | 0.347 |  |
| CBCL sulks a lot | 0.351 |  | 0.399 |  |
| CBCL suspicious |  |  |  |  |
| CBCL obscene language |  | 0.421 |  |  |
| CBCL talks about killing self |  | 0.518 |  |  |
| CBCL talks/walks in sleep |  |  |  |  |
| CBCL talks too much |  |  | 0.386 |  |
| CBCL teases a lot |  |  | 0.452 |  |
| CBCL temper tantrums |  |  | 0.553 |  |
| CBCL thinks sex too much |  | 0.339 |  |  |
| CBCL threatens people |  | 0.595 |  |  |
| CBCL thumb-sucking |  |  |  |  |
| CBCL overly neat/clean | 0.301 |  |  |  |
| CBCL trouble sleeping |  |  |  |  |
| CBCL skips school |  |  |  |  |
| CBCL lacks energy/slow | 0.423 |  |  |  |
| CBCL unhappy/depressed | 0.476 |  |  |  |
| CBCL unusually loud |  |  | 0.394 |  |
| CBCL uses alcohol or drugs |  |  |  |  |
| CBCL vandalism |  | 0.641 |  |  |
| CBCL wets self during day |  |  |  |  |
| CBCL wets the bed |  |  |  |  |
| CBCL whining |  |  | 0.349 |  |
| CBCL wants to be other sex |  |  |  |  |
| CBCL withdrawn | 0.356 |  |  |  |
| CBCL worries | 0.692 |  |  |  |
| CBCL any other problems |  |  |  |  |
| SDQ considerate of others |  |  | -0.347 |  |
| SDQ restless |  |  | 0.364 | 0.603 |
| SDQ complains of illness | 0.420 |  |  |  |
| SDQ shares well |  |  |  |  |
| SDQ temper tantrums |  |  | 0.495 |  |
| SDQ solitary, plays alone |  |  |  |  |
| SDQ generally obedient |  |  | -0.440 |  |
| SDQ often seems worried | 0.609 |  |  |  |
| SDQ helpful of others in need |  |  |  |  |
| SDQ constantly fidgeting |  |  |  | 0.570 |
| SDQ at least one good friend |  |  |  |  |
| SDQ often fights/bullies |  | 0.431 |  |  |
| SDQ often unhappy/tearful | 0.382 |  |  |  |
| SDQ generally liked by kids |  |  |  |  |
| SDQ easily distracted |  |  |  | 0.826 |
| SDQ nervous or clingy | 0.502 |  |  |  |
| SDQ kind to younger kids |  |  |  |  |
| SDQ often lies/cheats |  |  | 0.371 |  |
| SDQ picked on/bullied |  |  |  |  |
| SDQ volunteers to help others |  |  |  |  |
| SDQ thinks before acting |  |  |  | -0.496 |
| SDQ steals |  | 0.365 |  |  |
| SDQ relates better to adults than kids |  |  |  |  |
| SDQ easily scared | 0.609 |  |  |  |
| SDQ good attention span |  |  |  | -0.684 |

