Interuniversity Graduate School of Psychometrics and Sociometrics

- Leiden University
- University of Amsterdam
- University of Groningen
- Twente University
- Tilburg University
- Utrecht University
- KU Leuven, University of Leuven

Annual report 2012

Interuniversity Graduate School of Psychometrics and Sociometrics
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Contents

Introduction

This annual report presents the activities, achievements and resources of the Interuniversity Graduate School of Psychometrics and Sociometrics (IOPS) for the year 2012.

As usual, IOPS had a Summer conference (28-29 June 2012, in Maastricht) and a Winter conference (18-19 December 2012, in Enschede). Six specialized courses targeted at IOPS PhD students were organized (in Leiden, Utrecht, Tilburg, Twente, Groningen, and Leuven).

In 2012, 17 PhD projects were successfully completed with a thesis, 22 new projects were started, 3 projects were continuing beyond the original time limit, and no projects were left unfinished. On December 31, 2012, 53 PhD projects were still in progress. IOPS was happy to welcome 2 new junior staff members, while 1 senior staff member left IOPS, and 7 junior staff members were promoted to senior members. The total amount of staff counted 108 by the end of the year.

Sadly, we regret to report that we lost two of our long-time good colleagues: Dr. Rien van der Leeden died on July 24, 2012, after being ill for more than a year, and Dr. Wijbrandt van Schuur tragically died after a car accident in the United States, on July 25, 2012.

On the bright side, we are proud to mention that three of our senior staff members were honored with a scientific award. Professor Theo Eggen won the prize for the best PhD student supervisor of the Vereniging voor Onderwijsresearch, professor Han van der Maas won the Marie Curie TEMCOM prize, and professor Eric-Jan Wagenmakers was the inaugural recipient of the Newcastle Psychology Research Visitor Fellowship. We are also happy that we were able to win three NWO Research Talent Grants: one for Sascha Epskamp (Amsterdam), one for Tanja Krone (Groningen), and one for Abe Hofman (Amsterdam), and welcomed several new research grants for our Belgian colleagues from Leuven. Our former PhD student Baerbel Maus (Maastricht) won an NWO Rubicon Grant for a one-year post-doc position at the University of Warwick, UK. Finally, Rogier Kievit (Amsterdam) won the IOPS best paper award for his paper in the journal *Psychological Inquiry*.

In summary, IOPS is flourishing as ever before, and continues to live up to its reputation as the place to be for psychometricians and sociometricians all over Europe.

Willem J. Heiser,

President of the Board

1 Organization

1.1 Board

The IOPS Board consists of seven members delegated by the participating universities. At most three representatives of other research institutes may be appointed as an IOPS board member. Futhermore, two dissertation students' representatives attend the board meetings.

On 31 December 2012 the IOPS Board consisted of:
- Prof. Dr. W.J. Heiser, Chair, Leiden University
- Dr. D. Borsboom, University of Amsterdam
- Prof. Dr. R.R. Meijer, University of Groningen
- Prof. Dr. H. Kelderman, VU University Amsterdam
- Dr. G.J.A. Fox, Twente University
- Dr. L.A. Van der Ark, Tilburg University
- Prof. Dr. P.G.M. van der Heijden, Utrecht University
- Prof. Dr. F. Tuerlinckx, KU Leuven, University of Leuven
- Dr. A.A. Béguin, CITO (National Institute for Educational Measurement)
- Prof. Dr. J.G. Bethlehem, CBS (Statistics Netherlands)

President / Sctientific Director
Prof. Dr. W.J. Heiser, Leiden University.

PhD representatives
Iris Smits (University of Groningen), who served as asistant PhD student representative for a period of one year (1 January 2011 - 31 december 2011), was appointed as first representative as of 1 January 2012, for a period of one year. Renske Kuijpers (Tilburg University) was appointed assistant PhD student representative as of 1 January 2012 for a period of one year.

Changes in the IOPS Board
During the year 2012 Peter van der Heijden replaced Herbert Hoijtink as a delegate of Utrecht University in the IOPS Board.

Board meetings
The IOPS Board meets four times a year. In 2012 Board meetings were held on 19 April, 28 June, 12 October, and 18 December 2012.

1.2 Office

Since 1 October 2000 the IOPS Graduate School holds office at Leiden University. The secretariat is accommodated at:

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1.3 List of participating institutes

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Education and Child Studies

Institute of Education
Faculty of Social and Behavioural Sciences
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Statistical Science for the Life and Behavioral Sciences

Mathematical Institute
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University of Amsterdam

Psychological Methods

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Work and Organizational Psychology

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Methods and Statistics

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University of Groningen

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Theoretical Sociology

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Twente University

Educational Measurement and Data Analysis

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Methodology and Statistics

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Methodology and Statistics

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KU Leuven, University of Leuven, Belgium

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1.4 List of cooperating institutes

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Maastricht University

Department of Methodology and Statistics

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Erasmus University Rotterdam

Department of Econometrics

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Secretary Tineke Kurtz
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Psychology Institute

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Secretary Hanny Langedijk, Susan Schuring

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Wageningen University

Research Methodology Group

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2 Staff

The members of the staff belong to the participating universities. There are two categories of staff members: junior and senior staff members. Both require acknowledgment in their field according to, among others, international publications. Junior staff members have obtained their PhD less than five years ago, and do not necessarily have (co-)responsibility of dissertation research. Senior staff members do have (co-)responsibility of dissertation research.

Associated staff
In 1994, the establishment of graduate schools and the rearrangement of staff members as a result of this, caused IOPS to introduce a new category of staff for those who - for formal reasons - could not be a regular IOPS staff member. The requirements for associated staff members are identical to those of regular staff members. PhD students of these associated staff members can be admitted to IOPS as an external dissertation student.

2.1 Professorships

As of 1 April 2012, Dr. Lidia Arends (Erasmus University Rotterdam) was appointed professor of Methodology and Statistics of Social Science Research at the Faculty of Social Sciences of Erasmus University Rotterdam.

As of May 2012, Dr. Eric-Jan Wagenkmakers (University of Amsterdam) was appointed professor of Neurocognitive modeling : Interdisciplinary integration at the Faculty of Social and Behavioural Sciences of the University of Amsterdam (UvA).

2.2 Staff meetings

Plenary meetings for all IOPS members (staff and PhD students) are held twice a year during the IOPS conferences. In 2012 two plenary meetings took place, one on 28 June and one on 18 December 2012.

2.3 Staff changes

Junior staff members admitted to IOPS in 2012
- Dr. Marian **Hickendorff,** Leiden University
- Dr. Marike **Polak,** Erasmus University Rotterdam

Junior staff members leaving IOPS in 2012
No junior staff members left IOPS in 2012.

Senior staff members admitted to IOPS in 2012
No senior staff members were admitted to IOPS in 2012.

Senior staff members leaving IOPS in 2012
One staff members left IOPS in 2012.
- Prof. Dr. **Ger Snijkers,** Utrecht University

From junior staff to senior staff in 2012
- Dr. Wilco Emons, Tilburg University
- Dr. Marcel van Assen, Tilburg University
- Dr. Jelte Wicherts, Tilburg University
- Prof. Dr. Lidia Arends, Erasmus University
- Dr. Samantha Bouwmeester, Erasmus University
- Dr. Bas Hemker, Cito, Arnhem
- Dr. Frans Tan, Maastricht University

2.4 Number of staff members

On 1 January 2012, the IOPS staff consisted of 108 members:
- 24 junior staff members
- 73 senior staff members
- 11 honorary emeritus members

On 31 December 2012, the IOPS staff consisted of 107 members:
- 20 junior staff members
- 76 senior staff members
- 11 honorary emeritus members

2.5 List of staff members

Staff members at Leiden University

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- Dr. Henk **Kelderman** (senior)
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- Dr. Kees **Van Putten** (senior)
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Institute of Education and Child Studies

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Mathematical Institute

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Department of Developmental Psychology

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2.6 List of associated staff members

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2.7 List of honorary emeritus members

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3 Scientific awards and grants

3.1 Awards and grants honored to IOPS staff members

3.1.1 Scientific awards

In 2012, the following IOPS staff members were honored with a scientific award:

Eggen, T.J.H.M. (2011). Prize for the best PhD student supervisor of 2010. Vereniging voor Onderwijs-research (VOR). [This award was not included in the IOPS 2011 Annual Report]

Van der Maas, H.L.J. (2012). Marie Curie TEMCOM - Testing the multi-component model of human cognitive abilities.

Wagenmakers, E.-J. (2012). Inaugural recipient of the Newcastle Psychology Research Visitor Fellowship.

3.1.2 NWO grants

3.1.2.1 NWO Veni, Vidi, Vici grants

The Veni, Vidi, and Vici grants are part of the NWO Innovational Research Incentives Scheme [Vernieuwingsimpuls]. The following IOPS researchers were awarded:

- **Borsboom,** Denny (2007), University of Amsterdam
  Grant: Vidi grant
  Project: Causal networks for psychological measurement
  Period: 1 March 2008 - 1 March 2013
  Budget: € 600.000

- **Fox**, Jean-Paul (2007), Twente University
  Grant: Vidi grant
  Project: Bayesian methodology for large-scale comparative research
  Period: 1 December 2007 - 1 December 2012
  Budget: € 600.000

- **Hamaker**, Ellen (2010), Utrecht University
  Grant: Vidi grant
  Project: Time for change: Studying individual differences in dynamics

Period: 1 May 2011 - 1 May 2016
Budget: € 800.000

- **Moerbeek**, Mirjam (2008), Utrecht University
  Grant: Vidi grant
  Project: Improving statistical power in studies on event occurrence by using an optimal design
  Period: 1 February 2009 - 1 February 2014
  Budget: € 600.000

- **Morey,** Richard (2010), University of Groningen
  Grant: Veni grant
  Project: A modelling-based approach to testing item-based versus resource-based working memory storage
  Period: 1 May 2011 - 1 May 2014
  Budget: € 250.000

- **Raijmakers**, Maartje (2006), University of Amsterdam
  Grant: Vidi grant
  Project: The dynamics of rule learning in infants and preschoolers
  Period: 1 April 2007 - 1 April 2012
  Budget: € 405.600

- **Stegeman**, Alwin (2008), University of Groningen
  Grant: Vidi grant
  Project: Multi-way decompositions : Existence and uniqueness
  Period: 6 February 2009 - 5 February 2014
  Budget: € 600.000

- **Van de Schoot,** Rens (2011)
  Grant: Veni grant
  Project; Integrating background knowledge about traumatic stress experienced after trauma into statistical models assessing individual change over time
  Period: January 2011 – January 2016
  Budget: € 250.000

- **Vermunt**, Jeroen (2010), Tilburg University
  Grant: Vici grant
  Project: Stepwise model-fitting approaches for latent class analysis and related methods
  Period: 23 June 2011-22 June 2016
  Budget: € 1.500.000

- **Wagenmakers**, Eric-Jan (2006), University of Amsterdam
  Grant: Vidi grant
  Project: Modeling the relation between speed and accuracy [Rot maar vlot].
  Period: 1 June 2007 - 1 June 2012
  Budget: € 600.000

- **Wicherts**, Jelte (2007), University of Amsterdam
  Grant: Veni grant
  Project: Measurement distortion in experimental psychology and how factor analysis can help restore construct validity
  Period: 1 June 2007 - 1 June 2012
  Budget: € 208.000

- **Wicherts**, Jelte (2011), Tilburg University
  Grant: Vidi grant
  Project: Human Factors in Statistics
  Period: 1 Sept 2012 - 31 Aug 2017
  Budget: € 799.617

3.1.2.2 NWO Aspasia grants

With the Aspasia grants, NWO stimulates the promotion of female researchers in higher ranking. The following IOPS researchers were awarded:

- **Hamaker**, Ellen (2011), Utrecht University
  Grant: NWO Aspasia grant
  Project: Vidi project: Time for change: Studying individual differences in dynamics
  Period: 2011-2016
  Budget: € 100.000

- **Moerbeek,** Mirjam (2009), Utrecht University
  Period: 1 February 2009 - 1 February 2014
  Budget: € 100.000

- **Raijmakers,** Maartje (2006), University of Amsterdam
  Period: 1 April 2007 - 2012
  Budget: € 100.000

3.1.2.3 NWO Open Competition grants

The Open Competition is subsidy program for the advancement of innovative and high-quality scientific research in the social and behavioral sciences. The following IOPS researchers received an Open Competition grant by NWO (details of the research projects can be found in Chapter 4):

- **De Rooij,** Mark (2010), Leiden University
  Project: Multivariate logistic regression using the ideal point classification model
  PhD student: Haile M. Worku
  Period: 1 October 2010 - 1 October 2014
  Budget: € 209.513

- **Sijtsma,** Klaas, Wilco **Emons,** & Marcel **Van Assen** (2007), Tilburg University
  Project: Person-misfit in Item Response Models explained by means of nonparametric and multi-level logistic regression models
  PhD student: Judith **Conijn**
  Period: 2007 - 2012
  Budget: € 181.871

- **Sijtsma,** Klaas, & Wilco **Emons** (2006), Tilburg University
  Project: Minimal requirements of the reliability of tests and questionnaires
  PhD student: Peter **Kruyen**
  Period: 15 November 2008 - 15 November 2012
  Budget: € 181.871

- **Timmerman,** Marieke & Rob **Meijer** (2009), University of Groningen
  Project: Dimensionality assessment of polytomous Items
  PhD student: M.T. **Barendse**
  Period: 1 September 2010 - 1 September 2014
  Budget: € 209.513

- **Van der Ark,** Andries, Marcel **Croon**, & Klaas **Sijtsma** (2008), Tilburg University
  Project: Test construction using marginal models
  PhD student: Irena Mikolajun
  Period: 1 January 2009 - 1 January 2013
  Budget: € 186.995

- **Vermunt,** Jeroen, Andries **Van der Ark**, & Klaas **Sijtsma** (2009), Tilburg University
  Project: Multiple imputation using mixture models
  PhD student: Daniël **Van der Palm**
  Period: 1 September 2009 - 1 September 2013
  Budget: € 207.155

- **Wagenmakers,** Eric-Jan, Birte Forstmann, Sander Nieuwenhuis, & Han **Van der Maas** (2011), University of Amsterdam
  Project: A dynamic and formal account of what people do before and after they make an error
  PhD student: Helen Steingroever
  Period: 1 September 2011 - 1 September 2015
  Budget: € 208.193

- **Wagenmakers,** Eric-Jan & Birte Forstmann (2008), University of Amsterdam
  Project: The anatomical and neurochemical foundations of decision-making under time pressure
  Project leader: Birte **Forstmann**
  PhD student: Jasper Winkel
  Period: 1 April 2009 - 1 April - 2013
  Budget: € 218.000

- **Wagenmakers,** Eric-Jan, Birte Forstmann, Sander Nieuwenhuis, Rafal Bogacz, Scott Brown, John Serences & Han van der Maas. (2010):
  Project: The neural basis of decision-making with multiple choice alternatives
  Postdoc: Martijn Mulder
  Period: 01 June 2010 - 1 June 2013
  Budget: € 231.635

- **Wicherts,** Jelte (2009), University of Amsterdam
  Project: Expectancy effects on the analysis of behavioral research data.
  PhD student: Marjan Bakker
  Period: 1 April 2009 - 1 April 2013
  Budget: € 207.155

3.1.2.4 NWO Research Talent grants

NWO Research Talent is a responsive mode funding scheme, which offers talented and ambitious young researchers a platform to pursue a scientific career and carry out high-quality PhD research.

- **Borsboom,** Denny (2012), University of Amsterdam
  Project: Network psychometrics
  PhD student: Sacha Epskamp
  Period: 1 June 2006 - 20 September 2011
  Budget: € 167.576

- **Timmerman,** Marieke & Rob **Meijer** (2012), University of Groningen
  Project: Understanding human behavioural processes with Bayesian dynamic models
  PhD student: Tanja Krone
  Period: 1 July 2012 - 1 March 2016
  Budget: € 161.363

- **Van der Maas, H.L.J.** (2012), University of Amsterdam
  Project: Analyzing developmental change with time-series data of a large scale educational monitoring system
  PhD student: Abe **Hofman**
  Period: 1 September 2012 – 1 September 2016
  Budget: € 168.576

3.1.2.5 Other NWO grants

- **Huizenga,** Hilde, Raoul **Grasman,** Ingmar **Visser,** & Ellen **Hamaker** (2011)
  Grant: NWO Added Value for the Social Sciences by ("Meerwaarde")
  Project: A user-friendly website to improve evidence-based clinical practice
  Period: 2012-2013
  Budget: € 40.000

- Marija Maric & Denny **Borsboom** (2011)
  Grant: NWO Added Value for the Social Sciences ("Meerwaarde")
  Project: Evaluatie van werkingsmechanismen van behandelingen: De weg naar evidence-based practice
  Period: 1 October 2011 – 1 February 2013
  Budget: € 31.464

- **Van Putten,** Kees (Leiden University) & Anthon Béguin (Cito)
  Grant: NWO-PROO
  Project: Mathematics education in the classroom and students' strategy use and achievement in primary education
  Period: 1 September 2011 – 1 September 2015
  Budget: € 299.850

3.1.3 International grants

- Brown, S., A. Eidels, A. Heathcote, & Eric-Jan **Wagenmakers** (2011).
  Grant: Australian Research Council
  Project: Rapid decisions: From neuroscience to complex cognition
  Period: 2012-2014
  Budget: AUS $ 134,000

- **Gu Xin** and Herbert **Hoijtink** (2011)
  Grant: Chinese Scholarship Council
  Project Bayesian Evaluation of Inequality Constrained Hypotheses.
  Period: 2011-2015
  Budget: € 65.000

- **Jolani,** Shahab (2010)
  Grant: Statistical Research and Training Center, Tehran, Iran
  Project Investigation of Statistical Properties of proper ways to combine the nonresponse model and the outcome model for drawing imputations.
  Period: July 2010-June 2012
  Budget: € 36.000

- Karayanidis, F., R. Lenroot, M. Parsons, P. Michie, & Eric-Jan **Wagenmakers** (2011)
  Grant: Australian Research Council
  Project: Cognitive flexibility from adolescence to senescence: Variability associated with cognitive strategy and brain connectivity
  Period: 2012-2014
  Budget: AUS $ 387,000

