# Short & Sweet - Reducing questionnaire length using a genetic algorithm

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# Short and sweet: Comparing strategies for the reduction of questionnaires on self-criticism and social safeness while preserving construct validity

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Measuring psychological traits with standardised questionnaires is an essential component of clinical practice and research; however, patients and participants risk fatigue from overly long and repetitive measures. When developing the short form of a questionnaire, the most widely used method for selecting an item subset uses factor analysis loadings to identify the items most closely related to the psychological construct being measured. However, this approach will tend to select highly correlated, homogeneous items and might therefore restrict the breadth of the construct examined. In this study, we will present Yarkoni's genetic algorithm for scale reduction and compare it with the classical scale reduction method. The algorithm will be applied to the shortening of three instruments for measuring self-compassion and social safeness (two unidimensional measures and a three-factor measure). We evaluated the shortened scales using correlation with long-form scores, internal reliability and the change in the correlations observed with other related constructs. Findings suggested that the classical method preserves internal reliability, but Yarkoni's genetic algorithm better maintained correlations with other constructs. An additional qualitative assessment of item content showed that the latter method led to a more heterogeneous selection of items, better preserving the full complexity of the constructs being measured.

***Keywords:*** Scale abbreviation; Self-criticism; Social safeness; Construct validity; Scale reduction.

# EMWSS

1. I felt safe and secure
2. I felt appreciated the way I was
3. I felt understood
4. I felt a sense of warmth with those around me
5. I felt comfortable sharing my feelings and thoughts with those around me
6. I felt people enjoyed my company
7. I knew that I could count on empathy and understanding from people close to me when I was unhappy
8. I felt peaceful and calm
9. I felt that I was a cherished member of my family
10. I could easily be soothed by people close to me when I was unhappy
11. I felt loved
12. I felt comfortable turning to people important to me for help and advice
13. I felt part of those around me.
14. I felt loved even when people were upset about something I had done
15. I felt happy
16. I had feelings of connectedness
17. I knew I could rely on people close to me to console me when I was upset
18. I felt cared about
19. I had a sense of belonging
20. I knew that I could count on help from people close to me when I was unhappy
21. I felt at ease

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Latent Variables:

| | Estimate | Std.Err | z-value | P(>\|z\|) |
|---|---|---|---|---|
| EMWSS =~ | | | | |
| EMWSS1 | 0.733 | 0.051 | 14.303 | 0.000 |
| EMWSS2 | 0.804 | 0.049 | 16.319 | 0.000 |
| EMWSS3 | 0.823 | 0.049 | 16.911 | 0.000 |
| EMWSS4 | 0.779 | 0.050 | 15.567 | 0.000 |
| EMWSS5 | 0.768 | 0.050 | 15.257 | 0.000 |
| EMWSS6 | 0.664 | 0.053 | 12.531 | 0.000 |
| EMWSS7 | 0.796 | 0.049 | 16.089 | 0.000 |
| EMWSS8 | 0.755 | 0.051 | 14.886 | 0.000 |
| EMWSS9 | 0.768 | 0.050 | 15.261 | 0.000 |
| EMWSS10 | 0.852 | 0.048 | 17.852 | 0.000 |
| EMWSS11 | 0.844 | 0.048 | 17.586 | 0.000 |
| EMWSS12 | 0.780 | 0.050 | 15.618 | 0.000 |
| EMWSS13 | 0.846 | 0.048 | 17.637 | 0.000 |
| EMWSS14 | 0.783 | 0.050 | 15.696 | 0.000 |
| EMWSS15 | 0.798 | 0.049 | 16.128 | 0.000 |
| EMWSS16 | 0.821 | 0.049 | 16.856 | 0.000 |
| EMWSS17 | 0.891 | 0.046 | 19.191 | 0.000 |
| EMWSS18 | 0.811 | 0.049 | 16.538 | 0.000 |
| EMWSS19 | 0.839 | 0.048 | 17.413 | 0.000 |
| EMWSS20 | 0.878 | 0.047 | 18.746 | 0.000 |
| EMWSS21 | 0.820 | 0.049 | 16.807 | 0.000 |

