"LISREL, AMOS or PLS Does Not Deliver What You Need in Your PhD studies?"

How researchers **explore nonlinearities** and **interactions** in their **cause-effect-models** and **innovate** their research field with **exciting new discoveries**.

By Frank Buckler, PhD (Cologne, Germany) - Printable version

Sitemap

Why you should read this article?

How would it be when **you discover something exciting** unlike hundred students before you? How would you be able to amaze your doctorial supervisor, if you drew mind-blowing causal-effects insight from your survey data, which were *not* possible until now?

As **you read every word of this article**, you will discover how you'll let your PhD thesis impressively stand out.

Why are existing causal analysis methods like LISREL or PLS of limited help?

Structural Equation Modeling methods represent a major improvement over classical statistical methods for multivariate analysis. They are designed for testing theoretically supported linear and additive causal models. For this application field they deliver excellent results. Even in future, SEM methods will play a major role in social sciences.

A problem appears with SEM methods when their application assumptions are not met. In practice e.g. it is rather an exception then the rule that existing theory tells us upfront which paths to choose. An open secret is that theories get today "constructed" afterwards according to the "feasibility" of calculating with the available data using the available software as Lisrel or PLS. Within this "trimming process" all "feasible" results get somehow explained by selectively searched literature and displayed as a-priori hypothesis. The confirmatory coat of most studies destroyed in last decades a lot of trust in and reputation of quantitative research.

Furthermore classic causal analysis methods assume all relations to be linear and independent (i.e. that no moderating effects exist). Even considering more elaborate methods from the "lab", the main challenge remains unsolved: If you can not describe the relations upfront (a-priori) there is no method available, that helps researchers to learn from data.

Professor Hennig-Thurau and I took a deeper look into four arbitrarily chosen datasets, published in the world's most reputed scientific journals "*Journal of Marketing Research*" and "*Journal of Marketing*". We found in ever study clear indications for other unknown relations, for nonlinear effects or interactions. If worlds leading researchers fail to sensibly exploit today's causal analysis methods, how should ever doctorate students do so?

If problems are so obvious, why has nobody developed a solution?

The short answer is: The solution is not obvious. The detailed answer lies in the

following four reasons:

- First of all, the mathematical paradigms of today's methods (Structural Equation Modeling) are not suited to solve exploratory problems.
- Furthermore, the Structural Equation Modeling research community is dominated by a confirmatory research approach. Many researchers do not accept method that draw structural conclusions from data.
- While structural equation modeling was fully developed in the 60s and 70s of the last century, modern multivariate and exploratory methods – as Artificial Neural Networks - experienced major developments in recent years.
- Latest methods such as Artificial Neural Networks were not suited since they suffer from the Black Box Problem: they increase predictive performance but fail in conveying the "why".