- **Snijders,** Tom (2008), University of Oxford, United Kingdom
  Grant: Grant by National Institutes of Health (USA). Grant number: 1R01HD052887-01A2
  Principal investigator: John M. Light.
  Project: Adolescent peer social network dynamics and problem behavior
  Sub-project carried out at the University of Oxford and led by Tom Snijders
  Period: 2008-2012
  Budget: $ 711.324

- **Wagenmakers,** Eric-Jan (2012)
  Grant: Partner investigator on the Australian Research Council
  Project: Cognitive Flexibility from Adolescence to Senescence: Variability Associated with Cognitive Strategy and Brain Connectivity
  Period: 2012-2014
  Budget: AUS $ 387.000

- **Wagenmakers,** Eric-Jan (2012)
  Grant: Partner investigator on the Australian Research Council
  Project: Rapid Decisions: From Neuroscience to Complex Cognitions
  Period: 2012-2014
  Budget: AUS $ 134.000

- **Wagenmakers,** Eric-Jan (2011)
  Grant: Consolidator grant by the European Research Council
  Project: Bayes or Bust: Sensible hypothesis tests for social scientists
  Period: 1 May 2012-1 May 2017
  Budget: € 1.500.000

- **Wagenmakers,** Eric-Jan (2011).
  Grant: External advisor
  Project: Engineering and Physical Sciences Research Council project "Decision making in an unstable world" (investigators: Iain Gilchrist, Roland Baddeley, Rafal Bogacz, Simon Farrell, David Leslie, Casimir Ludwig, and John McNamara).
  Period: 2011-2015
  Budget: £ 1.858.354

3.1.4 Grants awarded to KU Leuven, University of Leuven

- **Ceulemans,** Eva, Patrick Onghena (KU Leuven, University of Leuven), and Marieke **Timmerman,** co-supervisor (University of Groningen) (2009)
  Grant: Grant by The National Fund for Scientific Research - Belgium [Fonds voor Wetenschappelijk Onderzoek - Vlaanderen]
  Project: Componenten- en HICLAS-modellen voor de analyse van structuurverschillen in reëelwaardige en binaire multivariate multiniveau gegevens
  Period: 1 January 2009 - 1 January 2013
  Budget: € 280.000

- **Tuerlinckx, Francis** (2012): KU Leuven, University of Leuven
  Grant: Grant by The National Fund for Scientific Research-Belgium [Fonds voor Wetenschappelijk Onderzoek-Vlaanderen]
  Project: Understanding the dynamics of the individual through network analyses of Experience Sampling data
  Period: 31 December 2012-31 December 2018
  Budget: € 296.517,65

- **Tuerlinckx**, Francis (2008), KU Leuven, University of Leuven
  Grant: Grant by The National Fund for Scientific Research - Belgium [Fonds voor Wetenschappelijk Onderzoek - Vlaanderen]
  Project: Niet-lineaire modellen voor affectdynamiek.
  Period: 2008 - 2012
  Budget: € 280.000

- **Van Mechelen,** Iven (2012), KU Leuven, University of Leuven
  Grant: Grant by Belgian Science Policy [Federaal Wetenschapsbeleid]
  Project: Developing crucial Statistical methods for Understanding major complex Dynamic Systems in natural, biomedical and social sciences
  Period: 2012 - 2017
  Budget: € 430.000

- **Van Mechelen,** Iven (2008), KU Leuven, University of Leuven
  Grant: Grant by The National Fund for Scientific Research - Belgium [Fonds voor Wetenschappelijk Onderzoek - Vlaanderen]
  Project: Een koninklijke weg tot een beter begrip van de mechanismen onderliggend aan persoonlijkheidsgerelateerd gedrag
  Period: 2008 - 2012
  Budget: € 280.000

- **Van Mechelen,** Iven, Francis **Tuerlinckx,** & Eva **Ceulemans** (2008), KU Leuven, University of Leuven
  Grant: GOA
  Project: Formele modellering van de tijdsdynamiek van emoties
  Period: 2008 - 2014
  Budget: € 1.400.000

- **Van Mechelen,** Iven (2011), KU Leuven, University of Leuven
  Grant: GSK (contract research) Van Mechelen -GSK Biologicals
  Project: Disentangling the innate and adaptive response to vaccines
  Period: 2011-2015
  Budget: € 200.000

- **Vanpaemel**, Wolf (2011), KU Leuven, University of Leuven
  Grant: OT (Onderzoekstoelage) and CREA; Research Council KU Leuven
  Project: The use of the prior predictive in modelling cognition
  Period: 2011-2015
  Budget: € 294.240

3.1.5 Other grants

- **Albers, C.J.** (2012).
  Grant: Contract with ProRail, Utrecht
  Project; Statistical analysis of data on railway accidents
  Period: 2012
  Budget: € 17.600

- **Boeije,** Hennie (2011), Utrecht University
  Grant: ZonMw (The Netherlands Organization for Health Research and Development)
  Project: Central Utrecht Elderly Care Project
  Period: September 2009 - September 2012
  Budget: € 2.326.459

- Boersma, P., Maartje **Raijmakers**, & S. Bögels, S. (2009), University of Amsterdam
  Grant: Cognition Program, Cognitive Science Center Amsterdam
  Project: Models and tests of early category formation: interactions between cognitive, emotional, and neural mechanisms
  Period: 2009 - 1 September 2015
  Budget: € 470.000

- Boo, G. de, P. Prins, T.G. Van Manen, & Hilde **Huizenga** (2007), University of Amsterdam
  Grant: ZonMW, Programma "Jeugd: Vroegtijdige signalering & interventies"
  Project: Effectiveness of a stepped-care school-based intervention for children with disruptive behavior disorders [Ontwikkeling en toetsing van een multisysteem interventieprogram-ma voor kinderen met gedragsproblemen uitgevoerd op school].
  Period: 1 April 2008 - 1 May 2012
  Budget: € 386.041

- **Candel,** Math (2011)
  Grant: ZonMw (The Netherlands Organization for Health Research and Development)
  Project; Sample size calculation for nested cost-effectiveness RCTs (PhD student project)
  Period: April 2012 - April 2016
  Budget: € 115.000

- Groeneveld, C. & Han **Van der Maas** (2010)
  Grant: SURF Foundation Tender: Toetsing en Toetsgestuurd Leren
  Project: Computer Adaptieve Monitoring in het statistiekonderwijs
  Period: 1 March 2011 - 28 March 2013
  Budget: € 348.821

- **Hoijtink,** Herbert & Guenther Maris (CITO) (2011),Utrecht University
  Grant: PhD project Unmixing Rasch Models. Funded by CITO and Dept. of Methodology and Statistics, Utrecht University
  Period: 2011-2015
  Budget: € 87.500 by CITO and € 87.500 by Dept. of Methodology and Statistics, Utrecht University

- **Hoijtink,** Herbert (2011),Utrecht University.
  Grant: Secondment to CITO for research on Diagnostic Testing. Funded by CITO
  Period: 2011-2012
  Budget: Approx. € 35.000

- Klinkenberg, S. & Han **Van der Maas** (2010)
  Grant: SURF Foundation Tender: Toetsing en Toetsgestuurd Leren
  Project: Nieuwe scoreregel voor digitale toetsen
  Period: 1 March 2011 – 28 March 2014
  Budget: € 77.766

- **Klugkist,** Irene and Kristel Janssen, (main applicants); Herbert **Hoijtink**, Carl Moons, (2009), Utrecht University
  Grant: Grant for PhD-project in Focus area Epidemiology, Utrecht University
  Period: September 2009 - August 2013
  Budget: € 210.000

- **Meijer,** Rob & Jorge **Tendeiro** (2012), University of Groningen
  Grant: Law School Admission Council Research Grant (U.S.A)
  Projects: Assessment of the validity of total scores in high-stakes testing through nonparametric statistical techniques
  Period: February 2013 – Febrauary 2014
  Budget: $ 100.000

- **Raijmakers, Maartje**, Han **Van der Maas,** & A. Haarhuis (2011), University of Amsterdam
  Grant: Research Grant from the Platform Beta Techniek [TalentenKracht]
  Projects: 1) Mental models: Guiding knowledge development in the individual child
  2) Optimizing materials for experimentation
  Period: 1 January 2012 – 1 january 2016
  Budget: € 417.000

- Ruiter, S.A.J., B.F. Van der Meulen, Marieke **Timmerman,** & W. Ruijssenaars (2009), University of Groningen
  Grant: ZonMw (The Netherlands Organization for Health Research and Development), Programma "Zorg voor Jeugd: Handelingsgerichte diagnostiek voor jonge kinderen met cognitieve en/of functionele beperkingen"
  Period: 2009 - 2013
  Budget: € 449.510

- **Van der Heijden**, Peter & Maarten **Cruyf**f (2011), Utrecht University
  Grant: Ministerie van Justitie en Veiligheid, WODC.
  Project: Ontwikkeling nieuwe methodologie voor omvangschattingen van fluctuerende verborgen populaties
  Period: 2011 - 2012
  Budget: € 21.000

- **Van der Maas, H.L.J.** (2012), University of Amsterdam
  Grant: IEF Marie Curie
  Project: Kovacs: Testing the multi-component model of human cognitive abilities
  Period: 2011 - 2012
  Budget: € 191.000

- **Veldkamp,** Bernard (2010), Twente University
  Grant: Law School Admission Council
  Project: Data mining for testlet modeling and its applications
  Period: 2010 - 2012
  Budget: € 200.000

- **Veldkamp,** Bernard (2010), Twente University
  Grant: ECABO
  Project: Quality of performance tests (PhD student project)
  Period: 2010 - 2013
  Budget: € 250.000

- **Viechtbauer,** Wolfgang (2009), Maastricht University
  Grant: ZonMw (The Netherlands Organization for Health Research and Development)
  Principal Investigator: Marijn de Bruin
  Project: Determining the cost-effectiveness of an effective intervention to improve adherence among treatment-experienced HIV-infected patients in the Netherlands
  Period: 2009 - 2012
  Budget: € 428.095

- **Viechtbauer,** Wolfgang (2009), Maastricht University
  Grant: Funded by Pfizer and the Stichting Gezondheidscentra Eindhoven.
  Principal Investigator: Daniel Kotz
  Project: Helping more smokers to quit by COmbining VArenicline with COunselling for smoking cessation: The COVACO randomized controlled trial
  Period: 2009 - 2013
  Budget: € 300.000

- **Wagenmakers,** Erik-Jan & Birte Forstmann (2011)
  Grant: Academy Colloquium Grant by Royal Netherlands Academy of Arts and Sciences (KNAW)
  Project: Colloquium New insights from model-based cognitive neuroscience
  Period: 2012
  Budget: € 23.000

3.2 Awards and grants honored to IOPS PhD students

3.2.1 Scientific awards

In 2012, the following IOPS PhD students were honored with a scientific award:

Bringmann, Laura (2012). Best presentation at EPA-EU GEI Conference "Closing in on the Enviroment in Mental Health", Maastricht, The Netherlands, 14 June 2012. Title of presentation: *A network*

approach to psychopathology. Authors: L.F. Bringmann, D. Borsboom, M. Wichers, N. Geschwind, & F. Tuerlinckx. [€ 250]

Bringmann, Laura (2012). Prize for best article Bringmann, L.F. & Geurts, H.M. (2010). Planningsvaardigheden bij autismespectrumstoornissen: Een kwalitatief en kwantitatief overzicht, *Wetenschappelijk Tijdschrift Autisme.* [€ 250]

Brinkhuis, Matthieu (2011). The 2011 New Assessment Researcher Award by AEA-Europe. [€ 500]

He, Qiwei & **Bernard Veldkamp** (2012). Best Paper Presentation Award at the IGS annual PhD day: Enschede (18 October 2012). Title of the presentation: Screening for posttraumatic stress disorder (PTSD) using verbal features in patients' self narratives: A text mining approach.

Kievit, Rogier (2012). IOPS Best Paper Award 2011 for his paper: Kievit, R.A., Romeijn, J.W., Waldorp, L.J., Wicherts, J.M., Scholte, H.S., & Borsboom, D. (2011). Mind the gap: A psychometric approach to the reduction problem. *Psychological Inquiry*, 22: 67-87, 2011. [€ 600]

3.2.2 Grants

- **Maus,** Baerbel (2011)
  Grant: NWO Rubicon grant
  Project; Undo the voodoo: Correction of bias in neuroimaging, at University of Warwick, United Kingdom.
  Period: January 2012 - January 2013
  Budget: € 74.098

4 Students and projects

Applicants for the IOPS dissertation training must have a Master's degree in one of the following disciplines. Behavioral Sciences, Technical Sciences, Mathematics or Econometrics. They are appointed as PhD student, or as an indirectly financed PhD student. PhD students within IOPS are financed by the participating universities or by NWO (Netherlands Foundation of Scientific Research).
The annual report of 2011 reported a total of 48 PhD student projects in progress on 31 December 2011.
In 2012, 17 PhD student projects were concluded, 22 new projects were started. No projects were prematurely ended. On 31 december 2012, 53 projects were still in progress. Three more projects exceeded the project time limits and are therefor no longer mentioned in the 2012 summary of projects.

4.1 Status of projects

Concluded projects

From 1 January - 31 December 2012, the following 17 PhD students successfully defended their PhD theses:

1. **Avetisyan,** Marianna (Twente University)
   Title of thesis: *A Bayesian approach for handling response bias and incomplete data.*
2. **Geerlings,** Hanneke (Twente University)
   Title of thesis: *Linear logistic test models for rule-based item generation.*
3. **Jolani,** Shahab (Utrecht University)
   Title of thesis: *Investigation of statistical properties of proper ways to combine the nonresponse model and the outcome model for drawing imputations.*
4. **Kan,** Kees-Jan (UvA Amsterdam)
   Title of thesis: *Testing the mutualism model of general intelligence.*
5. **Kieruj,** Natalia (Tilburg University)
   Title of thesis: *Question format and response style behaviour in attitude research.*
6. **Korendijk,** Elly (Utrecht University) dit project weer opnemen in de lijst nu als concluded
   Title of thesis: *Robustness issues for cluster randomised trials.*
7. **Kruyen,** Peter (Tilburg University)
   Title of thesis: *Minimal requirements of the reliability of tests and questionnaire.*
8. **Kuiper,** Rebecca (Utrecht University)
   Title of thesis: *Chained equations.*
9. **Lugtig,** Peter (Utrecht University)
   Title of thesis: *Tailoring to the MAX: Using new IC technology to increase data quality and efficiency in panel surveys.*

10. **Molenaar,** Dylan (UvA Amsterdam)
    Title of thesis: *Statistical modeling of (cognitive) ability differentiation.*
11. **Peeters,** Carel (Utrecht University)
    Title of thesis: *Inequality constrained Bayesian models for the multivariate normal covariance matrix.*
12. **Rippe,** Ralph (Leiden Univetrsity)
    Title of thesis: *Nonlinear modeling with high volume data sets from systems biology.*
13. **Straat,** Hendrik (Tilburg University)
    Title of thesis: *Higher measurement quality of tests and questionnaires by means of more powerful statistics.*
14. **Van Ravenzwaaij,** Don (UvA Amsterdam)
    Title of thesis: *Modeling the relation between speed and accuracy.*
15. **Verhagen,** Josine(Twente University)
    Title of thesis: *Bayesian modeling of heterogeneity for large scale comparative research.*
16. **Weeda,** Wouter (UvA Amsterdam) dit project weer opnemen in de lijst nu als concluded
    Title of thesis: *EEG/MEG components: A new statistical approach to analyze their (co)variance properties.*
17. **Wetzels,** Ruud (UvA Amsterdam)
    Title of thesis: *Bayesian hypothesis testing hierarchical models: A PhD proposal for the innovation of psychological methods.*

New projects

From 1 January - 31 December 2012, the projects of the following 22 PhD students were accepted in the IOPS Research School:

1. **Bartlema,** Annelies (KU Leuven)
   Title: *Measuring the complexity of psychological models*
2. **Bolsinova,** Maria (Utrecht University)
   Title: *New applications of Rasch modelss in educational measurement*
3. **Bringmann,** Laura (KU Leuven / UvA Amsterdam)
   Title: *Networks! New insights into time series data*
4. **Debeer,** Dries (KU Leuven)
   Title: *Psychometric models for differential item performance*
5. **De Klerk,** Sebastiaan (Twente University)
   Title: *Multimedia-Based Performance Assessment (MBPA) in Vocational Education and Training (VET) in the Netherlands*
6. **Doove,** Lisa (KU Leuven)
   Title: *Methodology for detecting treatment-subgroup interactions*
7. **Epskamp,** Sacha (UvA Amsterdam)
   Title: *Network Psychometrics*
8. **Fagginger Auer,** Marije (Leiden University / Cito)
   Title: *Mathematics instruction in the classroom and students' strategy use and achievement in primary education*
9. **Gerritse,** Susanna (Utrecht University)
   Title: *The estimation of population size and population characteristics using incomplete registries*
10. **Gu,** Xin (Utrecht University)
    Title: *Bayesian evaluation of informative hypotheses in general statistical models*

11. **Heylen,** Joke (KU Leuven)
    Title: *Modeling multilevel time-resolved emotion data*
12. **Hofman,** Abe (UvA Amsterdam)
    Title: *Analyzing developmental change with time-series data of a large scale monioring system*
13. **Jabrayilov,** Ruslan (Tilburg University)
    Title: *Improving assesment of individual change in clinical, medical and health psychology*
14. **Kampert,** Maarten (Leiden University)
    Title: *Distance based analysis of (gen)omics data*
15. **Krone,** Tanja (University of Groningen)
    Title: *Understanding human behavioural processes with Bayesian dynamic models*
16. **Minica,** Camelia (VU University Amsterdam)
    Title: *On modeling genetic association with addiction phenotypes*
17. **Oosterwijk,** Pieter (Tilburg University)
    Title: *Improving global and local reliability estimation in nonparametric item response theory*
18. **Rietdijk,** Silvia (Utrecht University)
    Title: *Time for a change: Studying individual differences in dynamics*
19. **Schuurman,** Noémi (Utrecht University)
    Title: *Studying individual differences in dynamics with multilevel multivariate autoregressive models*
20. **Van Grootel,** Leonie (Utrecht University)
    Title: *Not as we know it: Developing and evaluating synthesis methods that incorporate quantitative and qualitative research*
21. **Van Vlimmeren,** Eva (Tilburg University)
    Title: *The mapping of national cultures: Examining the robustness of measurements of cross-national cultural dimensions*
22. **Vervloet,** Marlies (KU Leuven)
    Title: Model construction in (multilevel) regression analysis

Projects in progress beyond project time limits

The projects of the following PhD students are still in progress, but have exceeded the project time limit:

1. Marthe **Straatemeijer** (University of Amsterdam
2. Janke **Ten Holt** (University at Groningen)
3. Khurrem **Jehangir** (Twente University)

The above projects are no longer mentioned in the summary of projects

Projects left unfinished

In 2012 there were no students leaving the IOPS Graduate School before completing the project:

4.2 Summary of projects

4.2.1 Concluded projects

A Bayesian approach for handling response bias and incomplete data
(concluded project)

PhD student	Marianna **Avetisyan**
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Project financed by	NWO (Netherlands Foundation of Scientific Research)
Project running from	1 July 2008 - 1 July 2012
Date of defence	6 December 2012
Title of thesis	Bayesian randomized item response modeling for sensitive measurement
Promotores	Prof. Dr. C.A.W. Glas, Ir. J.-P. Fox

Summary
The collection of data through surveys on personal and sensitive issues may lead to answer refusals and false responses, making inferences difficult. Respondents often have a tendency to agree rather than disagree (acquiescence) and a tendency to give socially desirable answers (social desirability). The randomized response (RR) technique has been used to diminish the response bias. Attention will be focused on the usefulness of the randomized response technique. Different settings will be explored, large-scale but also small-scale survey data for binary and polytomous response data. Methodological developments will be made to handle different settings and to test different real-data hypotheses.
Besides the problem of misreporting, respondents may not report an answer to one or more questions. Missing data can also occur due to other causes like, interviewer errors (omitted questions, illegible recording of responses, etc.), and inadmissible multiple responses. In fact, it is not unusual for large data sets to have missing data on a few items. The persons cannot be omitted from the analysis based on the fact that they skipped a few questions since it will result in deletion of a substantial part of the data (these participants provide information on the answered items). In a Bayesian approach, the incomplete data problem can be solved by repeatedly solving the complete data problem. In the setting of large-scale comparative survey data, attention is focused on country-specific imputation methods and/or models for the missing data mechanism.