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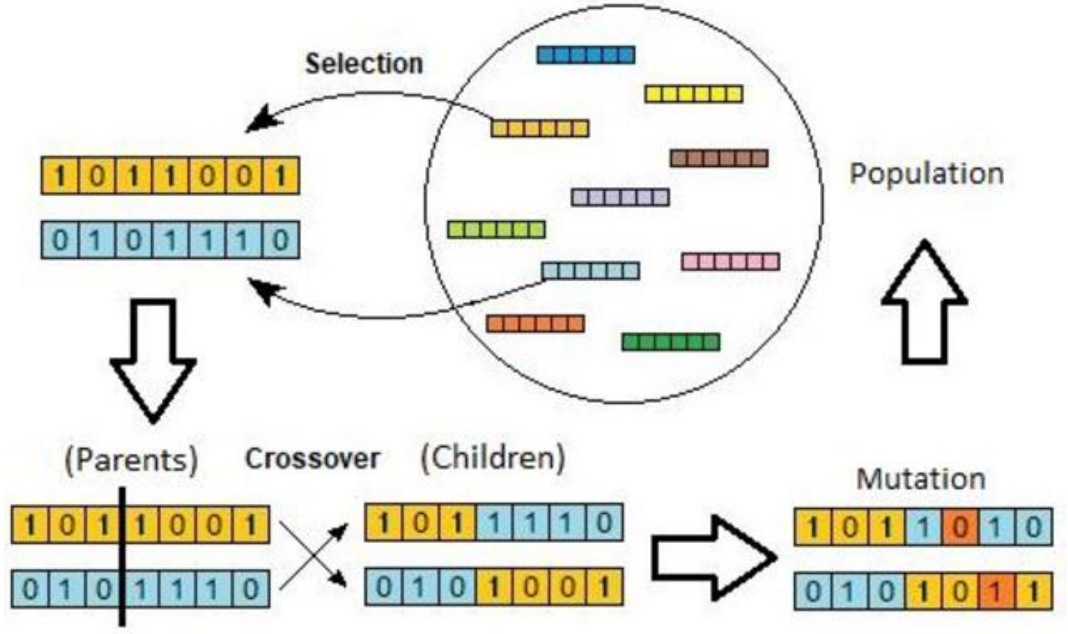
# Yarkoni's genetic algorithm

Yarkoni, T. (2010). The abbreviation of personality, or how to measure 200 personality scales with 200 items. *Journal of research in personality*, *44*(2), 180-198.