## Bottom-up approach - scales

# Supplementary Table VII Anxiety/depression scale consisting only of the CBCL items

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Item | Discrimination parameter | Threshold parameter category 1 | Threshold parameter category 2 | Chi-square | Degrees of freedom | Corrected p-value |
| CBCL obsessions | 1.02 | -2.09 | -4.30 | 51.29 | 46 | 1.00 |
| CBCL too dependent | 1.47 | -2.43 | -6.58 | 34.31 | 25 | 1.00 |
| CBCL lonely | 1.36 | -2.27 | -6.43 | 33.83 | 25 | 1.00 |
| CBCL confused | 1.71 | -3.56 | -8.29 | 18.79 | 26 | 1.00 |
| CBCL cries a lot | 1.36 | -2.68 | -6.54 | 14.82 | 26 | 1.00 |
| CBCL easily jealous | 1.21 | -1.12 | -4.34 | 35.06 | 42 | 1.00 |
| CBCL fears animals, situations | 0.89 | -1.73 | -4.24 | 45.12 | 45 | 1.00 |
| CBCL fears going to school | 1.44 | -3.73 | -7.94 | 39.30 | 26 | 1.00 |
| CBCL fears might do bad | 1.26 | -2.82 | -7.89 | 19.16 | 26 | 1.00 |
| CBCL fears has to be perfect | 0.93 | -1.29 | -4.03 | 43.94 | 45 | 1.00 |
| CBCL feels others out to get | 1.74 | -2.90 | -7.86 | 27.87 | 25 | 1.00 |
| CBCL feels worthless | 1.96 | -2.85 | -8.35 | 20.88 | 25 | 1.00 |
| CBCL loner | 1.05 | -2.17 | -5.66 | 36.77 | 26 | 1.00 |
| CBCL nervous or tense | 1.70 | -2.23 | -6.50 | 30.62 | 35 | 1.00 |
| CBCL nightmares | 0.87 | -1.51 | -5.20 | 30.03 | 26 | 1.00 |
| CBCL constipated | 0.82 | -2.55 | -5.81 | 20.90 | 26 | 1.00 |
| CBCL too fearful or anxious | 2.17 | -3.22 | -8.82 | 21.22 | 25 | 1.00 |
| CBCL feels dizzy | 1.26 | -3.65 | -8.85 | 20.86 | 24 | 1.00 |
| CBCL feels too guilty | 2.04 | -4.37 | -10.78 | 29.67 | 24 | 1.00 |
| CBCL overtired | 1.28 | -2.16 | -6.16 | 17.86 | 25 | 1.00 |
| CBCL no cause aches/pains | 0.74 | -1.28 | -4.40 | 24.44 | 35 | 1.00 |
| CBCL no cause nausea | 0.97 | -2.01 | -5.99 | 16.67 | 26 | 1.00 |
| CBCL no cause stomachaches | 0.79 | -1.23 | -4.61 | 22.91 | 30 | 1.00 |
| CBCL secretive | 1.28 | -1.78 | -6.10 | 21.86 | 24 | 1.00 |
| CBCL self-conscious | 1.33 | -0.29 | -3.72 | 44.64 | 41 | 1.00 |
| CBCL shy or timid | 0.93 | -0.94 | -4.14 | 51.40 | 39 | 1.00 |
| CBCL sudden change in mood | 1.40 | -1.65 | -5.15 | 29.33 | 40 | 1.00 |
| CBCL sulks a lot | 1.33 | -1.81 | -5.45 | 35.73 | 37 | 1.00 |
| CBCL overly neat/clean | 0.71 | -3.01 | -4.84 | 24.32 | 31 | 1.00 |
| CBCL lacks energy/slow | 1.31 | -3.23 | -6.82 | 32.34 | 25 | 1.00 |
| CBCL unhappy/depressed | 2.30 | -3.16 | -10.09 | 14.26 | 22 | 1.00 |
| CBCL withdrawn | 1.93 | -3.97 | -10.56 | 36.27 | 26 | 1.00 |
| CBCL worries | 1.96 | -1.28 | -6.24 | 41.55 | 32 | 1.00 |

**Supplementary Table VIII** Anxiety/depressionscale consisting only of the SDQ items

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Items | Discrimination parameter | Threshold parameter category 1 | Threshold parameter category 2 | Chi-square | Degrees of freedom | Corrected p-value |
| SDQ complains of illness | 0.83 | -0.82 | -3.10 | 13.83 | 10 | 0.90 |
| SDQ often seems worried | 2.32 | -1.42 | -6.07 | 13.88 | 8 | 0.43 |
| SDQ often unhappy/tearful | 1.55 | -2.21 | -6.54 | 15.36 | 9 | 0.41 |
| SDQ nervous or clingy | 1.18 | -0.64 | -3.60 | 18.16 | 9 | 0.17 |
| SDQ easily scared | 1.71 | -1.96 | -6.05 | 18.43 | 8 | 0.09 |