Linear logistic test models for rule-based item generation (concluded project)

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	Faculty of Educational Science and Technology, Twente University
Project financed by	Twente University
Project running from	1 September 2007 - 1 September 2011
Date of defence	23 March 2012
Title of thesis	Psychometric methods for automated test design
Promotores	Prof. Dr. C.A.W. Glas, Prof. Dr. W. J. Van der Linden

Summary

This project is embedded in a larger project called 'Rule-based Item Generation of Algebra Word Problems Based upon Linear Logistic Test Models for Item Cloning and Optimal Design' that is funded by the Deutsche Forschungsgemeinschaft (German Research Foundation). The project is a collaboration between the Universities of Münster and Twente. In this project, techniques from cognitive analysis, item response theory (IRT), hierarchical modeling, and optimal design theory are combined to develop procedures for automated item generation and test assembly for the testing of basic mathematical competencies in early secondary education, as can be assessed with algebra word problems. It will also be investigated how the models and procedures should be optimized and generalized when they are applied in computerized adaptive testing, testing for diagnosis, and large-scale educational assessments. The final goal is the development of a software program which adaptively generates tailor-made items for algebra word problems based on optimal design, linear-logistic test models, and models for test item cloning. The sub-project presented here focuses on the statistical aspects of the project. Starting point is the classical version of the linear-logistic test model (e.g., Fischer, 1995). This model will be extended through incorporating random effects as well as interaction effects. The hierarchical model for item cloning will be provided with a structure for the item parameters developed in other sub-projects. The parameters of the model will be estimated in a Bayesian framework, by means of Markov Chain Monte Carlo (MCMC) computation. If time allows, estimation in a frequentist framework (by means of Marginal Maximum Likelihood, MML, estimation) can also be considered. The result will be used in the application of optimal design techniques for automated test assembly from pools of item families. The selection criteria will be based on the hyperparameters that describe the item families instead of the usual lower-level parameters of the discrete items. Both information-based and Bayesian criteria for item selection will be studied.

Investigation of statistical properties of proper ways to combine the nonresponse model and the outcome model for drawing imputations (concluded project)

PhD student	Shahab **Jolani**
Affiliation	Methods & Statistics, Faculty of Social Sciences, Utrecht University
Project financed by	Utrecht University
Project running from	1 July 2010 - 1 July 2012
Date of defence	7 December 2012
Title of thesis	Dual imputation strategies for analyzing incomplete data
Promotores	Prof. Dr. S. van Buuren, Dr. L. E. Frank

Summary

Missing values are undesirable for a correct statistical analysis of data. Therefore, statisticians have always attempted to resolve the problem of missing values. The older and simple strategy is to choose ad-hoc methods (e.g. available case, complete case) which introduces bias in estimation methods and also changes the data features like variability, symmetry and so on. Rubin (1987) introduced an idea which is to replace each missing value more then once in the data set prior to analysis. Now, each complete set is analyzed in the same fashion by a complete-data method. This approach, which is called Multiple Imputation (MI), has become more popular and is considered as the State of the Art in missing data analysis (Schafer and Graham, 2002). MI produces estimates that are consistent, asymptotically normally distributed and asymptotically efficient if used correctly. In addition, MI can be used with virtually any kind of data and software is available to perform the analyses. Moreover, if the observed data contain useful information for predicting missing values, an imputation procedure can make use of this information and maintain high precision. Of course, MI has also drawbacks. It can be difficult to implement and it is easy to do it the wrong way. Most importantly, MI produces different estimates (hopefully, only slightly different) when we use it in the same data set for several times. The reason behind this is that random variation is deliberately introduced in the imputation process. Without a random component, deterministic imputation methods generally produce underestimates of variances for variables with missing data. A recent overview of MI has been published by Enders (2010) and references therein. A broad investigation in medical research has also been done by Kenward and Carpenter (2007).

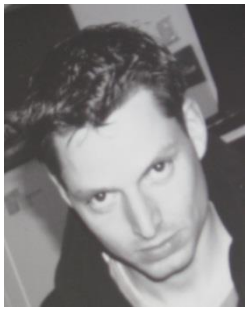
The most complex step in MI is to specify the imputation model, which is not always an easy task for different missing data mechanisms. It is generally accepted that imputation models should condition on both determinants in the outcome model and the nonresponse model. There are potentially many ways to combine both models, and it is not yet clear how these models should be represented in the imputation model. This research project will develop some new methods that would have desirable statistical properties for dealing with different types of missing data mechanisms.

Four research topics will be distinguished in this research project: (i) imputation models based on a combination of the outcome and the nonresponse models for the ignorable missing data mechanism, (ii) imputation models based on the combination of the outcome and the nonresponse models when the missing data mechanism is NOT ignorable, (iii) compatibility of fully conditional specification approach in imputation models, and (iv) imputation in planned missing data patterns. The following research questions will be addressed in this research project:

- What is the proper way to combine the outcome model and the nonresponse model for drawing imputation when missing data is at random?
- What is the proper way to combine the outcome model and the nonresponse model for drawing imputation when missing data is NOT at random?
- Under what circumstance fully conditional specification approach will be converge?
- Can we impute the missing potential outcome in nonrandomized studies, and estimate the treatment effect by the individual difference between potential outcomes?

The results will be presented in several research papers that will constitute the dissertation. Furthermore, based on the research in this PhD project, recommendations for routinely use of imputation methods will be made and R code will be developed for the new methods that will be created during the research project.

Testing the mutualism model of general intelligence (concluded project)



PhD student	Kees-Jan **Kan**
Affiliation	Department of Methodology, University of Amsterdam
Project financed by	University of Amsterdam
Project running from	1 April 2007 - 1 April 2011
Date of defence	24 January 2012
Title of thesis	The nature of nurture: The role of gene-environment interplay in the development of intelligence
Promotores	Prof. Dr. H.L.J. Van der Maas, Dr. C.V. Dolan

Summary

Van der Maas, Dolan, Grasman, Wicherts, Huizenga & Raijmakers (2006) proposed a new theory of general intelligence based on the idea of mutualistic interactions during development between the cognitive processes underlying intelligence. They showed that such interactions lead to a positive manifold of correlations between scores on cognitive tasks. This theory is an important alternative for the standard *g* theory (Jensen, 1998), which conceptualized *g* as a single latent dimension. The aim of this project is to further investigate the mutualism model. Topics are: model extension, model equivalence, evidence from experimental data, and evidence from longitudinal correlational data.

Question format and response style behaviour in attitude research
(concluded project)

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Project financed by	NWO (Netherlands Foundation of Scientific Research)
Project running from	1 September 2007 - 1 May 2011
Date of defence	2 March 2012
Title of thesis	Question format and response style behavior in attitude research
Promotores	Prof. Dr. J.K. Vermunt, Dr. G.B.D. Moors

Summary

Attitude questions differ in format, e.g. differences in numbering and labelling of response categories. It has been argued that the validity and reliability of attitudes is affected by the choice of question format. At the same time, it is acknowledged that response style behaviour can bias the measurement of attitudes as well as bias the estimates of the effect of covariates. This research project links these two issues by focusing on the impact of question format on the likelihood of response bias, i.e. acquiescence and extreme response style, in attitude research.

Robustness issues for cluster randomised trials (concluded project)

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Project financed by	NWO (Netherlands Foundation of Scientific Research)
Project running from	1 September 2005 - 1 September 2010
Date of defence	8 June 2012
Title of thesis	Robustness and optimal design issues for cluster randomized trials
Promotores	Prof. Dr. J.J. Hox, Dr. ir. M. Moerbeek

Summary

Cluster randomised trials randomise complete groups to treatment conditions. The estimates of the model parameters and their standard errors are only correct if the chosen statistical regression model includes all necessary fixed and random effects, and if the model assumptions are satisfied. Furthermore, optimal designs for cluster randomised trials depend on the values of certain model parameters, of which the true values must be specified in the design stage. This study researches two questions: What is the robustness of optimal designs and estimation methods? What should be done to correct for an incorrect model or an incorrect guess of the model parameters?

Minimal requirements of the reliability of tests and questionnaires
(concluded project)

PhD student	Peter **Kruyen**
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Project financed by	NWO (Netherlands Foundation of Scientific Research)
Project running from	15 November 2008 - 15 December 2012
Date of defence	14 December 2012
Title of thesis	Using short tests and questionnaires for making decisions about individuals: When is short too short
Promotores	Prof. Dr. K. Sijtsma, Dr. W.H.M. Emons

Summary

A test's reliability often is the basis for advise to test constructors, researchers and test users on which test to use for accurately classifying individuals in diagnostic categories. However, the classical reliability coefficient does not provide information that is adequate for this purpose. This study investigates how individual classification accuracy depends on properties of the test and its items, the population studied, and the decision-making problem. Its output will be tables that give the minimum quality requirements for tests and their constituent items, given a known population distribution and a well-defined classification problem.

Chained equations (concluded project)

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Project financed by	NWO (Netherlands Foundation of Scientific Research) Part of Vici project by H.J.A. Hoijtink "Learning more from empirical data using prior knowledge"
Project running from	1 May 2007 - 1 May 2012
Date of defence	27 January 2012
Title of thesis	Model selection: How to evaluate order restrictions
Promotor	Prof. Dr. H.J.A. Hoijtink

Summary

Theories often have multiple implications that have to be evaluated. Multiple hypotheses addressing different variables are not easily summarized in *one* statistical model, because often it is too complicated to account for the dependencies between the variables. Multiple hypotheses are usually evaluated separately which increases the probability of errors of the first kind and/or reduces the power. See, for example, Toothaker (1993), Benjamini and Hochberg (1995) and Maxwell (2004) for a discussion of these matters. In this project chained equations (van Buuren, Boshuizen, Knook, 1999; Raghunathan, Lepkowski, Van Hoewyk, and Solenberger, 2001; Buuren, Brand, Groothuis-Oudshoorn and Rubin, to appear) will be used to build statistical models for multiple hypotheses addressing the same or different data sets. Chained equations have thus far been used for multiple imputation of missing values. Here they will be used to build *one* statistical model for the evaluation of multiple hypotheses.

Tailoring to the MAX: Using new IC technology to increase data quality and efficiency in panel surveys (concluded project)

PhD student	Peter **Lugtig**
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Project financed by	Utrecht University
Project running from	1 September 2007 - 1 September 2012
Date of defence	24 February 2012
Title of thesis	I think I know what you did last summer. [ISBN: 978-90-393-57163]
Promotores	Prof. Dr. J.J. Hox, Dr. G.J.L.M. Lensvelt-Mulders

Summary

Panel studies hold the promise of providing reliable and valid data on change over time. This dissertation project investigates measurement error in panel data with the aim to improve the quality of future data collection and to enhance the scientific knowledge of the question-answer process. The possibilities of dependent interviewing techniques (DI) and the analysis of attrition patterns to improve data quality and survey efficiency will be evaluated. We compare three alternative approaches to dependent interviewing (proactive, reactive and optional) with traditional interviewing to study the effects of the different designs on measurement error. To do so we propose to conduct a 4×2×2 experimental design. Three main effects will be studied:

1) The effects of four different techniques for dependent interviewing on measurement error and stability of traits over time,
2) the effects of anchoring as a result of DI, and
3) the effects of DI on different kind of questions i.e. facts and attitudes.

All interaction effects will be studied as well. Attrition patterns will be studied and used to improve the imputation of missing data and in doing so improve the estimation of substantive variables. Because the methodological problems studied in this project stem from respondent's behaviour this project will be a joint work of the Departments of Methods and Statistics and Psychology of Utrecht University. Five hundred first year students will take part in a longitudinal survey on students' motivation, satisfaction, and grades, related to the development of their academic literacy during their bachelor years.

Statistical modeling of (cognitive) ability differentiation (concluded project)

PhD student	Dylan **Molenaar**
Affiliation	Department of Developmental Psychology, Faculty of Psychology, University of Amsterdam
Project running from	1 September 2007 - 1 September 2011
Date of defence	19 April 2012 (with distinction)
Title of thesis	Testing distributional assumptions in psychometric measurement models with substantive applications in psychology
Promotores	Prof. Dr. H.L.J. Van der Maas, Dr. C.V. Dolan

Summary
No suitable procedures are yet available to investigate ability differentiation, although this phenomenon has important implications for the measurement of cognitive abilities. The aim of the present project is to develop, test, and apply suitable models to investigate ability differentiation.

Inequality constrainted models for the multivariate normal mean: A Bayesian approach (concluded project)

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Project financed by	NWO (Netherlands Foundation of Scientific Research) Part of Vici project by H.J.A. Hoijtink "Learning more from empirical data using prior knowledge"
Project running from	1 February 2007 -1 September 2011
Date of defence	4 June 2012
Title of thesis	Bayesian exploratory and confirmatory factor analysis. [ISBN**:** 978-90-393-5787-3]
Promotor	Prof. Dr. P.G.M. van der Heijden

Summary

Researchers often have competing theories that can be translated into inequality constrained models. Such theoretical models cannot be addressed with standard null-hypothesis testing. In this project inequality constrained Bayesian statistical models for the multivariate normal covariance matrix will be developed. Models for the multivariate normal covariance matrix encompass such techniques as: factor analysis, growth curve models, multilevel models, path-models and errors in variables models. The formulation of these models under inequality constraints should make possible the evaluation of substantive inequality constrained theory. Issues such as formal Bayesian prior formulation, parameter estimation using sampling techniques, model selection and multiple group testing will be addressed. Next to articles, the project will also result in a statistical package which, in addition to the other procedures developed in the VICI project *Learning more from Empirical Data using Prior Knowledge*, will also encapsulate inequality constrained Bayesian statistics for models based on the multivariate normal covariance matrix.

Nonlinear modeling with high volume data sets from systems biology
(concluded project)

PhD student	Ralph **Rippe**
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Project financed by	Leiden University
Project running from	1 June 2006 - 1 June 2011
Date of defence	13 November 2012
Title of thesis	Advanced statistical tools for SNP arrays. [ISBN/EAN: 978-94-90858-14-8]
Promotores	Prof. Dr. J.J. Meulman, Prof. Dr. ing. P.H.C. Eilers

Summary

Prediction problems are typically regression problems and supervised classification problems, in which the development of the prediction procedures and their validation go hand-in-hand. Prediction problems are nonlinear when categorical (ordinal or nominal) variables are involved, possibly with numerical variables as well.

Large data sets generally come into two forms: either the number of variables is very large compared to the number of observations (*wide data sets*), or the number of observations is extremely large (*long data sets*). The current proposal will develop, extend and apply methodology to deal with both forms of large data sets, in a direction which is especially applicable to categorical data through the use of nonlinear transformations. This approach is firmly based in the data analytic and algorithmic tradition of the Data Theory Group at the Faculty of Social and Behavioral Sciences at Leiden University.

Higher measurement quality of tests and questionnaires by means of more powerful statistics (concluded project)

PhD student	**Hendrik Straat**
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Project financed by	Tilburg University
Project running from	1 September 2009 - 1 September 2012
Date of defence	23 November 2012
Title of thesis	Using scalability coefficients and conditional association to assess monotone homogeneity. Ridderkerk: Ridderprint BV. [ISBN / EAN: 978-90-5335-598-5]
Promotores	Prof. Dr. K. Sijtsma (Tilburg University), Prof. Dr. B.W. Junker (Carnegie Mellon University

Summary

Tests or questionnaires are often used to measure personality traits, attitudes, opinions, skills, and abilities. A measurement model transforms the respondents' item scores into a meaningful measurement value. Using a measurement model that does not fit the data may lead to incorrect conclusions with possibly severe consequences: e.g., a wrong diagnosis of a mental patient or an incorrect educational placement. For nonparametric item response theory models - a very general class of measurement models - the available methods to assess fit are insufficient to allow good test construction. In this project better methods are developed that have more power.

