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Research profile

One of my research interests is to develop and compare indices for assessing similarity between individuals or objects. These indices are used in many different scientific disciplines, e.g. Epidemiology, Psychology, Educational Research, Ecological biology, Test theory, Market research and Remote sensing. My research produces guidelines on which indices to use and how to interpret them.

Education

2013 B.Sc. Mathematics, Leiden University.

2008 Ph.D. Psychology, Leiden University (Cum laude).

2002 M.Sc. Psychology, Leiden University (Cum laude).

Employment history

2015–present University of Groningen, GION.

2011–2015 Leiden University, Psychology.

2011–2011 Tilburg University, MTO.

2008–2011 Leiden University, Psychology.

Publication summary and impact

Number of peer-reviewed articles in international journals: **69**

Number of non-peer-reviewed articles: **7**

Number of chapters in international books: **7**

Number of citations: **1145**

H-index: **19**

i10-index: **32**

Awards/Grants

2018 PhD Fund grant (with H. van der Hoef and M. Timmerman)
    Faculty of Behavioral and Social Sciences, University of Groningen. Euro 180.000.

2017 Interlinked Research Project grant (with R.J. Bosker and H. Korpershoek)
    Nationaal Regieorgaan Onderwijsonderzoek (NRO). Euro 544.325.

2011 VENI grant, Netherlands Organisation for Scientific Research (NWO). Euro 250.000.

2009 Chikio Hayashi award, IFCS Dresden.

2007 IOPS best paper award.

2007 ETS student travel award, IMPS Tokyo.

2002 Master thesis award Psychology, Leiden University.

Research highlights

Some relationships between Cronbach's alpha and the Spearman-Brown formula.
Warrens, M.J. (2015). Journal of Classification 32:127-137.

In this paper I present several new interpretations of Cronbach's alpha and standardized alpha that are also valid if some of their assumptions do not hold. For example, I prove that the stepped down alpha can be interpreted as an average of the alphas of all subtests of a specific size. The results show that the stepped down alpha can be calculated without using the Spearman-Brown formula.

Corrected Zegers-ten Berge coefficients are special cases of Cohen's weighted kappa.
Warrens, M.J. (2014). Journal of Classification 31:179-193.

In this paper I prove that the Pearson correlation for linear association and an intra-class correlation for assessing agreement on an interval scale are special cases of Cohen's weighted kappa. Since the magnitude of weighted kappa is greatly influenced by the relative magnitude of the weights a practical problem since its introduction has been, what weights should be chosen? In this paper I show that weighted kappa is no longer needed and that we may use the Pearson correlation instead.

Cohen's linearly weighted kappa is a weighted average.
Warrens, M.J. (2012). Advances in Data Analysis and Classification 6:67-79.

In this paper I prove that the overall weighted kappa with linear weights is a weighted average of the linearly weighted kappas corresponding to all distinct smaller tables of a specific size that can be obtained by combining adjacent categories. A direct consequence is that it is always possible to increase the reliability of an ordinal rating scale by combining two adjacent categories.

Cohen's kappa is a weighted average. Warrens, M.J. (2011). Statistical Methodology 8:473-484.

In this paper I prove that given a partition type of the categories, the overall kappa is a weighted average of the kappas of the collapsed tables corresponding to all partitions of that type. A direct consequence is that it is always possible to increase the reliability of a nominal rating scale by combining two categories.

Inequalities between multi-rater kappas.
Warrens, M.J. (2010). Advances in Data Analysis and Classification 4:271-286.

In this paper I show how the values of several kappa coefficients for assessing agreement between multiple observers can be calculated. Moreover, I prove that the kappa-values are always ordered in a certain way. The result formalizes an ordering between the kappa-values that is frequently observed in practice. This paper has been cited 96 times and is my most cited paper.

On association coefficients for 2x2 tables and properties that do not depend on the marginal distributions. Warrens, M.J. (2008). Psychometrika, 73, 777-789.