**Supplementary Table IX -** Anxiety/depressionscale consisting of the CBCL and SDQ items (excluded similar items)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Items | Discrimination parameter | Threshold parameter category 1 | Threshold parameter category 2 | Chi-square | Degrees of freedom | Corrected p-value |
| CBCL obsessions | 1.02 | -2.08 | -4.31 | 47.35 | 48 | 1.00 |
| CBCL too dependent | 1.53 | -2.46 | -6.76 | 21.95 | 27 | 1.00 |
| CBCL lonely | 1.32 | -2.24 | -6.36 | 33.01 | 27 | 1.00 |
| CBCL confused | 1.62 | -3.48 | -8.07 | 30.17 | 27 | 1.00 |
| CBCL cries a lot | 1.34 | -2.65 | -6.52 | 19.55 | 27 | 1.00 |
| CBCL easily jealous | 1.13 | -1.09 | -4.20 | 34.65 | 44 | 1.00 |
| CBCL fears animals, situations | 0.88 | -1.74 | -4.29 | 63.54 | 45 | 1.00 |
| CBCL fears going to school | 1.45 | -3.75 | -8.03 | 24.43 | 26 | 1.00 |
| CBCL fears might do bad | 1.22 | -2.79 | -7.81 | 17.16 | 27 | 1.00 |
| CBCL fears has to be perfect | 0.87 | -1.26 | -3.93 | 47.75 | 46 | 1.00 |
| CBCL feels others out to get | 1.61 | -2.80 | -7.55 | 35.19 | 27 | 1.00 |
| CBCL feels worthless | 1.93 | -2.82 | -8.32 | 18.26 | 27 | 1.00 |
| CBCL loner | 1.01 | -2.15 | -5.59 | 27.06 | 27 | 1.00 |
| CBCL nightmares | 0.82 | -1.49 | -5.12 | 29.15 | 27 | 1.00 |
| CBCL constipated | 0.80 | -2.54 | -5.78 | 35.21 | 26 | 1.00 |
| CBCL too fearful or anxious | 2.10 | -3.16 | -8.70 | 28.35 | 27 | 1.00 |
| CBCL feels dizzy | 1.28 | -3.67 | -8.98 | 40.67 | 26 | 1.00 |
| CBCL feels too guilty | 1.89 | -4.21 | -10.33 | 23.80 | 24 | 1.00 |
| CBCL overtired | 1.25 | -2.14 | -6.10 | 45.74 | 27 | 0.47 |
| CBCL no cause aches/pains | 0.74 | -1.27 | -4.41 | 35.14 | 36 | 1.00 |
| CBCL no cause nausea | 1.00 | -2.03 | -6.07 | 31.33 | 27 | 1.00 |
| CBCL no cause stomachaches | 0.80 | -1.24 | -4.63 | 40.65 | 27 | 1.00 |
| CBCL secretive | 1.17 | -1.73 | -5.88 | 35.13 | 26 | 1.00 |
| CBCL self-conscious | 1.27 | -0.28 | -3.63 | 47.23 | 43 | 1.00 |
| CBCL shy or timid | 0.99 | -0.95 | -4.23 | 48.49 | 43 | 1.00 |
| CBCL sudden change in mood | 1.35 | -1.63 | -5.06 | 34.23 | 42 | 1.00 |
| CBCL sulks a lot | 1.28 | -1.78 | -5.34 | 35.56 | 37 | 1.00 |
| CBCL overly neat/clean | 0.67 | -2.99 | -4.77 | 38.92 | 30 | 1.00 |
| CBCL lacks energy/slow | 1.29 | -3.21 | -6.78 | 40.30 | 26 | 1.00 |
| CBCL withdrawn | 1.87 | -3.92 | -10.43 | 35.85 | 26 | 1.00 |
| SDQ complains of illness | 0.80 | -0.82 | -3.05 | 59.05 | 48 | 1.00 |
| SDQ often seems worried | 1.40 | -1.14 | -4.32 | 72.64 | 43 | 0.11 |
| SDQ often unhappy/tearful | 1.31 | -2.08 | -5.87 | 25.65 | 27 | 1.00 |
| SDQ nervous or clingy | 1.05 | -0.64 | -3.39 | 54.57 | 46 | 1.00 |
| SDQ easily scared | 1.29 | -1.76 | -5.04 | 46.64 | 42 | 1.00 |