Modeling the relation between speed and accuracy (concluded project)

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Project financed by	NWO (Netherlands Foundation of Scientific Research)
Project running from	1 January 2008 - 1 January 2012
Date of defence	4 April 2012 [with distinction]
Title of thesis	The hare or the tortoise? Modeling optimal speed-accuracy tradeoff settings.
Promotores	Prof. Dr. H.L.J. van der Maas, Dr. E.J. Wagenmakers

Summary

In daily life as well as in the psychological laboratory, people continuously make decisions. These decisions pertain to widely different activities, such as buying new sun-glasses, driving your car to work, or writing grant proposals. All of these decisions, however, fall prey to the same dilemma. This dilemma concerns the meta-decision of when to stop information processing and commit to a decision. This is particularly evident in tasks where one can choose to respond faster at the cost of making more errors. Clearly then, task performance is a function of both response accuracy and response speed. A pervasive problem in cognitive psychology is how to combine speed and accuracy so as to obtain separate indices for task performance and response conservativeness.

Perhaps the only way to make progress is to use a mathematical model that explicitly addresses the tradeoff between speed and accuracy. The current proposal focuses on Ratcliff's diffusion model, which is arguably the most popular model of how people process information. The diffusion model allows one to estimate unobserved psychological processes such as perception, speed of information accumulation, response conservativeness, and response bias.

The proposed projects seek to theoretically extend and empirically test the diffusion model account of the speed-accuracy tradeoff. This account currently leaves open several important questions. The first project shows that the Fuzzy Logical Model of Perception (FLMP) can be unified with the diffusion model in a way that allows the FLMP to simultaneously account for response speed and response accuracy. The second project studies what happens under conditions in which there is almost no value in accurate responding. The third project considers variability in response conservativeness as an explanation for fast errors, and the fourth project concerns the changes in information processing that occur after an error.

Bayesian modeling of heterogeneity for large scale comparative research
(concluded project)

PhD student	Josine **Verhagen**
Affiliation	Department of Educational Measurement and Data Analysis, Faculty of Educational Science and Technology, Twente University
Project financed by	Twente University
Project running from	1 May 2008 - 1 May 2012
Date of defence	16 November 2012
Title of thesis	Bayesian Item Response Theory models for measurement variance
Promotores	Prof. Dr. C.A.W. Glas, Dr. ir. G.J.A. Fox

Summary
Inferences from large-scale (e.g., cross-national) studies have important implications for theory (e.g., causal relations between constructs, spurious relations, intervening variables) and practice (e.g., insights in policy related issues and malleable factors). The common item response theory models are not directly applicable to analyse large-scale survey data for comparative research. There are several measurement issues connected to comparative research that need to be addressed since ignoring them may lead to inferential errors. The approach is focused on delineating the source (i.e., individual or group differences in latent scores or in the way of responding to the questionnaire) and the direction of the significant differences in cross-national research. From a Bayesian point of view, (1) heterogeneity in the way individuals respond to the questionnaire is modelled. In addition, (2) a structural population model is built for the respondents' latent scores which is focused on heterogeneity. Within this modelling framework, the Bayesian methodology allows the development of tools that can be used to account for errors related to the measurement issues.

EEG/MEG components: A new statistical approach to analyze their (co)variance **Properties** (concluded project)

PhD student	Wouter **Weeda**
Affiliation	Developmental Psychology, FMG, University of Amsterdam
Project financed by	NWO (Netherlands Foundation of Scientific Research) Part of Vidi project by Hilde Huizenga "The association between intelligence and performance variability: A new statistical neuroscientific approach"
Project running from	1 March 2006 - 1 December 2010
Date of defence	28 March 2012
Title of thesis	New methods for the analysis of trial-to-trial variability in neuroimaging studies. [ISBN: 9789461912121]
Promotor	Prof. Dr. M.W. Van der Molen

Summary

In this project the primary aim is to assess variance and covariance properties of EEG/MEG components, without the need to localize these components. Such a method should meet several criteria. First, it is necessary that signal variance can be dissociated from noise variance. Second, it should be possible to disentangle latency variance and tests of amplitude and latency variance parameters. Third, it is neccessary that the amplitude covariance between components can be estimated and tested. Existing methods (e.g. variance, complexity, wavelets, independent component analysis, parallel factor analysis) are adequate to answer other reseacrh quetions, but they do not meet the aforementioned criteria, and thus are not suited for the present purposes.

We therefore develop a new statistical method that does meet these criteria. By modeling EEG/ MEG by a sum of a) partly random temporal component functions and b) a noise variance model, it will become possible to reliably assess variations in amplitude and latency, and the covariance of amplitudes. Since the proposed method is new and by no means straigthforward, it will be developed in several subprojects that have substantial merits in their own right.

Modeling the relation between speed and accuracy (concluded project)

PhD student	Ruud **Wetzels**
Affiliation	Psychological Methodology, Department of Psychology, FMG, University of Amsterdam
Project financed by	University of Amsterdam
Project running from	1 September 2008 - 1 September 2012
Date of defence	26 September 2012
Title of thesis	Bayesian model selection with applications in social science. [ISBN: 978-94-6191-404-0]
Promotores	Prof. Dr. H.L.J. van der Maas, Dr. E.J. Wagenmakers

Summary

One goal of this PhD project is to do Bayesian inference using all kinds of models that are popular in Psychology. Some examples of such models are ALCOVE (Kruschke, 1992) for category learning or the Expectancy-Valence model (Busemeyer and Stout, 2002) for decision making.

Another goal of the project is to implement and study Bayesian hypothesis testing for hierarchical, possibly order-restricted models. In hierarchical modeling, individual-level parameters are drawn from a group distribution. This way of modeling takes both differences and similarities between participants into account.

In general, the aim is trying to make Bayesian methods more easily available to empirically oriented psychologists who would like to take advantage of the Bayesian methodology but lack the time or the technical skills to implement their own software.

4.2.2 New projects

Measuring the complexity of psychological models (new project)

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Project financed by	KU Leuven
Project running from	1 January 2011 - 1 January 2015
Supervisors	Dr. Wolf Vanpaemel

Summary

Model selection is a very important aspect of scientific inquiry. The best model is the one that optimizes goodness-of-fit (how well the model and the empirical data match) and empirical content (how much the model tells us about the world) at the same time. Both aspects of the model are closely related to its complexity (the inherent flexibility of the model). A greater understanding of the complexity of models is therefore an important prerequisite for improving model selection.

The overall objective of my project is to gain a better understanding of model complexity. A first project is the systematic comparison of existing complexity measures, something that is not been done so far. A second project is the development of a new complexity measure, the Prior Predictive Complexity (PPC). Unlike most of the existing measures, the PPC will be sensitive to the prior distribution over parameters. The prior indicates, before the data are seen, which parameter values are likely and which are unlikely, and is an integral part of the model that is capable of expressing psychological theory. Part of this project will be the development of informative priors for psychological models.

New applications of Rasch modelss in educational measurement (new project)

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Project financed by	Utrecht University
Project running from	15 September 2011 - 1 September 2015
Supervisors	Prof. Dr. Herbert Hoijtink, Prof. Dr. Gunter Maris

Summary

Project 1: "Unmixing Rasch scales"

One of the most popular IRT models in educational measurement is the Rasch model [RM]. It models the probability of answering an item correctly by using only two paramaters: one for the item and one for the person. The main advantage of the Rasch model is that it has a sufficient statistic for person parameters and a sufficient statistic for item parameters. This is important for both estimation of the parameters and interpretation of test results. However, the RM is often too restrictive to fit the data. First, it assumes unidimensionality of the test. This means that the test measures only one latent trait which explains responses of persons to items. Second, all items are assumed to have the same discriminative power. In practice of educational testing it is not uncommon that a test measures more then one ability and that some of the test items are more closely related to the latent trait than the other. Two existing models – the between-item multidimensional model and the one parameter logistic model [OPLM] – relax the assumptions of the RM without losing its important property of sufficiency of test score. Both models imply that a test consists of sub-scales of items in which the RM holds. In both approaches though it is assumed that test structure is known and these sub-scales are pre-specified. In practice this information is not always available. We propose a multi-unidimensional Rasch model which also assumes that a test consists of Rasch sub-scales but scale memberships of items are considered as parameters that have to be estimated. A Markov chain Monte Carlo algorithm is introduced for estimation of the model. The algorithm allows to identify Rasch sub-scales constituting the test. The performance of the algorithm is evaluated using simulations. Rasch scales are recovered both when they represent separate abilities as in the between-item multidimensional model, and when they differ only in the discrimination power as in the OPLM.

Project 2: "Hypothesis testing based on the unmixed Rasch scales"
In the multi-unidimensional Rasch model introduced in Project 1 the person parameters are assumed to have a multivariate normal distribution. The variance-covariance matrix of this distribution specifies the relations between person parameters and can be used to distinguish three types of models. In the unconstrained model the variances of separate person parameters are different and the correlations between them are also different. In this model person parameters can be interpreted as different abilities. We can also put constraints on the relations between person parameters and set all correlation between them to 1. In this model the theta's associated with each dimension are the same but have a different scaling. In this model the standard deviation of the distributions of person parameters has the same interpretation as the discrimination index in the OPLM. Finally we can constrain the variances of each dimension to be the same, which yields the Rasch model. In the second project a test will be developed that can be used to determine which model is most appropriate for a data set of interest.

Project 3: "Rasch models for test equating using prior knowledge"
Image that a test consisting of 40 items is presented to persons taking an exam in the year 2010 (the reference exam). Imagine also a test consisting of 40 new items that is presented to persons taking an exam in the year 2011 (the current exam). The main goal of test equating is to determine a pass/fail criterion such that the ability of persons just passing the exam in 2011 is equal to the ability of persons just passing the exam in 2010. In order to be able to equate both tests, there has to be a so called linking group of persons that responds to some of the items from the 2010 exam and some of the items from the 2011 exam. Using the data resulting from the reference group, the linking group, and the current group, and assuming that responses to the 40 item from 2010 and the 40 items from 2011 can be modeled using the Rasch model, both tests can be equated. This equating procedure accounts for the fact that the reference and current exam may not be of the same difficulty and the fact that the reference and current populations may not be of the same ability.
However, there is a major weak point in test equating using the Rasch model: often the linking group is small and the number of items responded to by the linking group is also small. This implies that the link between both exams is weak, and that the credibility interval around the estimate of the norm score obtained is rather large. Project 3 will show that test equating using prior knowledge may be an important step towards a solution of this problem.

Networks! New insights into time series data (new project)

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Project financed by	KU Leuven
Project running from	1 October 2011 - 1 October 2015
Supervisors	Prof. Dr. Francis Tuerlinckx, Dr. D. Borsboom

Summary

Networks are all around us; for example, the World Wide Web, interpersonal connections and brain connectivity can be represented as networks. Recent research suggests that mental disorders can also be thought of as networks; namely, as networks of symptom interactions (Borsboom et al., 2011). From this perspective, disorders may arise as a result of causal relations between symptoms. Network approaches to psychopathology can explain clinical phenomena such as comorbidity and spontaneous recovery. However, there is a need for flexible statistical tools to empirically infer networks from typical clinical studies. Ideally, one would like to extract a network structure from multiple short time series of a sample of individuals. In this paper, we present a method that can do this, which we apply to an experience sampling study of depressed patients. It is shown how a network of psychologically relevant items can be formed by applying series of multilevel models. The results furthermore show which connections between the items are subject to high degrees of inter-individual variation in intra-individual structure. In addition, our method can be used to derive the specific network structure of an individual person from clinical data, which may be used to inform and assess therapeutic interventions.

Psychometric models for differential item performance (new project)

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Project running from	1 October 2010 - 1 October 2016
Supervisor	Rianne Janssen

Summary

In educational and psychological measurement, it is often – if not always – assumed that test scores and item responses only depend on the measured attribute of interest, and that the measurement is invariant with respect to the administering conditions. However, it has been repeatedly shown that the administration context might violate this measurement invariance. These context effects, and how to deal with them, will be the focus of my research.

Currently I am working on the effects of item position. In achievement testing, the use of alternate test forms with the same items, presented in different orders, is a common strategy to prevent copying and enhance test security. Consequently items are administered at different positions in the different test forms. These changes in item position can threat measurement invariance assumptions, or item parameter invariance assumptions. Within the IRT framework we are developing an integrated approach to detect and model these effects. Combining the logic of Differential Item Functioning (DIF) models and the Linear Logistic Test Model (LLTM), this method addresses both the item-side and the person-side of the issue, as it allows for individual differences in the effect of item position.

In the future, the framework will be extended to tackle other confounding context effects. Firstly, we will develop an approach to model omissions and “not reached” items as different cases of non-response. Secondly, we will focus on context related differential item functioning, where the functioning of the item depends on the content of the previously administered item(s).

Multimedia-Based Performance Assessment (MBPA) in Vocational Education and Training (VET) in The Netherlands (new project)

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Project running from	1 December 2012 - 1 December 2015
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Summary

Transitions in education require transitions in assessment, a statement that definitely holds for Vocational Education and Training (VET). On the verge of the new millennium the Dutch government introduced the so-called 'competency-based education' in vocational education, which now has been redefined as 'vocation-based education' (www.rijksoverheid.nl). During this period the focus in vocational education shifted from knowledge acquisition through 'traditional' classical courses toward a system equipped for teaching students the competencies needed to act as entry employees (Van Dijk, 2010; Zijlstra, 2002). The ultimate goal of vocational education is to provide the industry with well-trained and qualified entry employees. This implicitly holds that, for example, the role of the teacher has changed, from an authoritative role to a student-supportive role as coach. Students now design their own personal educational map, and teachers support them, if necessary, with educational content and with making the right choices for learning.

Methodology for detecting treatment-subgroup interactions (new project)

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Project running from	1 October 2012 - 1 October 2016
Supervisors	Prof. Dr. Iven Van Mechelen, Dr. Elise Dusseldorp, Dr. Katrijn Van Deun

Summary of project

For many medical and psychological problems, multiple treatment alternatives are available. A standard research question in such cases pertains to relative treatment effectiveness. A typical setting for the study of such a research question is that of randomized controlled trials (RCT's), in which the persons under study are randomly assigned to different alternative treatment conditions. Beyond some treatment alternative being globally best, treatment effectiveness may vary over groups of persons that can be characterized in terms of pre-treatment characteristics. The latter results may have significant consequences for the development of optimal treatment assignment strategies. The cornerstone for the development of such strategies is the detection of subgroups that are involved in meaningful so-called qualitative treatment-subgroup interactions, that is, interactions that imply that for some groups of persons treatment A outperforms treatment B, whereas for other groups the reverse holds true.

First, we will develop and implement a methodology that, given data from simple RCT's with a large number of background characteristics and one or more outcome variables, induces subgroups that are involved in sizeable qualitative treatment-subgroup interactions if these should be present in the data. Second, we will develop extensions of this methodology to more complex RCT's that induce more than two treatment alternatives. Third, we will control the correctness and reliability of the inferences that result from the to be developed methodology. Throughout, the methodology will be applied on real and simulated benchmark data sets and evaluated in comparison with alternative methods for the detection of treatment-subgroup interactions.

Network psychometrics (new project)

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Project running from	15 August 2012 - 15 August 2016
Supervisors	Dr. D. Borsboom, Prof. Dr. P.A.L. de Boeck

Summary

Theoretical considerations and empirical evidence point towards a network perspective in which psychological constructs are conceptualized as networks of interacting components (e.g., for major depression: insomnia ! fatigue ! concentration problems) instead of measurements of a latent construct, as is hypothesized in traditional perspectives. The proposed research develops a psychometric framework for analyzing such networks: 1) translating concepts from network analysis to the psychometric realm, and developing 2) procedures for estimating and fitting network models to data and 3) a new adaptive testing procedure. This work will be implemented in the R-package that the Ph.D. candidate has already developed (Epskamp et al., 2011).

Mathematics instruction in the classroom and students' strategy use and achievement in primary education (new project)

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Project running from	1 September 2011 - 1 September 2015
Supervisors	Dr. C.M. van Putten, Dr. M. Hickendorff, Prof. Dr. W.J. Heiser, Prof. Dr. A. Béguin

Summary

Why has the accuracy with which Dutch primary school students solve complex multiplication and division problems decreased considerably over the past two decades? National assessments have shown this achievement drop has occurred for both girls and boys and both immigrant and non-immigrant children, and did not demonstrate a relation between the drop and the introduction of new mathematics textbooks in the same period. However, more detailed analyses of the test materials of the last two national assessments have suggested that the achievement change is related to changes in the calculation strategies that students use to solve problems. Between the two assessments, the number of problems that students solved with traditional written computation greatly decreased, while the number of problems solved without any written working increased – especially for students of low mathematical ability. These purely mental calculation strategies were found to be highly inaccurate, thereby contributing to the explanation of the achievement drop with their increased use.

The aim of this project is to investigate which didactic practices in the classroom influence the strategies and the accuracy with which students solve complex multiplication and division problems. Special attention is paid to which type of didactic approach also produces more successful strategy choices and higher levels of accuracy in students of low mathematical ability.

The estimation of population size and population characteristics using incomplete registries (new project)

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Project running from	15 January 2012 - 15 January 2016
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Summary

A well known technique for estimating the size of a human population is to find two or more registries of this population to link the individuals in the registries and estimate the number of individuals that occur in neither of the registries (Fienberg, 1972; Bishop, Fienberg and Holland, 1975; Cormack, 1989; International Working Group for Disease Monitoring and Forecasting, 1995). If there are two registries, A and B, 'being in registry A' and ''being in registry B' are considered as variables with levels 'yes' and 'no' and estimation takes place under the assumption that A and B are independent. This is one of the key assumptions and violation may have a substantial impact, in particular when there is little overlap between the registries (see below, in section 3b). One of the approaches to make the impact of a possible violation of this assumption less severe is to include covariates into the model, in particular covariates whose levels have heterogeneous inclusion probabilities for both registries (see Bishop, Fienberg and Holland, 1975). Then loglinear models can be fit to the higher-way contingency table of registries A and B and the covariates. The restrictive independence assumption is replaced by a less restrictive assumption of independence of A and B conditional on the covariates, and subpopulation size estimates are derived (one for every level of the covariates) that add up to a population size estimate.