In this paper I prove that the linear transformations that set the value under independence at zero and the maximum value at unity, transform all coefficients that are linear transformations of the observed proportion of agreement given the marginal probabilities, into the same underlying coefficient, namely Loevinger's H. The family includes the phi coefficient and Cohen's kappa.

On the equivalence of Cohen's kappa and the Hubert-Arabie adjusted Rand index.
Warrens, M.J. (2008). Journal of Classification, 25, 177-183.

In this paper I prove that there is one underlying formula for Cohen's kappa and the Hubert-Arabie adjusted Rand index. The result is somewhat surprising since the two indices are used in two quite different disciplines. The result implies that issues that arise with the application of one index are also relevant to the application of the other index.

Publications

Journal articles

1. Warrens MJ (in press) Similarity measures for 2×2 tables. *Journal of Intelligent and Fuzzy Systems*
2. Warrens MJ, De Raadt A (in press) Properties of Bangdiwala's B. *Advances in Data Analysis and Classification*
3. De Raadt A, Warrens MJ, Bosker RJ, Kiers HAL (in press) Kappa coefficients for missing data. *Educational and Psychological Measurement*
4. Van der Hoef H, Warrens MJ (in press) Understanding information theoretic measures for comparing clusterings. *Behaviormetrika*
5. Hoekstra R, Vugteveen J, Warrens MJ, Kruyen PM (in press) An empirical analysis of alleged misunderstandings of coefficient alpha. *International Journal of Social Research Methodology*
6. Warrens MJ (2018) On the negative bias of the Gini coefficient due to grouping. *Journal of Classification* 35:580-586.
7. Wijsman LA, Saab N, Warrens MJ, Van Driel JH, Westenberg PM (2018) Relations of autonomous and controlled motivation with performance in secondary school students' favoured and disfavoured subjects. *Educational Research and Evaluation* 24:51-67.
8. Warrens MJ (2017) Transforming intraclass correlation coefficients with the Spearman-Brown formula. *Journal of Clinical Epidemiology* 85:14-16.
9. Warrens MJ (2017) Symmetric kappa as a function of unweighted kappas. *Communications in Statistics - Simulation and Computation* 46:5240-5245.
10. Warrens MJ (2017) If d is super-metric, then $d/(1+d)$ is super-metric. *International Mathematical Forum* 12:861-868.
11. Warrens MJ (2016) Inequalities between similarities for numerical data. *Journal of Classification* 33:141-148.
12. Warrens MJ (2016) Category kappas for agreement between fuzzy classifications. *Neurocomputing* 194:385-388.
13. Warrens MJ (2016) A comparison of reliability coefficients for psychometric tests that consist of two parts. *Advances in Data Analysis and Classification* 10:71-84.
14. Warrens MJ, Bunga C. Pratiwi (2016) Kappa coefficients for circular classifications. *Journal of Classification* 33: 507-522.
15. Warrens MJ (2016) Semigroups of data normalization functions. *International Mathematical Forum* 11:809-815.
16. Wijsman LA, Warrens MJ, Saab N, Van Driel JH, Westenberg PM (2016) Declining trends in student performance in lower secondary education. *European Journal of Psychology of Education* 31:595-612.
17. Warrens MJ (2015) Relative quantity and allocation disagreement measures for category-level accuracy assessment. *International Journal of Remote Sensing* 36:5959-5969.
18. Warrens MJ (2015) Five ways to look at Cohen's kappa. *Journal of Psychology & Psychotherapy* 5:197.
19. Warrens MJ (2015) Properties of the quantity disagreement and the allocation disagreement. *International Journal of Remote Sensing* 36:1439-1446.
20. Warrens MJ (2015) Some relationships between Cronbach's alpha and the Spearman-Brown formula. *Journal of Classification* 32:125-137.
21. Erdmann TP, De Mast J, Warrens MJ (2015) Some common errors of experimental design, interpretation and inference in agreement studies. *Statistical Methods in Medical Research* 24:920-935.
22. Warrens MJ (2015) Additive kappa can be increased by combining adjacent categories. *International Mathematical Forum* 10:323-328.
23. Warrens MJ, de Raadt A (2015) Ordering properties of the first eigenvector of certain similarity matrices. *Journal of Mathematics*, ID 582731.