**Supplementary Table X** ADHD scale consisting only of the CBCL items

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Items | Discrimination parameter | Threshold parameter category 1 | Threshold parameter category 2 | Chi-square | Degrees of freedom | Corrected p-value |
| CBCL acts too young | 1.36 | -1.86 | -5.55 | 12.96 | 17 | 1.00 |
| CBCL can`t concentrate | 4.24 | -2.32 | -9.27 | 10.47 | 10 | 1.00 |
| CBCL restless, hyperactive | 1.55 | -1.56 | -5.12 | 36.30 | 17 | 0.03 |
| CBCL day dreams | 1.10 | -1.15 | -3.93 | 39.52 | 18 | 0.02 |
| CBCL impulsive | 1.70 | -0.91 | -4.66 | 18.75 | 16 | 1.00 |
| CBCL poor school work | 1.98 | -2.59 | -6.88 | 16.28 | 14 | 0.40 |
| CBCL poorly coordinated | 1.30 | -2.84 | -6.53 | 13.03 | 16 | 1.00 |
| CBCL speech problem | 0.85 | -3.16 | -5.05 | 37.73 | 20 | 0.08 |

**Supplementary Table XI** ADHD scale consisting only of the CBCL items (after excluding item “CBCL day dreams”)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Items | Discrimination parameter | Threshold parameter category 1 | Threshold parameter category 2 | Chi-square | Degrees of freedom | Corrected p-value |
| CBCL acts too young | 1.33 | -1.84 | -5.48 | 16.35 | 13 | 1.00 |
| CBCL can`t concentrate | 3.78 | -2.12 | -8.39 | 6.41 | 8 | 1.00 |
| CBCL restless, hyperactive | 1.66 | -1.60 | -5.35 | 32.72 | 14 | 0.02 |
| CBCL impulsive | 1.71 | -0.91 | -4.68 | 8.76 | 13 | 1.00 |
| CBCL poor school work | 2.06 | -2.64 | -7.08 | 8.22 | 12 | 1.00 |
| CBCL poorly coordinated | 1.24 | -2.80 | -6.37 | 17.93 | 14 | 1.00 |
| CBCL speech problem | 0.86 | -3.17 | -5.07 | 26.08 | 16 | 0.37 |

**Supplementary Table XII** ADHD scale consisting only of the SDQ items

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Items | Discrimination parameter | Threshold parameter category 1 | Threshold parameter category 2 | Chi-square | Degrees of freedom | Corrected p-value |
| SDQ restless | 1.97 | -0.99 | -4.60 | 15.36 | 8 | 0.26 |
| SDQ constantly fidgeting | 1.74 | -1.26 | -4.58 | 20.23 | 8 | 0.05 |
| SDQ easily distracted | 2.99 | 0.11 | -3.74 | 12.78 | 7 | 0.38 |
| SDQ thinks before acting | 1.51 | 1.62 | -1.30 | 6.03 | 8 | 1.00 |
| SDQ good attention span | 2.04 | 0.71 | -2.39 | 24.22 | 8 | 0.01 |