Recently van der Heijden, Whittaker, Cruyff, Bakker and van der Vliet (submitted) have further developed this approach. Consider a contingency table formed of the two registries and the covariates. They showed that, for specific loglinear models, the contingency table is collapsible over covariates in the sense that the population size estimate will remain unchanged after collapsing the contingency table. To give a simple example, assume that the registries are A and B, the covariate is X and assume that the loglinear model is [AX][B]. In this situation the contingency table of the three variables AxBxX is collapsible over X in the sense that the population size estimate under loglinear model [AX][B] in the table AxBxX is identical to the population size estimate under loglinear model [A][B] in the contingency table AxB. This result is extended by van der Heijden et al. (submitted) to the situation that there are more covariates.

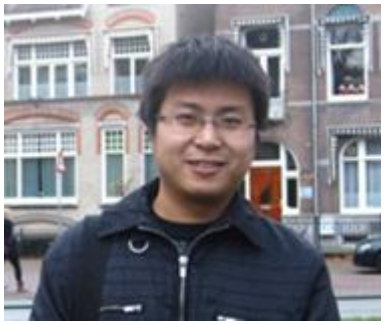
Van der Heijden et al. (submitted) introduce the terminology of *active* and *passive* covariates, i.e. an active covariate is a covariate whose presence in the contingency table has an impact on the estimate of the population size and a passive covariate is a covariate whose presence in the contingency table does not have an impact on the estimate of the population size. In the contingency table AxBxX, when the loglinear model is [AX][B], covariate X is a passive covariate, but when the loglinear model is [AX][BX], then X is an active covariate, because in this latter case the population size estimate under loglinear model [AX][BX] in the three-way array is different from the population size estimate in the two-way contingency table AxB under loglinear model [A][B].

A practical problem in population size estimation studies is that the number of covariates that is available in both registries (or available in the same format) is usually limited to, for example, gender and age. However, this problem is recently solved by Zwane and van der Heijden (2007, see also Van der Heijden, Zwane and Hessen, 2009), who show how to include covariates that are not available in all registries in the loglinear model. If a variable is only available in registry A, then it is missing for those observations that are in registry B but not in A. Zwane and van der Heijden use missing data approaches to estimate these observations. Assume that the set of covariates that is available in registry A is denoted by X1, the set of covariates that is available in registry B is denoted by X2 and the set of covariates both in registry A and B is denoted by X3. Then certain loglinear interaction parameters cannot be identified due to the missing data problem and the so-called saturated or maximal model is [AX2X3][BX1X3][X1X2X3]. Van der Heijden et al. (submitted) show that under this loglinear model all covariates X1, X2 and X3 are active. Interestingly, when X1 and X2 are independent conditional on X3, then X1 and X2 become passive covariates.

One of the advantages of this approach is that characteristics of the hidden population are estimated, under the condition that the above mentioned assumptions are not violated. Thus this approach allows to study the composition of the hidden population.

The aim of this PhD project is to further elaborate this new development.

Bayesian evaluation of informative hypotheses in general statistical models
(new poject)



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Summary

Null hypothesis significance testing is by far the dominant research tool for the evaluation of empirical data collected by experiments and observational studies in areas such as the behavioral and social sciences, biology, epidemiology and medicine. This is surprising because null hypothesis significance testing has strongly been criticized (see, for example, Cohen (1994), Royall (1997) and Wagenmakers (2007)). One of the reasons is probably that researchers tend to stick to the methods they have always used. However, another reason may very well be that there are no attractive alternatives.

Bayesian evaluation of informative hypotheses provides an attractive alternative. This approach no longer requires researchers to focus on the null hypothesis. It allows them to focus on the theory or expectation they are interested in and to answer the question: “is my theory/expectation supported by the data or not”. Applied researchers start to discover the existence of informative hypotheses and the first publications in which they are used have appeared. The PhD project proposed will substantially increase the class of statistical models for which informative hypotheses can be evaluated. It will therefore contribute to the construction of a toolkit that will enable researchers to straightforwardly evaluate their theories/expectations.

Furthermore, this project will address statistical issues related to the evaluation of informative hypotheses that are in need of further research: how to evaluate informative hypotheses formulated using equality constraints; and, how to move beyond the multivariate normal linear model. It will therefore also contribute to the further development of statistical theory.

Modeling multilevel time-resolved emotion data (new project)

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Project running from	1 October 2011 - 1 October 2015
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Summary of project

Nowadays, many research questions imply studying time-resolved data. For example, the time dynamics of emotions is a hot topic; hence, one recently has started gathering data on the intensity of different emotion components (e.g., appraisals, physiological features, subjective experience) at several time points during an emotion episode. Given these data, it is important to capture the different shapes that the time profiles may take and how these shapes depend on episodes' characteristics, person traits, and on the type of emotion component under examination. The latter implies two major methodological challenges.

First, we need to find out which method is best suited to gain insight into these shapes. Two classic strategies are functional component analysis (based on dimension reduction) and clustering approaches (implying categorical reduction of the time profiles). Since both strategies have some drawbacks, we intend to develop extensions that combine the attractive features of both.

Second, a proper solution to the problem of time alignment is required, which pertains to differences in shift and to stretching or contracting of the time axis. Although some functional models have been developed to deal with alignment issues (e.g., shifted and warped factor analysis), these methods have to be extended to deal with the inherent multilevel structure of the data under study.

Therefore, the goal of this project is to build new clustering and dimension reduction models for multilevel time-resolved emotion data that allow for shifting and/or warping, and to develop algorithms and model selection procedures for fitting these models to empirical data.

Analyzing developmental change with time-series data of a large scale monioring system (new project)

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Summary

Recently, an adaptive web-based training and testing system (Mathgarden) has been created that provides high frequency time-series data of thousands of children on different cognitive and scholastic tasks. Besides its applied value for children and teachers, the data generated by this system have great scientific potential. The data provide the opportunity of solving long-standing debates in cognitive development. With innovative statistical analyses we answer key questions on continuity/discontinuity, the role of critical periods, and mutual relations between learning domains. Resolving these debates will increase the already existing educational benefits of the Mathgarden, and will result in ways to improve the Dutch educational system.

Improving assesment of individual change in clinical, medical and health psychology (new project)

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Project running from	1 December 2011 - 1 December 2016
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Summary

In clinical therapy and medical treatment, psychological effects of treatment at the individual level are assessed using psychological tests and questionnaires. The difference between the scores before and after a treatment is interpreted as the result of treatment, and forms the basis for deciding whether the patient can be declared cured or needs psychological counceling. Current methods for individual-change assessment rest on classical tst theory and suffer from important flaws. This project investigates item response theory methods that fixes these problem, and provides recommendations on the psychometric requirements of tests for assessing statisical and clinical significant changes in individual patients.

Distance based analysis on (gen)omics data (new project)

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Collaboration with	Netherlands Metabolomics Center (Leiden University), Dept. of Biological Psychology (VU University, Amsterdam), and Biometris (Wageningen University & Research Center; WUR)
Project running from	1 December 2012 - 1 December 2016
Supervisor	Prof. Dr. J.J. Meulman

Summary

In the disciplinary fields of (gen)omics, there is a large need for statistical methods that can handle a large number of correlated variables in multiple high-dimensional data sets simultaneously. In the proposed PhD research project, we will investigate to what extend we can contribute to the statistical toolbox for omics research by using a multivariate distance-based analysis approach that is based on the clustering approach implemented in COSA (clustering objects on subsets of attributes). The proposal contains a number of steps, leading to separate projects. In the first project, we will study the behavior of the existing COSA algorithm, especially with respect to the attribute weights that play a crucial role in the COSA algorithm. We expect this will lead to various ways to improve upon the existing algorithm, resulting in COSA-NOVA. The new program will include smoothing of the weights, using prior knowledge, compositional PCA of COSA weights, and various alternative regularization options applied to the COSA weights. Also, the new program will use parallelization, and include state-of-the-art visualization. In the second project, we will extend COSA in such a way that it can analyze multiple data sets simultaneously, using a semi-supervised statistical learning approach. We will call the objective MIMO-COSA, which stands for COSA with Multiple Input and Multiple Output data sets. Project 3 investigates yet another approach to COSA, which is COSA applied to subspaces. In this approach, we combine projection to a lower-dimensional subspace (to make the analysis invariant under rotation of the attributes, the dimensions in high-dimensional space), and optimal scaling of the attributes in order to be able to deal with nominal and ordinal categorical data, and possible nonlinear relationships among the attributes. Last, Project 4 concentrates on the application of COSA on data from so-called systems biology. In this project we will fine-tune the MIMO-COSA algorithm (resulting from Project 2), hopefully leading to MIMOSA.

Understanding human behavioural processes with Bayesian dynamic models
(new project)

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Summary

The use of research designs with intensive measurements across time for individual subjects is becoming increasingly popular in psychological research. Such designs are necessary to achieve insight into the extremely complex phenomena of human behaviour like emotions (Scherer, 2009) and psychopathology (Frank et al., 2005). This complexity finds expression in behaviour fluctuating across time. Since those fluctuations depend on contextual and interindividual differences, understanding the underlying dynamics is extremely challenging. With this challenge, statistical time series analysis can be of great help. In general, the analysis of time series data serves either or both of the two main purposes:

(i) to study the time series itself to gain insight into the processes underlying the data;

(ii) (ii) to forecast, that is, to use observed data to predict unobserved future data.

(iii) When studying the time series, random noise is separated from systematic patterns in the data (e.g., Box et al., 1994). The systematic component is usually modelled, for example, by splitting into seasonal and trend components. This is relevant, for example, to identify whether a patient suffering from winter depression shows less symptoms of depression after a therapy, apart from the usual seasonal fluctuations. The main goal of forecasting models is to predict unobserved outcomes on the basis of observed history. Examples include statements on the density of traffic and on the necessary time for a patient to receive treatment before successful recovery.

(iv) Although the merits of the principles underlying time series analysis have been shown convincingly in psychology (e.g., Lodewyckx et al., 2011), the models used so far suffer from important limitations. As will be discussed below, the number of dependent variables and their nature to include in the analysis is limited. Furthermore, the models are static, rather than dynamic in nature. Those limitations imply that important dynamics will be kept hidden. Resolving those limitations would be extremely helpful, since understanding the dynamics offers a key to influencing, which is of utmost importance in diagnosis and planning psychological interventions. Furthermore, forecasting can be

very useful, for example in forensic psychiatry (e.g., to predict aberrant behaviour), or in youth care (e.g., early tracing of anomalies in development). To resolve the limitations of the time series models used so far, we will extend the linear multiregression dynamic model (LMDM; Queen et al., 1993, 2007, 2008, 2009) to more general Bayesian dynamic models (BDMs). The LMDM, which has been successfully applied to traffic forecasting, has a number of favourable properties that make the model eminently suitable for psychological time series. We will develop some necessary theoretical extensions, and apply the variant developed to empirical examples from typical psychological time series research. To examine the value of the BDMs in relationship to currently popular time series models, we will perform a comparative study based on simulated and empirical data.

On modeling genetic association with addiction phenotypes (new poject)

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Project running from	1 January 2012 - 1 January 2016
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Summary

My PhD project aims to identify genes and gene networks associated with individual differences in the liability to substance use and abuse. A second focus of my project is to investigate whether the genetic factors involved in addiction have substance specific effects. Thirdly, I will study and implement in my analyses alternative methods of increasing the power of genome-wide association studies. To fulfill these aims I will make use of the vast wealth of the phenotypic and genotypic data of the Netherlands Twin Register .

To reliably identify susceptibility loci involved in experimental and regular substance use I will use and develop state of the art methodology like genome wide association (GWA) analyses and candidate gene approaches where the relationship between measured genetic markers and the measured complex phenotypes will be studied by using developmentally realistic latent class modeling, including mixtures of growth curve modeling (with regime switching), and Markov modeling, survival models, pathway-analysis.

As the phenotypes of interest are complex ones and require relatively large samples for detection, I will investigate alternative ways of increasing power to detect genetic association. For instance, I will inquire the power advantages conferred by the inclusion into association analysis of family-based imputed genotypes. We will also combine our results with those of other research groups worldwide to increase power and replicate our findings in, for example, meta-analyses.

Improving global and local reliability estimation in nonparametric item response theory (new project)

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Summary

The goals of this project are twofold. First, investigate whether three methods from nonparametric item response theory for test-score reliability estimation are closer to the true reliability than other estimates, including Cronbach's alpha and the greatest lower bound (GLB). Second, to propose a test information function in the context of nonparametric item response theory that expresses reliability as a function of the scale, this recognizing that measurement accuracy can vary across the scale of an attribute.

Some explanation of these goals is the following. Well-known reliability methods such as Cronbach's alpha, the Guttman indices, and the GLB are known to be negatively biased relative to the reliability of the test score. Sijtsma and Molenaar found indications that for tests consisting of dichotonous items Mokken's two reliability methods and their own reliability method were nearly unbiased with respect to reliability, and certainly much closer than Cronbach's alpha and other methods. This project aims at providing more evidence for the small bias or perhaps the absence of bias for these three reliability methods and intends to generalize results to tests consisting of polytomous items.

The other aim of this project is to propose and investigate a test information function that allows for reliability assessment at different locations on the scale. The reliability coefficient is just one number, and is used for computing a standard measurement error and a confidence interval for each tested case, if is however feasible that for different location on a scale reliability of measurement also varies. A test information function would be a welcome addition to nonparametric item response theory, because it would further enhance the applicability of this flexible class of models for scale construction. Ramsay has provided some first attempts, which serve as point of departure in this project.

Time for a change: Studying individual differences in dynamics (new project)

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Project running from	1 September 2012 - 1 September 2016
Supervisors	Prof. Dr. Herbert Hoijtink, Dr. Ellen Hamaker

Summary

The aim of this project is to investigate the possibilities for studying intra- and inter-individual variability in intensive longitudinal data using Multilevel Latent Markov Models (LMMs). These models can be used with univariate or multivariate, and categorical, continuous or mixed data, which makes them especially useful for psychological studies. However, a proper investigation of inter-individual differences requires the inclusion of (multiple) random effects, and this may pose problems for the estimation of the model. The Bayesian framework seems to be quite robust but it remains to be seen which requirements should be met for feasible estimation. Simulations will be used to investigate the numbers of persons, measurements, and latent states that result in adequate estimates of the random and fixed effects. In addition, there are unsolved problems regarding model evaluation and comparison in the Bayesian framework, and how best to deal with label-switching, and how to deal with prior influence in the logit model underlying the latent state transitions. Simulations can be used to address these issues in more detail. Throughout the project, the models are also applied to observational data and questionnaire data, to illustrate the practical use and substantive interpretation of different types of LMMs.

Time for a change: Studying individual differences in dynamics with multilevel multivariate autoregressive models (new project)

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Project financed by	NWO (Netherlands Foundation of Scientific Research)
Project running from	1 September 2012 - 1 September 2015
Supervisors	Prof. Dr. Herbert Hoijtink, Dr. Ellen Hamaker

Summary

There is growing interest among psychological researchers to study processes unfolding over time, as opposed to merely focusing on the static outcomes of these processes. This paradigm shift is accompanied by an increased need for longitudinal models that capture the essence of processes, and allow for individual differences therein. While the study of *developmental processes* has blossomed with the introduction of latent growth curve models, statistical techniques for studying *stationary* (i.e., stable) *processes* are seriously lagging behind the needs of applied researchers. Stationary processes are characterized by within-person reversible variability over time in the absence of a gross underlying trend. Examples include the daily fluctuations in affect or the interaction between dyadic partners during a conversation. A general modeling strategy for such processes is based on a dynamic systems approach and consists of relating the observations to states (i.e., latent variables), and modeling the dynamics of the process through relating the states over time. From a substantive perspective, estimating random effects in the dynamics is of utmost interest, because they reflect individual differences in important phenomena such as regulatory mechanisms, coping strategies, or psychophysiological interactions. However, at present there are very few techniques available for modeling such individual differences, and those that exist are limited in scope. The current proposal seeks to fill this void by focusing on the development of new longitudinal random effects models for stationary processes. To guarantee these innovations will meet the needs of applied researchers, the current proposal evolves around two substantive topics: 1) the traitstate distinction, and 2) dyadic interaction. Moreover, through collaboration with applied researchers who have collected unique longitudinal datasets, the full potential of these new models will be explored. N. Schuurman's project is on topic 1: modeling traits and states. This project will focus on using multilevel multivariate autoregressive models for modeling dynamics in psychology.

Not as we know it: Developing and evaluating synthesis methods that incorporate quantitative and qualitative research (new project)

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Summary

The evidence-based movement has led to a large number of systematic reviews being produced (Dixon-Woods, et al., 2006; Petticrew & Roberts, 2006). Systematic reviews are used to determine effectiveness by aggregating the outcomes of evaluation studies, mainly randomized clinical trials (RCT's). This approach has proven valuable in providing evidence for the question: 'What works best to reduce problem X?'. Systematic reviews are characterised by explicit methods to the task, such as comprehensive searching, quality assessment of scientific studies and advanced analytical tools i.e. meta-analysis.

In policy-making and professional practice the need was felt to address other issues in addition to effectiveness, for example, how programs are received by target groups, how the program's processes are linked to input and output, and what facilitates and obstructs implementation (Lomas, 2005; Dixon-Woods, et al., 2011). As a rule these questions match a qualitative methodology that is suited to describe and understand people's experiences, considerations and decisions (Barbour, 2000; Harden et al., 2004). At the same time, qualitative research is often small-scaled and used to examine a specific, local context. However, when the available qualitative studies in a specific area are systematically synthesized, much more knowledge can be obtained than a single qualitative study can ever provide. The synthesis then covers larger and more diverse samples and more dimensions of the topic of interest (e.g. Van Wesel, Boeije, Alisic & Drost, in press).

By conducting a quantitative and a qualitative review on one topic, more and complementary knowledge can be gained when these reviews are integrated. This PhD-project focuses on the integration of quantitative and qualitative methods on the review level. Three methods that integrate evidence from qualitative and quantitative reviews are evaluated and further developed. The first method is based on the EPPI-approach, in which views of participants on the issue at hand are juxtaposed against effectiveness of an intervention. In the second method, the outcomes of the quantitative review will serve as a starting point of an exploration of the relations with the outcomes of the qualitative review. The third method

consists of a Bayesian meta-analysis, in which we will use the outcomes of the qualitative review as starting point for the meta-analysis.
The project focuses on the development of synthesis methods, but the application of the project is on educational science. The topic of both reviews is collaborative learning in primary and secondary education.