24. Warrens MJ (2015) On association measures for continuous variables and correction for chance. *Journal of Probability and Statistics*, ID 375491.

25. Warrens MJ (2014) Corrected Zegers-ten Berge coefficients are special cases of Cohen's weighted kappa. *Journal of Classification* 31:179-193.

26. Warrens MJ (2014) On marginal dependencies of the 2×2 kappa. *Advances in Statistics*, ID 759527.

27. Warrens MJ (2014) Power weighted versions of Bennett, Alpert and Goldstein's *S*. *Journal of Mathematics*, ID 231909.

28. Warrens MJ (2014) On agreement tables with constant kappa values. *Advances in Statistics*, ID 853090.

29. Warrens MJ (2014) On Cronbach's alpha as the mean of all possible k-split alphas. *Advances in Statistics*, ID 742863.

30. Warrens MJ (2014) New interpretations of Cohen's kappa. *Journal of Mathematics*, ID 203907.

31. Warrens MJ (2013) Cohen's weighted kappa with additive weights. *Advances in Data Analysis and Classification* 7:41-55.

32. Warrens MJ (2013) Conditional inequalities between Cohen's kappa and weighted kappas. *Statistical Methodology* 10:14-22.

33. Warrens MJ (2013) Weighted kappas for 3×3 tables. *Journal of Probability and Statistics*, ID 325831.

34. Warrens MJ (2013) A comparison of multi-way similarity coefficients for binary sequences. *International Journal of Research and Reviews in Applied Sciences* 16:64-75.

35. Warrens MJ (2013) The Cicchetti-Allison weighting matrix is positive definite. *Computational Statistics and Data Analysis* 59:180-182.

36. Warrens MJ (2013) On fixed points of the correction for chance function for 2×2 association coefficients. *International Journal of Research and Reviews in Applied Sciences* 15:239-247.

37. Warrens MJ (2013) On association coefficients, correction for chance, and correction for maximum value. *Journal of Modern Mathematics Frontier* 2:111-119.

38. Warrens MJ (2013) A comparison of Cohen's kappa and agreement coefficients by Corrado Gini. *International Journal of Research and Reviews in Applied Sciences* 16:345-351.

39. Warrens MJ (2012) Some paradoxical results for the quadratically weighted kappa. *Psychometrika* 77:315-323.

40. Warrens MJ (2012) Cohen's linearly weighted kappa is a weighted average. *Advances in Data Analysis and Classification* 6:67-79.

41. Warrens MJ (2012) Equivalences of weighted kappas for multiple raters. *Statistical Methodology* 9:407-422.

42. Warrens MJ (2012) The effect of combining categories on Bennett, Alpert and Goldstein's S. *Statistical Methodology* 9:341-352.

43. Warrens MJ (2012) A family of multi-rater kappas that can always be increased and decreased by combining categories. *Statistical Methodology* 9:330-340.

44. Warrens MJ (2012) Cohen's quadratically weighted kappa is higher than linearly weighted kappa for tridiagonal agreement tables. *Statistical Methodology* 9:440-444.

45. Warrens MJ (2012) On the equivalence of multi-rater kappas based on 2-agreement and 3-agreement with binary scores. *ISRN Probability and Statistics*, ID 656390.

46. Warrens MJ (2011) Cohen's kappa is weighted average. *Statistical Methodology* 8:473-484.

47. Warrens MJ (2011) Cohen's linearly weighted kappa is a weighted average of 2×2 kappas. *Psychometrika* 76:471-486.

48. Warrens MJ (2011) Chance-corrected measures for 2×2 tables that coincide with weighted kappa. *British Journal of Mathematical and Statistical Psychology* 64:355-365.