# Yarkoni's genetic algorithm

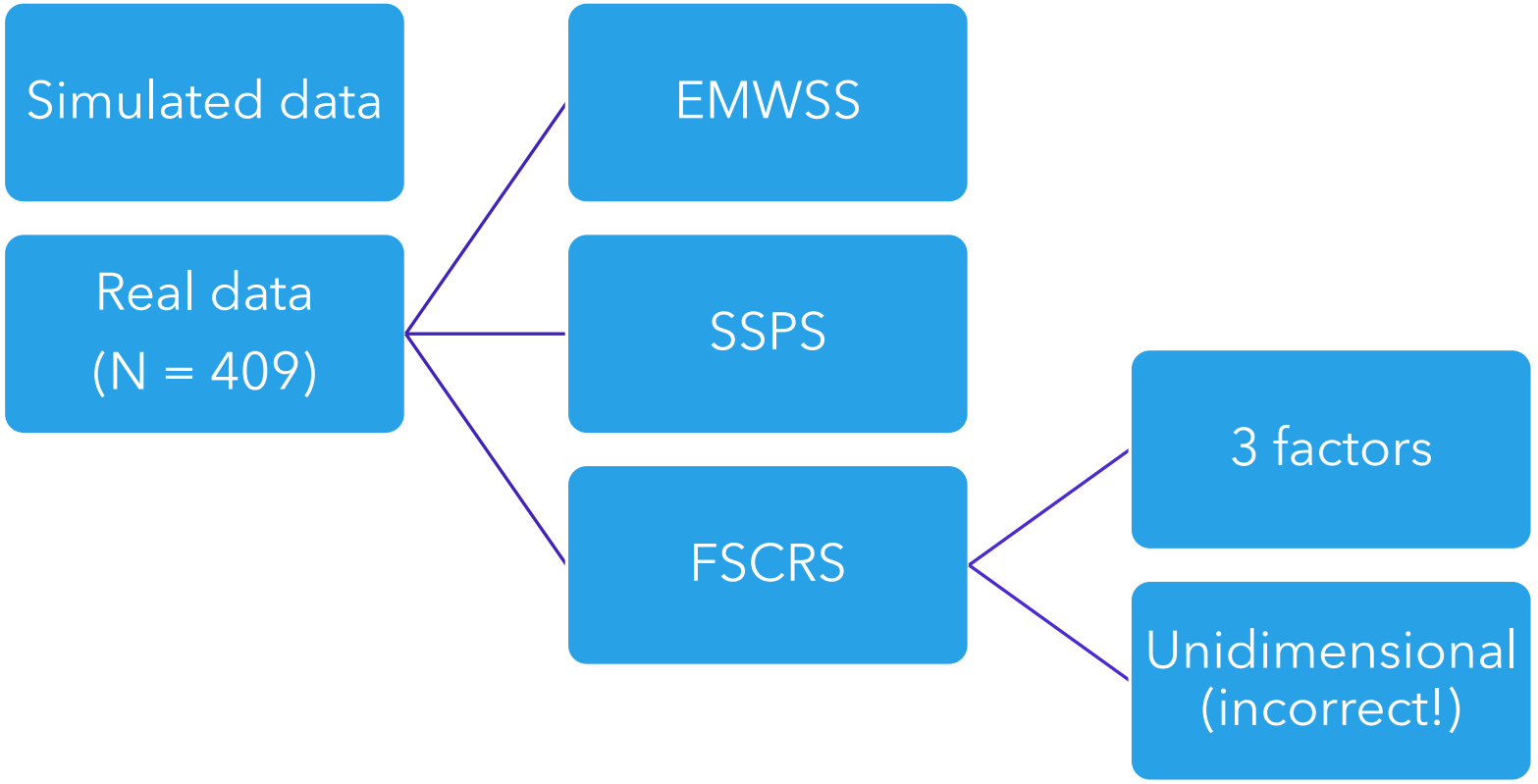
$$Loss = Ik + \sum_{i=1}^{s} 1 - R_i^2$$

Item cost

# of retained items

Variance explained

# The data


Simulated data
Real data
(N = 409)
EMWSS
SSPS
FSCRS
3 factors
Unidimensional
(incorrect!)

# Our approach

01

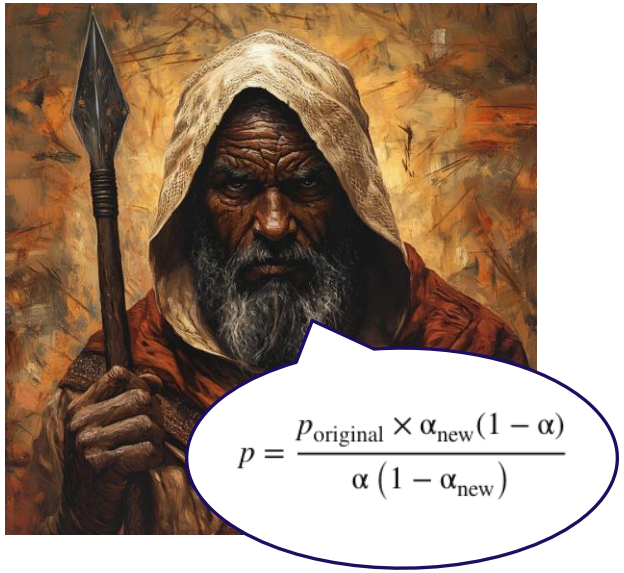
Identify optimal length (Spearman-Brown prophecy)

02

Reduce scales using the classical and genetic methods

03

Compare methods





# Comparison

Chronbach's alpha for the reduced scale

Correlation between shortened and full scale score

*Correlation with other, related constructs*

Training + test dataset!