The mapping of national cultures: Examining the robustness of measurements of cross-national cultural dimensions (new project)

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Summary

Researchers often aggregate individual-level survey-data to measure national cultures. Whether these aggregated data adequately measure cultural differences needs to be researched. This research focuses on a set of related methodological issues. The first isse referes to item selection and scal construction and involves researching measurement equivalence and cultural variations in response bias. The second issue raises the question of who to select as raters of national cultures and how to identify them in a given dataset. Finally this research considers that full comparisons of all national cultures might be unfeasible and investigates whether regions of national cultures can be identified.

Model construction in (multilevel) regression analysis (new project)

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Summary

Multilevel regression analysis is one of the most popular techniques in educational research. It is used to relate a set of predictors to a criterion, when the observations have a nested structure (e.g., pupils nested into classes). One of the major challenges is how one should construct an appropriate model: which effects are random and which fixed, how to avoid multicollinearity problems, …? One of the goals of this project is to propose a new model construction strategy, called multilevel covariates regression. Building on the key principle of Principal Covariates Regression (PCovR; De Jong & Kiers, 1992), this strategy boils down to summarizing the main information in the predictor variables by reducing them to a few components in such a way that the criterion scores can be optimally reconstructed. There are, however, still some gaps that need to be filled concerning the PCovR method. Firstly, it includes a weighting parameter that allows one to emphasize the reconstruction of the predictors or rather the prediction of the criterion, but it is unknown how the weighting parameter influences the performance of the method and how an appropriate value should be selected. Secondly, the PCovR code is not yet available in a non-commercial software program. Thirdly, it is not known how PCovR compares to Exploratory Structural Equation Modeling, which is a similar, but stochastic approach. After clearing out these issues, multilevel covariates regression models as well as associated algorithms will be developed and simulation studies will be set up to evaluate their performance.

4.2.3 Running projects

Stepwise model-fitting approaches for latent class analysis and related methods

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Summary

Latent class analysis (LCA) is used by social and behavioral scientists as a statistical method for building typologies, taxonomies, and classifications based on a set of observed characteristics. Examples include atitudinal typologies of citizens based on survey questions measuring their attitudes toward freedom of speech, subtypes of schizophrenia patients derived from recorded mood symptoms, or taxonomies of temporal project networks based on characteristics of these projects and the related organizations.

The project focuses on developing and testing correction methods for the three step latent class analysis. This is an approach to extend the latent class model to include external variables. First the underlying latent construct is estimated based on a set of observed indicator variables, then in the second step individuals are assigned to the latent classes, and in the third step the class assignments from step two are used in further analyses. The project is divided in four main parts:

- Subproject 1 deals with the extension of the existing correction methods developed for correcting the bias introduced in step two of the three step latent class analysis to situations where the external variable is an outcome variable in an ANOVA type model;
- Subproject 2-3 deal with the study of the robustness of the adjustments for model assumption violations, namely: subproject 2 deals with the consequences of direct effects of external variables on indicator variables, and subproject 3 deals with the violation of the distributional assumptions of the external variables;
- Subproject 4 deals with the extension of the correction methods to models, with multiple latent variables, namely latent class factor analysis models.

Expectancy effects on the analysis of behavioral research data

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Summary

Behavioral researchers normally try to avoid expectancy effects during data collection, but they perform the statistical analysis of their study themselves. In this project we study whether researchers' expectations can bias their statistical results. We propose that researchers may suffer from confirmation bias which may result in a failure to notice statistical errors that are in line with their hypotheses. Moreover, we hypothesize that researchers may resort to alternative analyses when the planned analysis fails to support their hypothesis. Expectancy effects on statistical outcomes will be studied by means of re-analyses and by employing correlational, experimental, and meta-analytical methods.

Micro-macro multilevel analysis for discrete data

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Summary

This project deals with multilevel models for predicting outcomes at the higher level (e.g. team performance) from predictors measured at the lower level (e.g. employee's motivation and skills). This form of "reversed" multilevel analysis, which is rather common in social sciences, is something referred to as micro-macro analysis. Recently, Croon and Van Veldhoven proposed a statistical model for micro-macro multilevel analysis. The aim of this project is to generalize their approach so that it can also be applied when the model of interest contains explanatory and outcome variables which are discrete instead of continuous and normally distributed.

The theory and practice of item sampling

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Summary of project

In the seminal work of Lord and Novick, Statistical Theories of Mental Test Scores (1968), the idea of item sampling is put forth. Though Johnson and Lord (1958) already introduced the idea a decade before, it seems that it has not gained much popularity in neither literature nor applications since. One of the explanations for the lack of attention in this area might be the use of generalized symmetric means (gsm) (Lord and Novick, p. 238), which are a highly complicated set of expressions limiting the usability of the whole procedure.

However, responses gathered through randomly selected items hold several desirable properties for which other procedures than the one suggested by Lord and Novick can be employed. Purpose of this proposal is to develop and apply such alternative procedures, and thus to extend item sampling theory.

Person-misfit in item response models explained by means of nonparametric and multilevel logistic regression models

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Summary

Performance on psychological tests and personality inventories may be unexpected. This may be due to cheating or test anxiety (achievement testing), or response inconsistency or lack of traitedness (personality). Traditional person-fit measures are primitive in that they only flag unexpected performance but do not provide explanatory information. Two recent approaches provide more explanatory information. One is flexible (i.e., nonparametric) but only suggests an explanation. The other is not as flexible (i.e., parametric) but explicitly uses auxiliary information in a multilevel framework. Both approaches are studied and integrated so as to provide a better understanding of individual test performance.

Causal networks for psychological measurement

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Summary

Current psychometric models conceptualize psychological constructs as latent variables. Latent variables function as the common cause of a number of observable 'indicator' variables; for instance, the latent variable 'depression' is taken to be the common cause of a number of observable depression symptoms, such as fatigue, depressed mood, and lack of sleep. Individual differences on the (aggregated) observable indicators are then used to infer individual differences in the constructs measured. This is the logic of construct validity theory, as it has been practiced in the past decades. For many important psychological attributes, however, it is unlikely that this conceptualization is correct. For instance, the correlation between sleep deprivation and fatigue is more likely to result from a direct effect (i.e., if you do not sleep, you get tired) than from a common cause, as hypothesized in a latent variable model. In such situations, a plausible hypothesis is that constructs like depression refer to causal networks that involve a set of observables, rather than to the common cause of these observables. Indicator variables that are relevant to a construct will, in such cases, be correlated; not, however, because they result from the same underlying cause, but because they are part of the same causal system. Because this is fundamentally inconsistent with existing psychometric theory, to accommodate situations in which constructs form causal networks, a different methodological approach is needed. The present project aims to develop such an approach through three subprojects: a) the development of new psychometric theory based on the assumption that constructs are causal networks, b) the development of a methodological toolbox that allows for the implementation of this theory in empirical research, and c) an application of the theory to diagnostic systems used in clinical psychology.

Fast adaptive diagnostic assessment for internet therapy

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Summary

A considerable problem in mental health testing is the multitude of questionnaires used for clinical assessment. This has negative effects, such as the unwillingness to participate in internet therapy. In this project we develop a method for short clinical examination, *fast adaptive diagnostic assessment* (FADA), which unites two methods for reducing assessment time. Computerized Adaptive Testing is used to shorten the administration of each questionnaire. Decision trees are used to select a short sequence of questionnaires which is most informative for predicting diagnostic class. In four projects, the hybrid model is gradually refined, to come to an optimal model for FADA.

Computerized adaptive text-based testing in psychological and educational measurement

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Summary of project

Computerized adaptive testing (CAT, Wainer et al., 1990, van der Linden & Glas, 2002, 2010 (in Press)) has become increasingly popular during the past decade in both educational and psychological measurement. The flexibility of CAT combined with the possibilities of internet-based testing seems profitable for many operational testing programs (Bartram & Hambleton, 2006).

In CAT, the items are adapted to the level of the respondent, that is, the difficulty of the items is adapted to the estimated level of the respondent. If the performance on previous items has been rather weak, an easy item will be presented next, and if the performance on previous items has been rather strong, a more difficult item will be selected for administration. The main advantage of this approach is that the test length can be reduced considerably without loosing measurement precision. Besides, the respondents are administered items at their specific ability level, which implies that they won't get bored by to easy items or frustrated by too difficult ones.

The measurement framework underlying CAT comes from Item Response Theory (IRT). One of the key features of IRT is that both item and person parameters are distinguished in the measurement model. For dichotomously scored items, the probability of a correct or positive response depends on person parameters such as the ability level of the person and on item parameters such as the difficulty-, discrimination- and pseudo-guessing parameter. For a thorough introduction to IRT, one is referred to Hambleton and Swaminathan (1985) or Embretson and Reise (1991).

In this PhD project, the focus is on open answer questions where more complicated automated scoring algorithms have to be developed. Applications are either within the context of psychological or educational measurement. The technology of CAT has been developed for multiple-choice items in the cognitive domain that are dichotomously or polytomously scored. For these items, both the correct and the incorrect answers are precisely defined and automated scoring can be implemented on the fly. For other item types, application of CAT is less straightforward. For example for open-answer questions, automated scoring rules can be much more complicated. Further, CAT is more and more applied outside the traditional cognitive domain. Initially, the present project will focus on the assessment of post traumatic stress disorder (PTSD).

Competence based assessment in vocational education in The Netherlands

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Summary of project

In the past five years competence based assessment has become the prominent method of examination in vocational education in the Netherlands. The majority of the exams are practical, authentic competence based assessments. This research proposes to look into certain unresolved issues regarding practical and performance assessments.

To assess the quality of the exams, the classification accuracy of a competence based exam is evaluated. This classification accuracy is measured in the total percentage of misclassification ("should have failed exam but passed" and "should have passed but failed"). Furthermore, the influences of decision rules, cut-off score and distribution of ability on the classification accuracy is investigated.

It is not always necessary to measure all supposed constructs with an equal amount of dimensions in a multidimensional IRT model (Reckase, 2009). In the case of competence based assessment, it is not clear whether the competences as they are used in exams, overlap in such a way that they should be seen as parts of one dimension, or even a combination of two dimensions. This research proposes to use multi-dimensional IRT modeling (Reckase, 2009) in an exploratory fashion to investigate the structure of the competences.

For competence based assessment, it is important to work with authentic test situations in which the student's performance on different competences is assessed (Gulikers, 2006). However, the authentic situations tend to be different for each student. It could be that this yields also different difficulties of assessment per student, since decisions and thus actions of a person are always embedded within the specific context (Roelofs & Sanders, 2007). Does the lack of standardization of the context in fact impacts the validity and reliability of the inferences from the performance assessment or not?

Often, performance assessments are ended with a criterion based interview or an interview in which the student is asked to reflect on the exam. This research proposes to find out how well students (and assessors) are prepared for this cognitively complex task.
In general, assessment by more than one person tends to be more reliable than assessment by only one person. Furthermore, independent, or objective, assessors tend to be less sensitive to adverse effects, such as halo or horn effects. However, a single assessor, that has seen the student for an extended period of time in his internship has more data available to base his decision on. Besides, it is very cost ineffective to assess a student with two independent observers, and a logistic nightmare. How much, if at all, does the quality of the assessment suffer if only one dependent observer is used?

Bias in the measurement of child attributes in educational research: Measurement bias in multilevel data

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Summary

Background

The measurement of child attributes brings about problems because informants (e.g., the children themselves, their parents, their teachers, etc.) may have different frames of reference when answering test or questionnaire items. Such different frames of reference may result in measurement bias, so that observed differences and changes in test scores do not reflect true differences and changes in child attributes. Measurement bias thus complicates all research into child attributes (e.g., evaluation of intervention effects, sex differences, cultural differences, relationships with explanatory variables).

Objectives

We will extend existing structural equation modelling (SEM) procedures for the detection of measurement bias with procedures for bias detection in multilevel data, continuous and discrete.

We will investigate the feasibility of these new procedures, by applying them in secondary analyses of educational data, investigating the impact of measurement bias on the results of testing substantive hypotheses in educational research, and investigating different ways to account for apparent measurement bias.

Method

We will first investigate measurement bias in existing data sets of our department by means of secondary analyses. When we find measurement bias, we will account for this bias, and investigate whether the test results of the original hypotheses are different from the test results that are obtained when measurement bias is accounted for. Dependent on our findings, we may modify the SEM procedures, and further investigate the latent variable modelling procedures with simulated data, e.g., to investigate power, effect size indices, and the impact of measurement bias. This approach will be used with various sets of multilevel data, and various sets of discrete data.

Relevance

We will obtain additional knowledge of:

(1) the psychometric properties of several measurement instruments that are commonly applied in educational research,
(2) the extent of measurement bias in educational research,
(3) the impact of possible measurement bias on substantive conclusions,
(4) the robustness of educational research to possible measurement bias. Moreover, the research project is psychometrically relevant because it extends and further develops procedures for testing measurement bias in multilevel data, continuous and discrete. Methods to detect measurement bias and to account for measurement bias will result in stronger substantive conclusions.

Modelling individual differences in intraindividual change and variability

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Summary

If one realizes how the meaning of the autoregressive and cross-lagged regression parameters changes once the model is combined with the LGC model, a natural next step is to include these parameters as random rather than common effects. Doing so would allow individuals to differ with respect to their inertia, and it would allow the influence of one variable on the other to be different across people. However, there are a number of problems associated with including autoregressive and cross-lagged regression parameters as random effects in the model. The current PhD project is focused on developing a random effects extension of the bivariate ALT model and tackling some important problems associated with this extension. This random effects extension of the bivariate ALT model will provide us with a much richer picture of psychological processes as they unfold over time. Moreover, it will allow us to investigate moderation effects in these longitudinal models. For instance, if we have observed the affect of two spouses (bivariate longitudinal data), we may find that the effect of one spouse on the other, represented by the cross-lagged regression, depends on personality characteristics such as Agreeableness and Neuroticism, but also on relationship quality. This would imply that the influence of one partner on the other is moderated by personality and relationship features.

Improving statistical power in studies on event occurrence by using an optimal design

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Summary

The main research question in studies on event occurrence is whether and when subjects experience a particular event, such as the onset of daily smoking or the shift to adulthood. The experience of such an event and its timing can be related to explanatory variables such as gender, socio-economic status, educational level, and, in the case of an experiment, treatment condition. Such a variable's effect should be identifiable with sufficient probability, so the power of a study on event occurrence should be controlled in the design phase. In studies on event occurrence subjects may be monitored continuously, or be measured at intervals. Interval measurement is often used in the behavioural sciences but sample size formulae for such trials are not readily available. The proposed research aims to remedy this deficiency by providing guidelines for the indices governing the number of subjects, the number of measurements per subject, the placement of the measurement points in time and the duration of the study. Where possible, mathematical formulae that relate sample size and duration to statistical power will be derived analytically.

Otherwise, the effect of these design factors on statistical power will be studied on the basis of simulation studies taking into account realistic conditions such as drop-out rates and the varying costs per treatment condition.

A study that is not carefully designed is a waste of resources. Therefore, ethical review committees and organizations funding scientific research frequently require research proposals to include power calculations. The proposed research will provide guidelines for efficient study-designs for use in event occurrence studies – ensuring that the financial cost and the number of subjects are minimized and sufficient power is guaranteed. From a scientific point of view this proposed research project is fundamental since it will enable future researchers to plan their research more efficiently.

Keywords: statistical power, cost-efficient designs, survival analysis, hypothesis testing.

Question format and response style behaviour in attitude research

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Summary

Attitude questions differ in format, e.g. differences in numbering and labelling of response categories. It has been argued that the validity and reliability of attitudes is affected by the choice of question format. At the same time, it is acknowledged that response style behaviour can bias the measurement of attitudes as well as bias the estimates of the effect of covariates. This research project links these two issues by focusing on the impact of question format on the likelihood of response bias, i.e. acquiescence and extreme response style, in attitude research.

Statistical models for reductive theories

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Summary

This project reformulates the reduction problem as measurement problem, by focusing on the question how we should combine physical and psychological indicators in a single measurement structure. In the first subproject, different positions that have been articulated in the philosophy of mind, such as identity theory and supervenience, are translated into different psychometric models. In the second subproject, these models are applied to existing datasets involving a) the relation between IQ and physical properties of the brain (e.g., brain volume), b) the relation between EEG measures of speed of processing and IQ,and c) the relation between anatomical differences in the brain and different kinds of synesthetic experience. In the third subproject, the prospects for a reductive explanation of inter-individual differences on the basis of intra-individual processes is evaluated according to theoretical insights taken from the philosophical literature on reduction.

Nonresponse and response bias in mixed-mode surveys

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Summary

Mode bias is a nuisance in surveys using more than one survey mode (mixed-mode surveys) and longitudinal surveys that need to switch modes in the course of their lifetime. Sources of mode bias include mode-specific response propensity distributions of the population (causing mode-specific nonresponse error) and mode-, survey- and item-specific measurement distributions for each population unit (aggregating to mode-specific measurement errors). Mode biases are the aggregated net effects of these errors when comparing estimates from two or more modes. To date, both singular and generalizable knowledge on the size of these errors is scarce, but is keenly needed in order to assess the relative effects of mode-switches in mixed-mode and longitudinal surveys. Developing a common theory of the errors underlying mode bias and how they interact is the first goal of the research. Consequently, we will review and develop methods useful to assess the size of the errors based on empirical data from a parallel multi-mode experiment.

The influence of strategy use on working memory task performance

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Summary

There are some robust effects on WM that are replicated in different studies over the years, like the visual similarity effect and the phonological similarity effect (e.g., Hitch et al., 1989; Poirier et al., 2007). The nature of these effects has been investigated, but research in which group means are compared show inconsistent results. Other researchers have focused more on the methodology and individual differences in WM research (e.g., Logie et al, 1996; Della Sala & Logie, 1997; Engle, 1999). These studies have shown that there are different influences on performance besides the aforementioned effects, like task demands and strategy use. Because this focus seems to lead to useful information about the cognitive processes involved in working memory, there is a need for further refinement of the methodology. The aim of this project is to address this issue. First, we want to investigate the development of WM and test the hypothesis that younger children process information mostly visually, whereas older children process information mostly verbally. Second, we want to further investigate this question by distinguishing the different cognitive processes that underlie the different strategies. Third, we want to explore different measurement tools that enable us to investigate the influence of strategy use and task demands on performance in order to better understand the model of working memory of Baddeley and Hitch and its generalization. Finally, in addressing these aims, we will apply a latent variable approach.