49. Warrens MJ (2011) Weighted kappa is higher than Cohen's kappa for tridiagonal agreement tables. *Statistical Methodology* 8:268-272.

50. Warrens MJ (2010) A formal proof of a paradox associated with Cohen's kappa. *Journal of Classification* 27:322-332.

51. Warrens MJ (2010) Inequalities between multi-rater kappas. *Advances in Data Analysis and Classification* 4:271–286.

52. Warrens MJ (2010) Cohen's kappa can always be increased and decreased by combining categories. *Statistical Methodology* 7:673–677.

53. Warrens MJ (2010) A Kraemer-type rescaling that transforms the odds ratio into the weighted kappa coefficient. *Psychometrika* 75:328–330.

54. Warrens MJ (2010) Inequalities between kappa and kappa-like statistics for $k \times k$ tables. *Psychometrika* 75:176–185.

55. Warrens MJ (2010) n-Way metrics. *Journal of Classification* 27: 173-190.

56. Warrens MJ (2009) On Robinsonian dissimilarities, the consecutive ones property and latent variable models. *Advances in Data Analysis and Classification* 3:169–184.

57. Warrens MJ (2009) k-Adic similarity coefficients for binary (presence/absence) data. *Journal of Classification* 26:227–245.

58. Warrens MJ (2009) A comment on "The J index as a measure of nominal scale response agreement". *Applied Psychological Measurement* 33:486–487.

59. Warrens MJ, Heiser WJ (2009) Diagnostics for regression dependence in tables re-ordered by the dominant correspondence analysis solution. *Computational Statistics and Data Analysis* 53:3139–3144.

60. Warrens MJ (2008) On similarity coefficients for 2×2 tables and correction for chance. *Psychometrika* 73:487–502.

61. Warrens MJ (2008) On association coefficients for 2×2 tables and properties that do not depend on the marginal distributions. *Psychometrika* 73:777–789.

62. Warrens MJ (2008) On the indeterminacy of resemblance measures for binary (presence/absence) data. *Journal of Classification* 25:125–136.

63. Warrens MJ (2008) On the equivalence of Cohen's kappa and the Hubert-Arabie adjusted Rand index. *Journal of Classification* 25:177–183.

64. Warrens MJ (2008) Bounds of resemblance measures for binary (presence/absence) variables. *Journal of Classification* 25:195–208.

65. Warrens MJ (2008) On multi-way metricity, minimality and diagonal planes. *Advances in Data Analysis and Classification* 2:109–119.

66. Warrens MJ, De Gruijter DNM, Heiser WJ (2007) A systematic comparison between classical optimal scaling and the two-parameter IRT model. *Applied Psychological Measurement* 31:106–120.

67. Joekes K, Maes S, Warrens MJ (2007) Predicting quality of life and self-management from dyadic support and overprotection after myocardial infarction. *British Journal of Health Psychology* 12:473–489.

68. Colzato LS, Warrens MJ, Hommel B (2006) Priming and binding in and across perception and action: A correlational analysis of the internal structure of event files. *Quarterly Journal of Experimental Psychology, Part A* 59:1785–1804.

69. Warrens MJ, Heiser WJ, De Gruijter DNM (2005) Reparametrization of homogeneity analysis to accommodate parallel item response functions. *Behaviormetrika* 32:127–139.

Contributions to books

1. Warrens MJ (2015) On Cronbach's alpha as the mean of all split-half reliabilities. In R.E. Millsap et al. (eds.) *Quantitative Psychology Research*. The 78th Annual Meeting of the Psychometric Society, Springer Proceedings in Mathematics & Statistics 89, 293–300.

2. Heiser WJ, Warrens MJ (2010) Families of relational statistics for 2×2 tables. In H Kaul and HM Mulder (eds) *Advances in Interdisciplinary Applied Discrete Mathematics*, 25–52. Singapore: World Scientific.