**Supplementary Table XIII** Combined ADHD scale consisting of the both CBCL and SDQ items (excluded similar items)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Items | Discrimination parameter | Threshold parameter category 1 | Threshold parameter category 2 | Chi-square | Degrees of freedom | Corrected p-value |
| CBCL acts too young | 1.22 | -1.79 | -5.25 | 17.98 | 25 | 1.00 |
| CBCL can`t concentrate | 3.58 | -2.02 | -7.98 | 14.25 | 16 | 1.00 |
| CBCL impulsive | 1.53 | -0.87 | -4.38 | 32.45 | 22 | 0.77 |
| CBCL poor school work | 1.81 | -2.47 | -6.46 | 24.11 | 23 | 1.00 |
| CBCL poorly coordinated | 1.12 | -2.72 | -6.05 | 23.79 | 21 | 1.00 |
| CBCL speech problem | 0.75 | -3.10 | -4.80 | 38.78 | 28 | 0.93 |
| SDQ restless | 1.52 | -0.91 | -3.90 | 33.41 | 23 | 0.82 |
| SDQ constantly fidgeting | 1.40 | -1.17 | -4.01 | 30.62 | 25 | 1.00 |
| SDQ easily distracted | 3.20 | 0.14 | -3.99 | 15.29 | 16 | 1.00 |
| SDQ thinks before acting | 1.53 | 1.63 | -1.32 | 29.25 | 21 | 1.00 |
| SDQ good attention span | 2.13 | 0.74 | -2.48 | 14.11 | 19 | 1.00 |

## Bottom-up approach - figures

**Supplementary Figure 4** Factor analysis on all of the 145 items with no rotation



**Supplementary Figure 5** Item fit curve for item 3 (“CBCL restless, hyperactive”) from ADHD scale consisting only of the CBCL items (bottom-up approach)



**Supplementary Figure 6** Item fit curve for item 4 (“CBCL day dreams”) from ADHD scale consisting only of the CBCL items (bottom-up approach)

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**Supplementary Figure 7** Item fit curve for item 3 (“CBCL restless, hyperactive”) from ADHD scale consisting only of the CBCL items after excluding item with bad item fit (bottom-up approach)



**Supplementary Figure 8** Item fit curve for item 5 (“SDQ good attention span”) from ADHD scale consisting of the SDQ items (bottom-up approach)

## Test information curves – Top-down approach



**Supplementary Figure 9** Anxiety/depression CBCL items – test information curves

black line – all of 31 anxiety/depression CBCL items,

blue line – 28 anxiety/depression CBCL items using item parameters from the new model (consisted only of 28 CBCL items)

red line – 28 anxiety/depression CBCL items using item parameters from combined scale



**Supplementary Figure 10** ADHD CBCL items – test information curves

black line – all of 11 ADHD CBCL items,

red line – 8 ADHD CBCL items from combined scale with existing item parameters

blue line – 8 ADHD CBCL items from the combined scale using item parameters from the new model

## Scatter plots – Top-down approach



**Supplementary Figure 11** Changes in anxiety/depression CBCL item parameters after combining them with SDQ items

Scale 1 – all anxiety/depression CBCL items (31 items)

Scale 2 – anxiety/depression CBCL items from the combined scale (28 items)



**Supplementary Figure 12** Changes in ADHD CBCL item parameters after combining them with SDQ items

Scale 1 – all ADHD CBCL items (11 items)

Scale 2 – ADHD CBCL items from the combined scale (10 items)

## Example R code to obtain harmonized scores for anxiety/depression and ADHD based on item parameters from this study

Example R code to obtain harmonized scores for anxiety/depression and ADHD based on item parameters from this study is presented below. The researchers only need to implement this code on their data in order to get harmonized scores.

library(mirtCAT) # Package required for obtaining harmonized scores based on existing item parameters

# Anxiety/depression - Obtain harmonized scores based on all item parameters from table III from the manuscript

# Define item parameters: a1 = discrimination parameter, d1 = threshold 1 parameter, d2 = threshold 2 parameter

# Item parameters are ordered as in table III from the manuscript

parameters <- data.frame(a1 = c(1.28, 1.21, 1.22, 0.84, 1.12, 1.57, 1.87, 1.02, 1.47, 1.78, 1.36, 1.84, 1.27, 0.85, 0.78, 1.19, 0.62, 0.64, 0.91, 0.92, 1.33, 1.20, 1.26, 1.00, 1.29, 1.18, 1.64, 1.25, 2.15, 1.86, 1.84, 0.91, 1.42, 1.33, 0.98, 1.17),