Test construction using marginal models

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Project running from	1 September 2010 - 1 September 2014
Supervisors	Prof. Dr. K. Sijtsma, Dr. M.A. Croon, Dr. L.A. Van der Ark

Summary

Mokken scale analysis is an important statistical tool for the construction of psychological tests. For parts of the tool no statistical significance tests were available until recently, but Van der Ark, Croon, and Sijtsma (2007) showed that marginal models provided these tests. Marginal models substantially increase the possibilities of Mokken scale analysis but are available only for short tests consisting of dichotomous items. The proposal aims at extending the approach to longer tests and polytomous items, and developing it into user-friendly software tool for test construction.

Multi-way decompositions: Existence and uniqueness

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Summary

Over the last 10 years the interest in multi-way data representations has increased exponentially. There is growing awareness that if data are not 2-way (e.g., subjects multi-way (e.g., subjects is often desirable. Such representations are given by multi-way generalizations of Principal Component Analysis (PCA) or, equivalently, of the Singular Value Decomposition (SVD), and are called multi-way decompositions or tensor decompositions. This research project concerns the existence (main project) and uniqueness (PhD project) of an important class of multi-way decompositions and is expected to greatly bene t the application of multi-way models.

Simulator-based automatic assessment of driving performance

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Project running from	1 January 2009 - 1 january 2014
Supervisors	Prof. Dr. C.A.W. Glas, Prof. Dr. K. Brookhuis, Dr. M.J.H. Van Onna

Summary

The purpose of this PhD project is to design a reliable and valid automatic performance scoring system for a simulator based test for driving.

In order to design a simulator test, apart from optimizing the technical or virtual presentation of the scenario's in the simulator, several statistical and methodological problems have to be tackled. First, because performance in the simulator cannot be automatically scored yet, assessors have to be used to obtain evaluation of pupil driver behaviour. A cognitive model is developed at TNO that learns the relation between ratings of assessors and registered objective performance measures by the simulator. Since the quality of the cognitive model is dependent on the quality of the information provided by assessors, a sound IRT-based measurement model for the assessors' data has to be developed to feed the cognitive model with optimal information.

The output of the cognitive model will be used to select objective measures which are good predictors of the judgements of the assessors. Then a compound IRT model will be designed where one element is the IRT-based measurement model for the assessor judgements and the other an IRT model for assessment based on the selected predictors.

When the test has been designed and the models have been developed and validated, two projects remain. First, a cross-sectional study will be performed to create norm distributions for groups defined as beginning pupil drivers, advanced pupil drivers, license candidates, drivers one year post-licences, and very experienced drivers. Second, the assessors' and simulator assessment scores will be correlated with additional measurements of supposedly related cognitive processes involved in driving, in particular in-car performance assessments, self-evaluation of driving competence and the Cito Drive computer based tests of responsible driving.

Application of mixed IRT models and person-fit methods in educational measurement

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Summary

Item response theory (IRT) models have specific properties that are useful in educational measurement. These properties support the construction of measurement instruments, linking and equating of measurements, and evaluation of test bias, among other things (Scheerens, Glas, & Thomas, 2007). However, these properties are only useful if the IRT model fits the data and if the proficiency level and item parameters are accurately estimated. Unfortunately, due to various reasons, this condition is not always met. For example, if groups of respondents display “sleeping” behavior (e.g., inaccurately answering the first items in a test due to problems getting started), “plodding” behavior (e.g., spending too much time on the first items and thereby answering the later items incorrect due to too little time left), random response behavior (e.g., answering items randomly) or cheating behavior (e.g., copying answers from other examinees) an IRT model might not fit to specific subgroups of respondents within the total group (Meijer & Sijtsma, 2001; Meijer, 2003).

Several methods were proposed to identify these aberrant response behaviors. For example, person-fit methods assign a value to each individual vector of items scores, and a statistical test is used to decide whether the underlying IRT model or other measurement model fits the item scores. Significant person-fit values identify item-scores that are aberrant relative to the IRT model, and the researcher may decide to remove the aberrant item-score vectors from the data set (Meijer & Sijtsma, 1995). This is expected to improve the fit of the IRT model and the correctness of the parameter estimates. A well-known person-fit statistic is the l_z, statistic (Drasgow, Levine, & Williams, 1985). Research showed that the normal approximation to l_z is invalid, which yields a conservative test, in particular for detecting aberrant responses at the lower and higher end of the level scale and when applied to short scales (Van Krimpen-Stoop & Meijer, 1999). Fortunately, Snijders (2001) and De la Torre and Deng (2008) developed methods for the accuracy of person-fit analysis using l_z.

Alternatively, mixed IRT models assume that the data are a mixture of different data sets from two or more

latent populations (Rost, 1997; Von Davier & Yamamoto, 2004), also called latent classes. If this assumption is correct, a particular IRT model does not hold for the entire population, but different model parameters are valid for different subpopulations. Hence, mixed IRT models may be used to identify classes in our data displaying different types of responsive behavior, and the researcher may decide to remove an entire class from the data set so as to improve IRT model fit and parameter estimates. For example, one can specify the mixed IRT model in such a way that one of the latent classes represent high-stakes response behavior while the other latent class represents low-stakes responsive behavior (Béguin, 2005; Béguin & Maan, 2007).
The goal of this project is to investigate how mixed IRT models and person-fit methods can be used to improve educational measurement procedures. More specifically, research is done into equating and linking procedures in which two high-stakes tests are compared.

Prediction of disease classes using resting rate state neuroimaging data

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Project running from	1 March 2010 - 1 March 2014
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Summary

Resting state functional magnetic resonance imaging (RS-fMRI) has become a very popular technique to study functional connectivity in the brain. It appears that the brain is very active even in the absence of explicit input or output behavior. The networks obtained in rest, resemble networks that are typically observed activated during cognitive, sensory or motor tasks and this therefore providing insight into the intrinsic functional architecture of the brain.

Furthermore, functional connectivity measures have improved our understanding of variability of behavior and associated brain activity. In addition, RS-fMRI has provided insight in alterations in brain activity between healthy, dementia, depression, ADHD, autism, schizophrenia, Parkinson's disease, and MS subjects.

Most investigations are limited to studying whether brain signals differ between patient and control groups. These studies provide important new insights about average (group mean) functional brain connectivity changes in diseases. However, to understand to what extent this innovative technique can be applied for (early) diagnostics en treatment predictions, it is of great interest to study whether we can classify a subject based on his/her RS-fMRI scans. Meaning we are able to see whether RS-fMRI scans of a single subject allow us to determine whether a subject has for instance Alzheimer's disease, a depression, etc, or is healthy.

Suppose there are brain scans of n subjects, which are known to come from different disease classes. The question is whether we can distinguish these groups on the basis of the brain scans, and whether we can accurately predict the status of a single subject based on earlier obtained rules. This is a typical classification question, normally solved using discriminant analysis or some form of logistic regression, but in this case the number of variables is very large, i.e. the measurements on each of the voxels at each of the time points (volumes)

This project's aim is to develop techniques for building highly sophisticated classifion rules, which can be used as a multiclass prediction tool for RS-fMRI scans.

Heterogeneity in studies with discrete-time survival endpoints: Implications for optimal designs and statistical power analysis

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Supervisors	Prof. Dr. P.G.M. Van der Heijden, Dr. Ir. M. Moerbeek

Summary

The main research question in studies on event occurrence is whether and when subjects experience a particular event, such as the onset of daily smoking or the shift to adulthood. The experience of such an event and its timing can be related to explanatory variables such as gender, socio-economic status, educational level, and, in the case of an experiment, treatment condition. Such a variable's effect should be identifiable with sufficient probability, so the power of a study on event occurrence should be controlled in the design phase.

In studies on event occurrence subjects may be monitored continuously, or be measured at intervals. Interval measurement is often used in the behavioural sciences. The sample sizes that should be used to achieve a desired power level are often large and not always feasible in social science research. It is therefore worthwhile to study to what extent covariates can improve statistical power and reduce sample size. The costs of taking such covariates is also taken into account. We will also study optimal designs where treatment and covariates are used as predictor variables in the statistical model.

Furthermore we study trials where part of the heterogeneity is unobserved. To what extent does ignoring unobserved heterogeneity result in incorrect conclusions with respect to the treatment effect and its significance? How large should sample size be if unobserved heterogeneity is taken into account?

The incremental value of Item Response Theory to personality assessment

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Summary

Psychological assessment is one of psychology's major contributions to everyday life. An important part of psychological assessment is personality assessment which is a professional activity of numerous research, clinical, and industrial psychologists.

In personality assessment often self-report inventories or scales are used. Scale construction and revision within the field of personality measurement relies heavily on classical test theory (CTT) and factor analytic methods. Though CTT methods of scale development and scoring have served personality measurement reasonably well over the last 80 years, CTT has serious limitations and shortcomings (see, for instance, Fischer, 1974). These limitations and shortcomings are related to the fact that CTT is a model for the test performance of a randomly drawn respondent from some well-defined population where the influence of the ability level of the respondent and the influence of the difficulty of tests or items on the test score are not separated. In item response theory (IRT, for an overview, see van der Linden & Hambleton, 1997), on the other hand, the influence of respondents and test items are explicitly modeled by different sets of parameters. This model property proved essential for such activities as linking and equating measurements and evaluation of test bias and differential item functioning. Further, it provided the underpinnings for item banking, optimal test construction, and various flexible test administration designs, such as multiple matrix sampling, flexi-level testing, and computerized adaptive testing. Therefore, in the last decades IRT modeling has rapidly become the theoretical basis for educational assessment and assessment of cognitive ability.

In psychology, the development of personality and attitude questionnaires through IRT is almost nonexisting although these models are becoming more popular (e.g., Reise & Waller, 2009; Egberink & Meijer, in press; Meijer, Egberink, Emons, & Sijtsma, 2008). This is unfortunate because the requirements with respect to the objectivity, reliability and validity of psychological assessment are increasing.

In this project, we explore the incremental value of IRT to the assessment of personality and psychopathology.

Constant latent odds-ratios models for the analysis of discrete psychological data

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Project running from	1 September 2008 -1 September 2013
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Summary

The main objective of this project is developing statistical procedures for Constant Latent Odds-Ratios models (CLORs) for dichotomous item scores. Since under dichotomous CLORs models the total score, i.e., the unweighted sum of the item scores, is a sufficient statistic for the latent variable, sound statistical procedures for estimation and goodness of fit assessment are readily attainable. The development of such procedures will make the CLORs models available for practical use. Furthermore, the characteristic assumption of constant latent odds-ratios will be used to define new models for polytomous item scores

Multiple imputation using mixture models

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Project running from	1 September 2009 - 1 September 2013
Supervisors	Prof. Dr. J.K. Vermunt, Prof. Dr. K. Sijtsma, Dr. L.A. Van der Ark

Summary

The main focus of this project is on the use of mixture models for multiple imputation (MI) of missing data, or more specifically, item nonresponse. Vermunt, Van Ginkel, van der Ark, and Sijtsma (2008) explored the use of a simple latent class model (Goodman, 1974), which is a mixture model for categorical response variables, as a tool for MI. Despite of being a very promising approach, various issues remain unresolved when applying mixture models for MI. The purpose of this project is to address four unresolved problems mentioned by Vermunt et al. (2008) in the discussion section of their article:

1. Whereas Vermunt et al. (2008) concentrated on imputation of data sets containing only categorical variables, most data sets contain combinations of categorical and continuous variables. The current project will investigate how imputation by means of mixture models can best be generalized to such mixed data sets.
2. It is not clear at all whether the decision which statistical model explains the data best (also known as model selection) in the context of mixture modeling for generating multiple imputations can be taken in the same way as when applying mixture models to build a substantively meaningful model. More specifically, standard model selection statistics such as information criteria (AIC, BIC) and overall goodness-of-fit tests seem to be less appropriate for deciding whether a model is a good imputation model.
3. An extended comparison between MI with mixture models and other MI approaches is lacking. In order to assess the usefulness of our approach, it is important to investigate in which situations it performs better than possible alternatives, such as MICE and hot deck imputation.
4. As most of the work on MI, the article by Vermunt et al. (2008) dealt with imputation of data sets containing independent observations. However, many studies in the social and behavioural sciences use designs yielding dependent observations, examples of which are studies using multilevel designs and longitudinal designs. A fourth aim of this project is to develop mixture MI models for dealing with such complex designs.

Besides addressing these four topics, the project should yield software implementations so that the MI methodology becomes available for applied researchers. We aim for making SPSS macro's available as freeware on the Internet.

Methods for making classification decisions

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Project running from	1 September 2009 – 1 September 2013
Supervisor	Prof. Dr. T.J.H.M. Eggen

Summary

Most adaptive tests are constructed in order to estimate the examinees' ability as efficient and accurate as possible. Computerized classification testing has a different goal: classify the examinee as efficient and accurate as possible into mutual exclusive groups. Computerized classification testing will be investigated in this PhD project. Computerized classification tests (CCT) are computerized adaptive tests (CAT) that select items sequentially for each examinee in order to make a classification decision. The test are also denoted in the literature as sequential mastery tests (SMT). Traditionally, CATs have the goal of estimating the respondent's ability as accurate as possible, but CCTs have the goal of classifying respondents into groups. A classification decision is made in which the examinee is assigned into one of two or more mutually exclusive categories along the ability scale (Lin & Spray, 2000) using cutting points to separate the categories (Eggen, 1999).

A computerized classification test is of variable length and examinees ''are classified as masters or non-masters as soon as there is enough evidence to make a decision'' (Finkelman, 2008). The classification procedure must choose between three options: to stop testing and classify an examinee as a master, to stop testing and classify an examinee as a non-master, or to continue testing and select a new item. Several procedures are available for making the decisions but also for the way in which items are selected. Six research topics have been formulated for this project. The six research topics are:

- A multiple objective stochastic curtailed sequential probability ratio test with exposure control
- Multidimensional classification decisions
- Exploring methods for classification decisions
- Making classification decisions on infomation about future items
- Classification decisions using latent class models
- Sequential mastery testing methods for respondents near the cutting point.

Restrictive imputation of incomplete survey data

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Project running from	1 September 2009 - 1 September 2013
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Summary

Imputation is a method to correct for missing data by using various models to estimate missing values whilst adding the estimated data to the original dataset. The completed dataset can then be analyzed by methods for complete data. To estimate the reliability of estimates on imputed data, however, special techniques are needed, because standard methods for complete data do not discriminate between real and imputed data.

Imputations are predictions for the values that could have been encountered, if the missing data would have been observed. Because imputations are, to some extent, used as real observations, these predictions have to be as accurate as possible. In order to obtain accurate estimates, models have to be constructed that optimally represent the properties of the various variables and their internal coherence. In addition to the quality of predictions, plausible imputations also have to meet certain a priori knowledge, such as variable restrictions (e.g. an income must be greater than or equal to zero) or restrictions conform to known population distributions (e.g. the known amount of cars in a country).

Three research topics will be distinguished in this research proposal: imputing variables that have to meet restrictions (§A), imputing semi-continuous variables (§B) and measuring the quality of imputation models and the accuracy and reliability of estimations on imputed data (§C). These research questions can be answered within a PhD position, resulting in a dissertation, as well as new software. Expected results include answering the following general research questions:

- How can imputations under row and column restrictions be executed?
- How can imputations on semi-continuous data best be done?
- How can imputations most effectively and plausibly be evaluated?

Furthermore, based on the research in this PhD-project, recommendations for routinely use of imputation methods at Statistics Netherlands will be made.

Comparing rating and ranking procedures for the measurement of values in surveys

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Project running from	1 March 2011 - 1 March 2015
Supervisors	Prof. Dr. J.K. Vermunt, Dr. J.P.T.M. Gelissen, Dr. G.B.D. Moors

Summary

The study of values lies at the heart of the social sciences. Nonetheless, empirical social researchers have been involved in a long-standing discussion about the proper measurement of human value orientations, which revolves around the use of rating or ranking procedures. This project examines the appropriateness of both approaches in much-needed and novel ways, by: 1) directly considering the effects of response bias, 2) gathering and analysing data based on within-subjects survey experiments, which are from a Dutch nationality representative sample, and 3) making use of recent developments in statistical modelling of response styles and of rating and ranking data.

A Bayesian approach to the analysis of individual change

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Project running from	1 September 2010 - 1 September 2014
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Summary

It is clear that NHST has serious shortcomings in hypothesis testing, and that the Bayesian approach can ameliorate many if not all of the problems inherent to NHST. Because applied researchers in the field of individual change seem to be unaware of the existence or benefits of the Bayesian approach, we consider it to be useful to introduce them to the benefits of Bayesian statistics. Therefore, in the first part of the dissertation we will discuss NHST and the Bayesian approach as outlined above. We will provide examples with emprical and simulated data to show how results from NHST can be misleading and compare them with Bayesian results, in the context of single subject research.

In the second part, we will adapt existing statistics and tests for single-subject data to simple Bayes factor formulae and compare them using emprical and simulated data. Empirical data are available from several projects in which our research group is involved. Examples of statistics and tests already used in single subject studies are the percentage of non-overlapping data (the percentage of observations in a post-intervention phase exceeding the highest point in a pre-intervention phase), Cohen's *d*, permutation tests, and time series analysis. Rouder et al. (2009) already presented a Bayes factor for Cohen's *d* for group studies and provided a Web-based program that performs the calculations. A similar interface for single subject Bayes factors would make computing Bayes factors convenient even for researchers without deep knowledge of Bayesian statistics.

In the third part of the dissertation, we will adapt existing statistics and tests for individual change within group data to Bayes factor formulae. Again, the classical and Bayes factor statistics will be compared using empirical and simulated data. An example is the RCI of Jacobson & Truax (1991) which was already discussed for this type of data, and several variations of this measure have been developed (e.g., Bruggemans, Van de Vijver, & Huysmans, 1997; Chelune, Naugle, Lüders, Sedlak, & Awad, 1993; Hageman & Arrindell, 1999; McSweeny, Naugle, Chelune, & Lüders, 1993; for a comparison of measures, see Maassen, Bossema, & Brand, 2009). If possible, online toolkits will be provided where researchers can

easily calculate the Bayesian variants of their statistics.