# α!

Cronbach's α for the shortened scales, together with inter-item correlations (mean ± standard deviation)

| *Questionnaire* | *Full scale (training)* | *Classical method (training)* | *Genetic method (training)* | *Full scale (test)* | *Classical method (test)* | *Genetic method (test)* |
|---|---|---|---|---|---|---|
| EMWSS | .97 (.63 ± .07) | .92 (.86) | .83 (.71) | .97 (.63 ± .08) | .92 (.86) | .81 (.68) |
| SSPS | .92 (.51 ± .11) | .83 (.62 ± .03) | .81 (.59 ± .00) | .93 (.56 ± .14) | .85 (.66 ± .06) | .84 (.64 ± .05) |
| FSCRS (unidimensional) | .94 (.06 ± .44) | .87 (.62 ± .05) | .77 (.00 ± .51) | .95 (.05 ± .47) | .86 (.60 ± .06) | .77 (−.04 ± .51) |
| FSCRS (hatred) | .81 (.47 ± .10) | .80 (.50 ± .11) | .72 (.40 ± .05) | .81 (.46 ± .10) | .77 (.46 ± .11) | .74 (.41 ± .08) |
| FSCRS (inadequacy) | .91 (.53 ± .08) | .84 (.62 ± .02) | .82 (.60 ± .07) | .91 (.54 ± .09) | .84 (.64 ± .01) | .83 (.62 ± .04) |
| FSCRS (self-kindness) | .88 (.49 ± .07) | .82 (.53 ± .08) | | .92 (.58 ± .06) | .85 (.59 ± .08) | |

*Note:* Shortened versions on the EMWSS have no standard deviation for inter-item correlation, since they comprise only two items. Metrics for the full scales are reported for comparison. Numbers in red indicate potentially critical internal consistency.

# r!

Correlations between shortened versions of the scales and the original questionnaires' scores

| *Questionnaire* | *Classical method (training)* | *Genetic method (training)* | *Classical method (test)* | *Genetic method (test)* |
|---|---|---|---|---|
| EMWSS | .91 | **.94** | .90 | **.93** |
| SSPS | .93 | **.95** | **.95** | .95 |
| FSCRS (unidimensional) | .90 | **.94** | .89 | **.94** |
| FSCRS (hatred) | .97 | **.99** | .98 | **.99** |
| FSCRS (inadequacy) | .93 | **.95** | .92 | **.94** |
| FSCRS (self-kindness) | **.95** | | **.96** | |

# Δr!

Standard deviation of differences between correlations observed using the full scales and correlations observed using the shortened scales

| *Questionnaire* | *Classical method (training)* | *Genetic method (training)* | *Classical method (test)* | *Genetic method (test)* |
|---|---|---|---|---|
| EMWSS | .050 (29%) | **.033 (7%)** | .092 (64%) | **.036 (0%)** |
| SSPS | .036 (21%) | .031 (29%) | .044 (21%) | **.026 (0%)** |
| FSCRS (unidimensional) | .048 (45%) | **.020 (0%)** | .096 (64%) | **.038 (18%)** |
| FSCRS (hatred) | **.006 (0%)** | .017 (27%) | .020 (0%) | **.014 (0%)** |
| FSCRS (inadequacy) | .054 (64%) | **.030 (27%)** | .050 (9%) | **.033 (9%)** |
| FSCRS (self-kindness) | .022 (27%) | | .024 (0%) | |

# Take-home messages

- The classical method of scale reduction may reduce the breadth of the construct examined
- The genetic method leads to lower internal consistency but preserves correlations
- Questionnaires should be like coffee

Short and sweet: Comparing strategies for the reduction of questionnaires on self-criticism and social safeness while preserving construct validity