d1 = c(-2.22, -2.56, -2.79, -1.26, -1.66, -2.77, -2.78, -2.15, -2.11, -2.89, -3.75, -4.16, -2.15, -1.31, -1.07, -2.14, -3.84, -2.25, -1.27, -3.24, -3.23, -1.74, -0.28, -0.95, -3.14, -1.73, -3.98, -3.18, -3.13, -3.91, -1.26, -0.84, -1.14, -2.09, -0.63, -1.70),

d2 = c(-6.27, -6.19, -7.84, -3.89, -5.39, -7.46, -8.20, -5.60, -6.08, -7.79, -9.28, -10.22, -6.16, -4.61, -4.06, -6.55, -5.78, -5.08, -4.83, -7.44, -7.70, -5.95, -3.63, -4.27, -8.15, -5.13, -9.51, -6.70, -9.93, -10.46, -6.16, -3.21, -4.36, -5.92, -3.30, -4.80))

# Generate object and define the used model. In this study, we used General Partial Credit Model (“gpcm”)

mod <- generate.mirt\_object(parameters, 'gpcm')

# Create vectors with participants` responses

Response\_pattern\_A <- c(0, 0, 1, 2, 1, 0, 1, 2, 2, 2, 0, 1, 1, 1, 0, 0, 0, 0, 0, 1, 1, 2, 1, 2, 1, 2, 1, 0, 1, 0, 0, NA, NA, NA, NA, NA) # Participant who filled in only CBCL items

Response\_pattern\_B <- c(NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, 1, 0, 1, 2, 2)

# Participant who filled in only SDQ items

Response\_pattern\_C <- c(0, 0, 1, 0, 2, 2, 1, 2, 1, 2, 0, 0, 0, 1, 1, 1, 1, 2, 0, 0, 0, 2, 1, 1, 1, 1, 2, 0, 1, 0, 0, 1, 2, 1, 0, 1) # Participant who filled in both CBCL and SDQ items

Response\_pattern\_D <- c(2, NA, 2, 2, 1, 2, 0, 1, 2, 1, 1, 0, 0, 1, 1, 0, 1, 2, NA, 2, 1, 2, 2, 0, 1, 0, 1, 1, 2, 1, NA, 1, 0, 1, 2, 2) # Participant who filled in both CBCL and SDQ items with some missing values

# Create a data matrix based on these vectors

responses <- rbind(Response\_pattern\_A, Response\_pattern\_B, Response\_pattern\_C, Response\_pattern\_D)

# Obtain harmonized scores for anxiety/depression using the above-defined object (“mod”) and data matrix which contains participants` responses as response patterns.

fscores(mod, response.pattern = responses)

# As a result, researchers will get harmonized scores and standard errors for these response patterns.

# Because of the high number of items in the anxiety/depression scale, the results will contain a lot of data, so we have not presented it here. Instead of that, in Supplementary Table XVI, you can find complete results related to the ADHD scale which contains a smaller number of items.

# Instead of creating vectors with participants` responses, researchers can simply import an existing database. In that case, they will use the database as response patterns.

# For example: fscores(mod, response.pattern = database)

# ADHD - Obtain harmonized scores based on all item parameters from Table IV from the manuscript

# define item parameters: a1 = discrimination parameter, d1 = threshold 1 parameter, d2 = threshold 2 parameter

# Item parameters are ordered as in table IV from the manuscript

parameters <- data.frame(a1 = c(1.28, 3.71, 1.31, 1.71, 1.11, 1.58, 0.65, 0.83, 1.84, 1.19, 1.19, 1.41, 1.34, 3.24, 1.44, 1.99),

d1 = c(-1.82, -2.07, -1.51, -3.59, -1.15, -0.88, -1.69, -3.53, -2.49, -2.77, -3.08, -0.89, -1.16, 0.15, 1.58, 0.70),

d2 = c(-5.39, -8.22, -4.80, -8.63, -3.96, -4.45, -4.26, -5.36, -6.52, -6.27, -8.05, -3.72, -3.92, -4.02, -1.28, -2.37))

# Generate object and define the used model. In this study, we have used General Partial Credit Model (“gpcm”)

mod <- generate.mirt\_object(parameters, 'gpcm')