3. Heiser WJ, Warrens MJ (2008) On the recovery of the consecutive ones property by generalized averaging algorithms. In K Shigemasu, A Okada, T Imaizumi, and T Hoshino (eds) *New Trends in Psychometrics*, 107–110. Tokyo: University Academic Press.

4. Warrens MJ (2008) On resemblance measures for binary data and correction for maximum value. In K Shigemasu, A Okada, T Imaizumi, and T Hoshino (eds) *New Trends in Psychometrics*, 543–548. Tokyo: University Academic Press.

5. Warrens MJ, Heiser WJ (2007) Robinson Cubes. In P Brito, P Bertrand, G Cucumel and F de Caravalho (eds) *Selected Contributions in Data Analysis and Classification*, 515–523. Heidelberg: Springer.

6. Warrens MJ, Heiser WJ (2006). Scaling unidimensional models with multiple correspondence analysis. Chapter 9 in M J Greenacre and J Blasius (eds) *Multiple Correspondence Analysis and Related Methods*, 219–235. Boca Raton: Chapman and Hall/CRC.

Other publications

1. Gower JC, Warrens MJ (2017) Similarity, dissimilarity, and distance, measures of. Wiley StatsRef: Statistics Reference Online.

2. Warrens MJ, De Raadt A, Vugteveen J, Van Rijn N, Korpershoek H, Guldemond H, Timmermans AC, Van Rooijen M, Opdenakker M-C (2016) Overgangen en aansluitingen in het onderwijs. Deel-rapportage 4: Draaien aan de knoppen: een simulatiestudie naar de effecten van enkele beleidsparameters op de aansluiting po-vo. GION Onderwijs/Onderzoek: Groningen.

3. Warrens MJ, van Rooijen M, Korpershoek H, Opdenakker MC (2016) Maak brugklassen breed en meerjarig. Didactief, 46, 24-25.

4. Warrens MJ (2014) Heiser numbers. In M de Rooij and CM van Putten (eds) Psychology and Statistics: Ready for the Future? Liber Amicorum for Willem J Heiser. Leiden: Leiden University.

5. Warrens MJ (2008) *Similarity Coefficients for Binary Data. Properties of Coefficients, Coefficient Matrices, Multi-way Metrics and Multivariate Coefficients*. Proefschriftmaken.nl: Oisterwijck.

6. Warrens MJ (2008) A comment on Zysno's "The Modification of the Phi-coefficient Reducing its Dependence on the Marginal Distributions".
www.dgps.de/fachgruppen/methoden/mpr-online/issue2/index.html

Talks

Invited

1. Warrens MJ (2017) On the Gini coefficient, Cohen's kappa, weighted kappa, ICCs and the SB formula. P&S Groningen.

2. Warrens MJ (2010) Understanding Cohen's kappa. MTO Tilburg.

3. Warrens MJ (2008) On similarity coefficients for 2×2 tables and correction for chance. IOPS Leiden.

Contributed

1. De Raadt A, Warrens MJ, Bosker RJ, Kiers HAL (2018) A comparison of agreement coefficients for categorical and interval scales. IOPS at CITO Arnhem

2. Warrens MJ (2018) On the negative bias of the Gini coefficient due to grouping. VOC Utrecht.

3. Van der Hoef H, Warrens MJ (2018) Mogelijkheden en keuzes bij het clusteren van onderwijsdata. ORD Nijmegen.

4. Dijks M, Warrens MJ (2018) Schooladviezen voor het voortgezet onderwijs: advies van de leerkracht vs centrale eindtoets. ORD Nijmegen.