In sum, we hope to show researchers in the field of individual change the merits of the Bayesian approach and will provide them with tools to use it. The Bayesian approach will give researchers the odds of their hypotheses, rather than the probabilities of observed and unobserved data.

Multivariate logistic regression using the ideal point classification model

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Project running from	1 October 2010 - 1 October 2014
Supervisors	Dr. M. De Rooij, Prof. Dr. W.J. Heiser, Prof. Dr. P. Spinhoven (Leiden University)

Summary

Multivariate categorical data, with multiple dependent variables and one or more independent variables, are often collected in the social sciences. However, only limited tools are available for the analysis of such data. The methodology that is available makes unverifiable assumptions or requires the independent variables to be categorized, with all negative consequences. In this project new methodology is proposed, based on the ideal point classification model, which requires a minimal set of assumptions and takes the data as it is. Essential tools for the evaluation of effects and for the design of empirical studies will also be proposed.

5 Graduate training program

5.1 Courses in the IOPS curriculum

In 2012 6 IOPS courses were organized, of which one had to be cancelled:

- *Optimization and numerical methods* (elective course in the IOPS curriculum)
  Instructors: Francis Tuerlinckx, Geert Molenberghs, Katrijn van Deun, and Tom Wilderjans (KU Leuven)
  Dates: 29-30 November & 6-7 December 2012 (4 days)
- *Probability Theory* (elective course in the IOPS curriculum; this course has been cancelled)
  Instructors: Alwin Stegeman and Richard Morey (University of Groningen)
  Dates: 31 October and 1 November 2012 (2 days)
- *Analysis of measurement instruments: Introduction to classical test theory, item response models and multilevele item response models*
  Course instructors: Prof. Dr. Cees Glas, Dr. Jean-Paul Fox (Twente University)
  Dates: 15-18 October 2012 (4 days)
- *Generalized latent variable modeling* (elective course in the IOPS curriculum)
  Instructor: Jeroen Vermunt (Tilburg University)
  Dates: 4-5 June 2012 (2 days)
- *Applied Bayesian Statistic*s (elective course in the IOPS curriculum)
  Course instructors: Herbert Hoijtink, Irene Klugkist, Ellen Hamaker, C. Rietbergen, Joran Jongerling, Hennie Boeije (Utrecht University)
  Dates: 7-11 May 2012 (5 days)
- *What is Psychometrics* (mandatory course in the IOPS curriculum)
  Course instructors: Denny Borsboom, Paul De Boeck, Willem Heiser, Henk Kelderman, Don Mellenbergh, Eric-Jan Wagenmakers (University of Amsterdam, Leiden University, and VU University Amsterdam)
  Dates: 7-9 March 2012

5.2 Conferences

5.2.1 27th IOPS summer conference

The 27th IOPS summer conference was held in Maastricht on 28-29 June 2012. Maastricht University, co-organiser and host of the conference, welcomed 53 participants.

Conference presentations

Invited speaker presentations

- Ariel **Alonso,** Maastricht University
  Title: *Reliability in a longitudinal context: Issues and extensions*
- Danny **Brouwer,** Twente University
  Title: *How should we use the Beck Depression Inventory in clinical practice?*

IOPS PhD students presentations

- Marianna **Avetisyan,** Twente University
  Toward a multidimensional randomized item response model
- Mariska **Barendse,** University of Groningen
  Title: *Determining dimensionality of discrete responses*
- Rivka **De Vries,** University of Groningen
  Title: *Bayesian hypothesis testing with single-subject data*
- Shahab **Jolani,** Utrecht University
  Title: *Combining the complete-data and nonresponse models for drawing imputations under MAR*
- Thomas **Klausch,** Utrecht University
  Title: *Measurement effects of survey mode on the equivalence of ordinal rating scale questions*
- Maryam **Safarkhani,** Utrecht University
  Title: *Accounting for unobserved heterogeneity reduces bias in trials with discrete-time survival endpoints*
- Hendrik **Straat,** Tilburg University
  Title: *Minimum sample size requirements for Mokken Scale analysis*
- Josine **Verhagen,** Twente University
  Title: *Bayesian item response models for measurement variance*
- Ruud **Wetzels,** University of Amsterdam
  Title: *A comparison of default priors for Bayesian model selection*

Lab presentations

During IOPS conferences the hosting university prepares a Lab Meeting where specific and new research of this group is presented and discussed. The following members of the Faculty of Health, Medicine and Life Sciences of Maastricht presented their research:

- Huub **Hamers** and Michiel **Vestjens,** Maastricht University
  Title: *A taste of lab facilities at the Faculty of Psychology and Neuroscience Maastricht*
- Gerard **Van Breukelen,** Maastricht University
  Title: *Design and analysis of studies in health sciences: the Methodology & Statistics research program at Maastricht University*

Forum discussion

Part of the 27th IOPS summer conference was a forum discussion on the subject: *Questionable research practices.* Presenters were: Marjan **Bakker** (University of Amsterdam) and Rink **Hoekstra** (University of Groningen)

IOPS Best paper award 2011

During the 27th IOPS summer conference, the IOPS Best Paper Award 2011 was delivered to **Rogier Kievit,** University of Amsterdam, for his paper: Kievit, R.A., Romeijn, J.W., Waldorp, L.J., Wicherts, J.M., Scholte, H.S., & Borsboom, D. (2011). Mind the gap: A psychometric approach to the reduction problem. *Psychological Inquiry*, 22: 67–87, 2011.

5.2.2 22nd IOPS winter conference

The 22nd IOPS winter conference was held on 18 and 19 December 2012 at Enschede. Twente University, co-organiser and host of the conference, 54 participants.

Conference presentations

Invited speaker presentations

- Henk **Kelderman,** University of Amsterdam
  Title: *Are we doing applied psychology a favor by pushing IRT?*
- **Angélique Cramer,** University of Amsterdam (invited Speaker)
  Title: *"I feel sad therefore I don't sleep: Mental disorders as complex systems"*

IOPS PhD students presentations

- Marjan **Bakker,** University of Amsterdam
  What to do with outliers?
- Matthieu **Brinkhuis,** Cito, Arnhem
  Title: *Item bank monitoring: tracking item drift using pairwise comparisons*
- Judith **Conijn**, Tilburg University
  Title: *Detecting and explaining aberrant response behavior on the outcome questionnaire-45*
- Marije **Fagginger Auer,** Leiden University
  Predicting students' mathematical strategy use from teachers' reports of instructional practice: A multilevel latent class analysis
- Britt Qiwei **He,** Twente University
  Combining textual analysis and IRT scale estimates using a Bayesian approach
- Joke **Heylen,** KU Leuven
  Title: *Clusterwise Non-negative Matrix Factorization (NMF) for capturing variability in time profiles*
- Shahab **Jolani,** Utrecht University
  Title: *Random indicator imputation for missing not at random data*
- Kasia **Jozwiak,** Utrecht University
  Title: *Accrual by groups in trials with discrete-time survival endpoints* 2
- Tham Thi Thanh **Lam,** University of Groningen
  Three-mode factor analysis by means of Candecomp/Parafac
- Marie-Anne **Mittelhaeuser,** Tilburg University
  Application of mixed IRT models and person-fit methods in educational measurement
- Pieter **Oosterwijk,** Tilburg University
  Sampling fluctuation of reliability coefficients

Lab presentation

Twente University presented “RCEC: 21st Century Assessment”. In 2008, RCEC, a cooperation of CITO and University of Twente, started a mission to improve the quality of examination and certification, both in the Netherlands and abroad. RCEC facilitates independent research, provides training, and is involved in consultancy project. Around 20 researchers are involved in this initiative. During the Lab presentation, the Research Center for Examination and Certification (RCEC) was introduced. The general theme of the RCEC research is how to develop assessments in the 21st Century.

6 Publications

A quantitative overview and a list of publications by IOPS staff members and PhD students under auspices of IOPS in 2012 is given below.

Quantitative overview of publications in 2012

Dissertations by IOPS PhD students	12
Other dissertations under supervision of IOPS staff members	12
Articles in international English-language journals	331
Contributions to international English-language volumes	32
Book reviews	2
Books	5
Articles in other journals	19
Software and test manuals	1
Other publications	43

6.1 Dissertations

6.1.1 Dissertations by IOPS PhD students

Avetisyan, M. (2012, December 06). *Bayesian randomized item response modeling for sensitive measurements.* Enschede: Twente University (125 pp.). Prom./coprom.: Prof. Dr. **C.A.W. Glas** & Dr. Ir. **G.J.A. Fox.**

Geerlings, H. (2012, March 23). *Psychometric methods for automated test design.* Enschede: Twente University (122 pp.). Prom./coprom.: Prof. Dr. **C.A.W. Glas** & Prof. Dr. **W.J. van der Linden**.

Jolani, S. (2012, December 07). *Dual Imputation Strategies for Analyzing Incomplete Data.* Utrecht University (105 pp.). Prom./coprom.: Prof. Dr. **S. Van Buuren** & Dr. **L.E. Frank**.

Kieruj, N.D. (2012, March 02). *Question format and response style behavior in attitude research.* Tilburg University (153 pp.). Oisterwijk: BOXPress. Prom./coprom.: Prof. Dr. **J.K. Vermunt** & Dr. **G.B.D. Moors.**

Korendijk, E. (2012, June 08). *Robustness and Optimal Design Issues for Cluster Randomized Trials.* Utrecht University (197 pp.). Prom./coprom.: Prof. Dr. **J.J. Hox** & Dr. **M. Moerbeek.**

Kruyen, P.M. (2012, December 14). *Using short tests and questionnaires for making decisions about individuals: When is short too short.* Tilburg University (162 pp.). Prom./coprom.: Prof.Dr. **K. Sijtsma** & Dr. **W.H.M. Emons.** Ridderkerk: Ridderprint.

Kuiper, R.M. (2012, January 27). *Model selection criteria : how to evaluate order restrictions.* Utrecht University (212 pp.). Prom./coprom.: Prof. Dr. **H.J.A. Hoijtink.**

Lugtig, P.J. (2012, February 24). *I think I know what you did last summer : improving data quality in panel surveys.* Utrecht University (141 pp.). Prom./coprom.: Prof. Dr. **J.J. Hox** & Dr. **G.J.L.M. Lensvelt-Mulders.**

Peeters, C.F.W. (2012, June 04). *Bayesian exploratory and confirmatory factor analysis: Perspectives on constrained-model selection.* Utrecht University (164 pp.). Prom./coprom.: Prof. Dr. **P.G.M. Van der Heijden.**

Rippe, R. (2012, November 13). *Advanced statistical tools for SNP Arrays.* Leiden University (187 pp.). Prom./coprom.: Prof. Dr. **P.H.C. Eilers,** Prof. Dr. **J.J. Meulman.**

Straat, J.H. (2012, November 23). *Using scalability coefficients and conditional association to assess monotone homogeneity.* Tilburg University (137 pp.). Prom./coprom.: Prof.Dr. **K. Sijtsma** & Dr. **L.A. van der Ark.** Ridderkerk: Ridderprint.

Verhagen, A.J. (2012, November 16*). Bayesian item response theory models for measurement variance*. Enschede: Twente University (145 pp.). Prom./ coprom.: Prof.Dr. **C.A.W. Glas** & Dr. Ir. **G.J.A. Fox.**

6.1.2 Other dissertations under supervison of IOPS staff members

Amodio, S. (2012, February). *Generalized boosted additive models.* Naples University. Prom./ coprom.: Prof.Dr. A. Ambrosio, Prof. Dr. **J.J. Meulman.**

De Jong, K. (2012, April 17). *A chance for change: Building an outcome monitoring feedback system for outpatient mental health care*. Leiden University/GGZ Noord-Holland Noord, Heiloo. (132 pp.). Prom./coprom.: prof.Dr. **W.J. Heiser**, Prof. Dr. P. Spinhoven, & Dr. M.A. Nugter.

Lodewyckx, T. (2012, December 20). *Statistical tools for modeling emotion dynamics.* KU Leuven, University of Leuven. Prof. Dr. Dr. **F. Tuerlinckx,** Dr. P. Kuppens.

Makransky, G. (2012, March 30). *Computerized adaptive testing in industrial and organizational psychology.* Twente University (136 pp.). Prom./coprom.: Prof.Dr. **C.A.W. Glas** & Dr. S. Kreiner.

Petrovici, C.D. (2012, June 07). *Early retirement culture, active ageing and the life course.* Tilburg University (132 pp.). Prom./coprom.: prof.Dr. **J.K. Vermunt** & Dr. **G.B.D. Moors.** Ridderkerk: Ridderprint.

Schakel, L. (2012, December 06). *Online computer-based testing in human resource management: Contributions from item response theory*. University of Groningen, Faculty of Behavioral and Social Science. Prom./coprom.: Prof. Dr. **R.R. Meijer** & Dr. I.J.L Egberink.

Schouteden, M. (2012, October 19). *Simultaneous component methods to identify common and distinctive mechanisms underlying linked data.* KU Leuven, University of Leuven. Prom./coprom.: Prof. Dr. **I. van Mechelen,** Dr. K. Van Deun.

Stevenson, C.E. (2012, September 13). *Puzzling with Potential: Dynamic Testing of Analogical Reasoning in Children*. Leiden University. Prom./coprom.: Prof. Dr. **W.J. Heiser** & Prof. Dr. W.C.M. Resing.

Tokuda, T. (2012, September 21). *A solution to some problems in the clustering of high dimensional data.* KU Leuven, University of Leuven. Prom./coprom.: Prof. Dr. **I. Van Mechelen,** Prof. Dr. **F. Tuerlinckx.**

Van Schijndel, T.J.P. (2012, April 27). *A Developmental psychology perspective on preschool science learning: Children's exploratory play, naïve theories, and causal learning.* Prom./ coprom.: Prof. Dr. **H.L.J. van der Maas,** Dr. **M.E.J. Raijmakers.**

Van Wietmarschen, H.A. (2012, December 18). *Mathematical and applied statistics, A systems approach to sub-typing of rheumatoid arthritis.* Leiden University. Prom./coprom.: Prof. Dr. J. van de Greef, Prof. Dr. **J.J. Meulman.**

Vande Gaer, E. (2012, September 19). *Clusterwise regression with reduction of predictors***.** KU Leuven, University of Leuven. Prom./coprom.: Prof. Dr. **E. Ceulemans,** Prof. Dr**. I. Van Mechelen.**

6.2 Articles in international English-language journals

Aarts, S., Van den Akker, M., Bosma, H., **Tan, F.,** Verhey, F., Metsemakers, J., & Van Boxtel, M. (2012). The effect of multimorbidity on health related functioning: temporary or persistent? Results from a longitudinal cohort study. *Journal of Psychosomatic Research, 73(*3), 211-217.

Akbari Chermahini, S., **Hickendorff, M.,** & Hommel, B. (2012). Development and validity of a Dutch version of the Remote Associates Task: An item-response theory approach. *Thinking Skills and Creativity*, 7 (3), 177-186.

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Avetisyan, M. & **Fox, G.J.A.** (2012). The Dirichet-Multinomial model for multivariate randomized response data and small samples. *Psicologica: Journal of Methodology and Experimental Psychology, 33(2),* 362-390.

Azevedo, C.L.N., Andrade, D.F., & **Fox, G.J.A.** (2012). A Bayesian generalized multipel group IRT model with model-fit assessment tools. *Computational statistics and data analysis, 56(12),* 4399-4412.

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Berger, M.P.F. (2012). Comment on: S. G. Gilmour and L.A. Trinca (2012). Optimum design of experiments for statistical inference, *Journal of the Royal Statistical Society, Series C*, *61 (3),* 345-400.

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7 Finances

7.1 Financial statement 2012

Receipts

The participating institutes of Leiden University, University of Amsterdam, University of Groningen, Twente University, Tilburg University, Utrecht University, KU Leuven, University of Leuven, Statistics Netherlands (CBS), and Cito Arnhem contributed financially according to the number of their PhD students that participated in IOPS on 1 July 2012. The participation fee for 2012 was € 700 per PhD student. Associated institutes with PhD students in the IOPS Graduate School, participated on the same terms.

The Foundation for the Enhancement of Data Theory donated an amount of € 600 for the winner of the IOPS Best Paper Award.

Apart form the above mentioned annual contributions, no other funds are available for the IOPS Interuniversitary Graduate School.

This resulted in a credit balance for the year 2012 of € 9608,52

7.2 Summary of receipts and expenditures in 2012

Receipts and expenditures 2012					
Receipts	**Euro**	**Totals**	**Expenditures**	**Euro**	**Totals**
Salaries IOPS Office			**Salaries IOPS office**		
FSW, Leiden University: Director (0,1 fte)	15.000,00		Director (0,1 fte)	15.000,00	
Subtotal		**15.000,00**	Secretary, 17 hrs per week 01-01-2012 / 31-12-2012	25.630,90	
Contributions participating institutions			**Pay acc. 2011:** Secretary: July-December 2011, 0.44 fte	12.682,25	
Contributions, including late payments of 2011	59.700,00		**Subtotal**		**53.313,15**
Subtotal		**59.700,00**	**IOPS office**		
IOPS office			Leiden Univ.: housing secretariat (estimated)	3.800,00	
Leiden Univ.: housing secretariat (estimated)	3.800,00		Leiden Univ.: communication and postage costs (estima	1.000,00	
Leiden Univ.: communication and postage costs (estimated)	1.000,00		Office supplies	3,91	
Subtotal		**4.800,00**	Printed matter	893,32	
			Copy cards	69,00	
			Hosting website	21,00	
			Subtotal		**5.787,23**
			Representations costs		
			Representation costs	1.208,35	
			Travelling expenses	1.275,65	
			Subtotal		**2.484,00**
			Courses		
			Course instructor fees	8.307,10	
			Subtotal		**8.307,10**
			Balance		
			Credit balance	9.608,52	
			Subtotal		**9.608,52**
Total receipts	**79.500,00**	**79.500,00**	**Total expenditures**	**79.500,00**	**79.500,00**

7.3 Balance sheet 2012

IOPS Own Funds 2012			
Debet	Euro	Credit	Euro
Own Funds 31-12-2012	118.880,23	Own Funds 01-01-2012	122.529,46
		Preliminary Results 2012	3.649,23
Totaal Debet	118.880,23	Totaal Credit	118.880,23

Resultaat SAP + 9.608,52 '-/- (corr NTO 2011) 28.000+ (corr NTB 2011) 14.742,25