# Create vectors with participants responses

Response\_pattern\_A <- c(0, 1, 1, 0, 2, 1, 0, 0, 0, 0, 1, NA, NA, NA, NA, NA) # Participant who filled in only CBCL items

Response\_pattern\_B <- c(NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, 2, 0, 2, 1, 1) # Participant who filled in only SDQ items

Response\_pattern\_C <- c(1, 1, 2, 0, 1, 2, 1, 1, 0, 0, 0, 2, 0, 1, 1, 1) # Participant who filled in both CBCL and SDQ items

Response\_pattern\_D <- c(0, 2, 2, 1, 1, 2, 1, NA, 1, 1, 0, NA, 1, 2, 2, 2) # Participant who filled in both CBCL and SDQ items with some missing values

# Create a data matrix based on these vectors

responses <- rbind(Response\_pattern\_A, Response\_pattern\_B, Response\_pattern\_C, Response\_pattern\_D)

# Obtain harmonized scores for ADHD using the above-defined object (“mod”) and data matrix which contains participants` responses as response patterns. The complete results are presented in the Supplementary Table XVI.

fscores(mod, response.pattern = responses)

# Instead of creating vectors with participants` responses, researchers can simply import an existing database. In that case, they will use the database as response patterns.

# For example: fscores(mod, response.pattern = database)

**Supplementary table XVI** IRT illustration: Harmonized scores and their standard errors for several imaginary response patterns based on discrimination and threshold parameters of ADHD items from this study

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Item | Discrimination parameter | Threshold parameterCategory 1 | Threshold parameter Category 2 | Response pattern A | Response pattern B | Response pattern C | Response pattern D |
| CBCL acts too young | 1.28 | -1.82 | -5.39 | 0 | NA | 1 | 0 |
| CBCL can’t concentrate | 3.71 | -2.07 | -8.22 | 1 | NA | 1 | 2 |
| CBCL restless, hyperactive | 1.31 | -1.51 | -4.80 | 1 | NA | 2 | 2 |
| CBCL confused | 1.71 | -3.59 | -8.63 | 0 | NA | 0 | 1 |
| CBCL day dreams | 1.11 | -1.15 | -3.96 | 2 | NA | 1 | 1 |
| CBCL impulsive | 1.58 | -0.88 | -4.45 | 1 | NA | 2 | 2 |
| CBCL nervous or tense | 0.65 | -1.69 | -4.26 | 0 | NA | 1 | 1 |
| CBCL nervous movements | 0.83 | -3.53 | -5.36 | 0 | NA | 1 | NA |
| CBCL poor school work | 1.84 | -2.49 | -6.52 | 0 | NA | 0 | 1 |
| CBCL poorly coordinated | 1.19 | -2.77 | -6.27 | 0 | NA | 0 | 1 |
| CBCL stares blankly | 1.19 | -3.08 | -8.05 | 1 | NA | 0 | 0 |
| SDQ restless | 1.41 | -0.89 | -3.72 | NA | 2 | 2 | NA |
| SDQ constantly fidgeting | 1.34 | -1.16 | -3.92 | NA | 0 | 0 | 1 |
| SDQ easily distracted | 3.24 | 0.15 | -4.02 | NA | 2 | 1 | 2 |
| SDQ thinks before acting | 1.44 | 1.58 | -1.28 | NA | 1 | 1 | 2 |
| SDQ good attention span | 1.99 | 0.70 | -2.37 | NA | 1 | 1 | 2 |
| Sum score |  |  |  | 6 | 6 | 14 | 18 |
| Harmonized score |  |  |  | 1.07 | 1.23 | 1.22 | 2.15 |
| Standard Error |  |  |  | .33 | .40 | .26 | .29 |

Note: “NA” indicates missing data.

Response pattern A – Participant who filled in only CBCL items.

Response pattern B – Participant who filled in only SDQ items.

Response pattern C – Participant who filled in both CBCL and SDQ items.

Response pattern D – Participant who filled in both CBCL and SDQ items with some missing values.