5. Warrens MJ, Van der Hoef H (2017) Understanding external validity indices. IFCS Tokyo.

6. Van der Hoef H, Warrens MJ (2017) Understanding information-theoretic measures for comparing clusterings. IFCS Tokyo.
7. De Jong R, Brouwer J, Warrens MJ (2017) Pitch onderwijs. Data challenge RUG-CBS Groningen.
8. Warrens MJ (2017) Modelleren van schoolloopbaankansen van leerlingen. ORD Antwerpen.
9. De Raadt A, Warrens MJ (2017) Kappa coefficients for missing data. IOPS Leuven.
10. Warrens MJ, Van der Hoef H (2017) External validity indices for individual clusters. VOC Leiden.
11. Van der Hoef H, Warrens MJ (2017) Decomposing information-theoretic indices. VOC Leiden.
12. Warrens MJ (2016) Modelleren van schoolsoorten en schoolloopbanen. ORD Rotterdam.
13. Warrens MJ (2016) Modelleren van schoolsoorten en schoolloopbanen. Kom over de brug! Rotterdam.
14. Van Rooijen M, Korpershoek H, Warrens MJ, Opdenakker M-C (2016) De po-vo overgang: Bevindingen op basis van empirisch onderzoek en simulatie. ORD Rotterdam.
15. Van Rooijen, M, Korpershoek H, Warrens MJ, Opdenakker M-C (2016) De po-vo overgang: Bevindingen op basis van empirisch onderzoek en simulatie. Kom over de brug! Rotterdam.
16. Warrens MJ (2015) Mediation analysis. Seminar general statistics Groningen.
17. Warrens MJ (2015) Correction for chance and correction for maximum value. IFCS Bologna.
18. Warrens MJ (2014) Descriptions of Cronbach's alpha. M&S Leiden.
19. Warrens MJ (2013) On the abundance of false positives in psychology. M&S Leiden.
20. Warrens MJ (2013) Cronbach's alpha as the mean of all split-half reliabilities. IMPS Arnhem.
21. Warrens MJ (2013) Pearson's r is a special case of Cohen's weighted kappa. IFCS Tilburg.
22. Warrens MJ (2013) Circle maps. Dynamical systems seminarium, Mathematics Leiden.
23. Warrens MJ (2012) Cohen's weighted kappa. M&T Leiden.
24. Warrens MJ (2012) De stelling van Gel'fond-Schneider. Bachelorseminarium Mathematics Leiden.
25. Warrens MJ (2012) Transcendente getallen. Bachelorseminarium Mathematics Leiden.
26. Warrens MJ (2009) On multi-way metricity, minimality and diagonal planes. IFCS Dresden.
27. Heiser WJ, Warrens MJ (2009) Detecting complete positive regression: Using the dominant axis of correspondence analysis. IMPS Cambridge.
28. Heiser WJ, Warrens MJ (2008) Horseshoe effects in multiple correspondence analysis: distance transformations that let them disappear. CSNA St. Louis.
29. Warrens MJ (2007) Some relations between similarity coefficients for binary data. IOPS Utrecht.
30. Warrens MJ (2007) On the equivalence of Cohen's kappa and the Hubert-Arabie adjusted Rand index. IMPS Tokyo.
31. Warrens MJ (2007) Some relations between similarity coefficients: Correction for chance similarity and k-adic formulations. M&T Leiden.
32. Warrens MJ (2005) Scaling monotone latent variable models with multiple correspondence analysis. IMPS Tilburg.
33. Warrens MJ (2004) On ordering properties in classical optimal scaling. RC33 Amsterdam.
34. Warrens MJ (2004) On reciprocal averaging of a binary matrix. M&T Leiden.
35. Warrens MJ (2004) Some properties of classical optimal scaling. IMPS Monterey.
36. Warrens MJ (2003) Homogeneity analysis and the Rasch model. M&T Leiden.
37. Warrens MJ (2003) Homogeneity analysis applied to data from unidimensional cumulative IRT models. IOPS Amsterdam.
38. Warrens MJ (2003) Properties of homogeneity analysis of dichotomous test items. IMPS Cagliari.