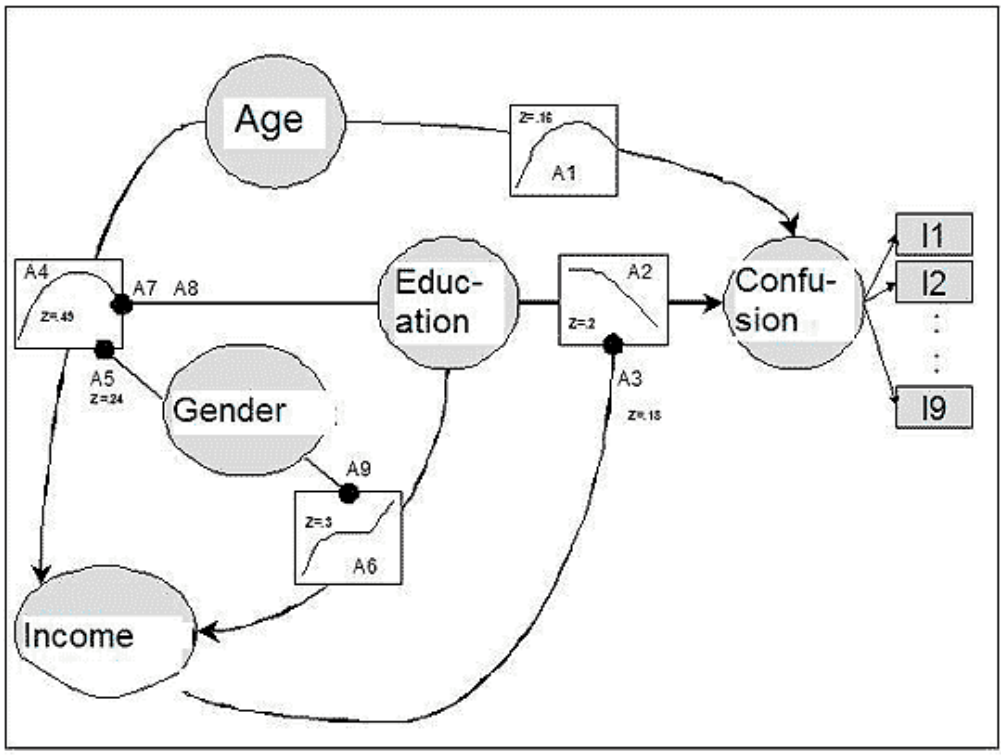
Imagine a solution,

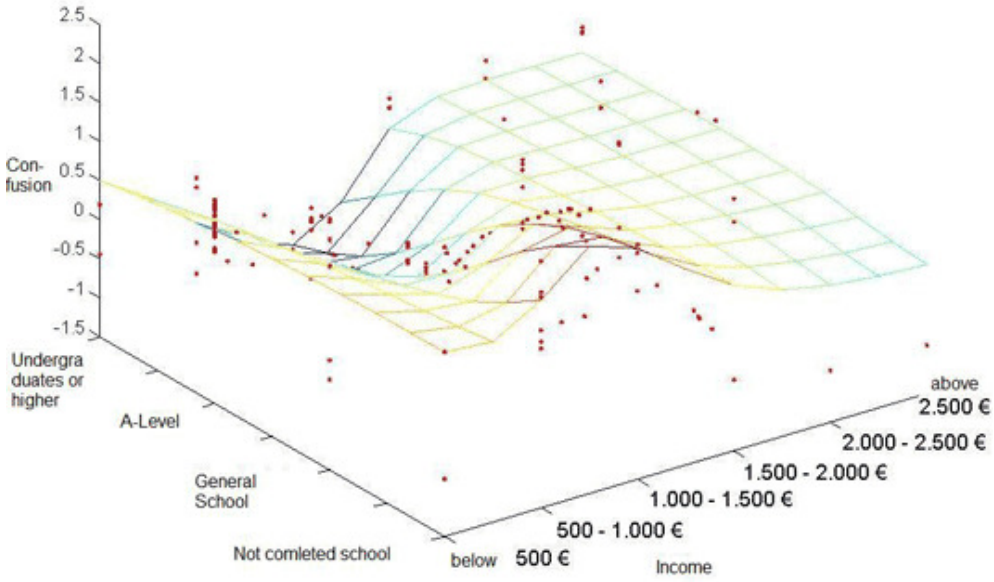
that is able to explore cause-effect-relations with little a priori knowledge… that is able to reveal u-shape relations if existent… that shows you that improving sales only works if you deploy direct marketing **and** radio advertising jointly …

Imagine …

… your research field is customer confusion which is heavily influenced by a number of **nominal scales variables**. You apply an advanced causal analysis and retrieve the model below. All paths with a dot-end are interacting influences. For every interaction your analysis shows plots like the second one below. It shows that the effect of education on customer confusion is only valid for medium income respondents. The higher the education, the lower the confusion, but only for medium incomes. All other have probably developed simpler decision heuristics: the poor buy the cheapest, the rich buy the best.

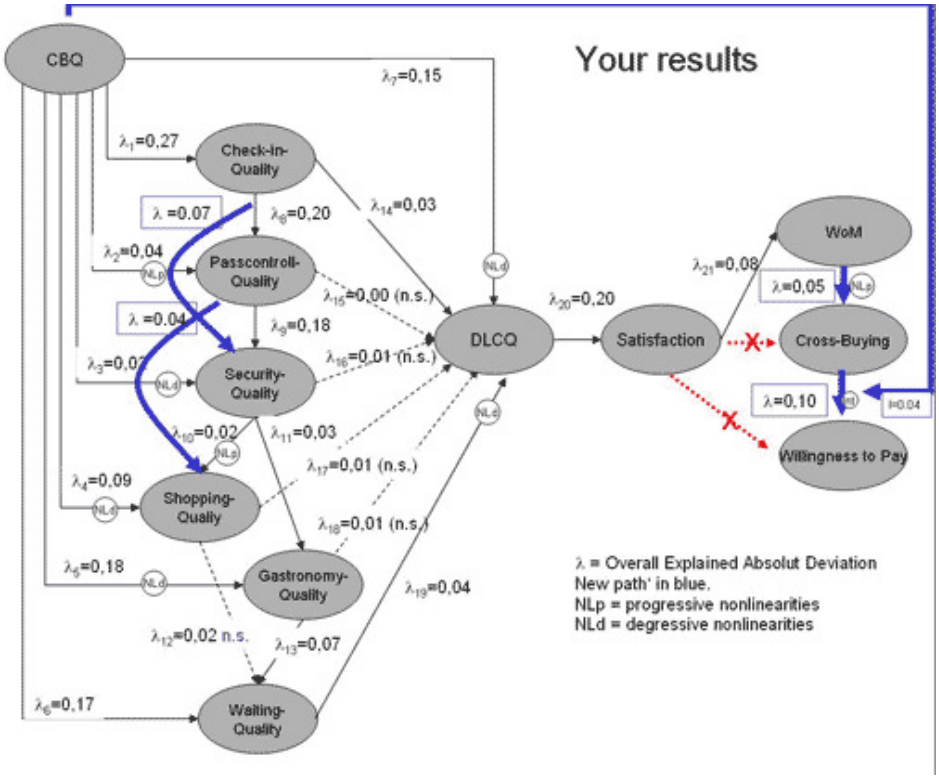
Have you (or your doctorial supervisor) ever seen such causal analysis finding? Likely your supervisor will recommend you with proud for "summa cum laude"…





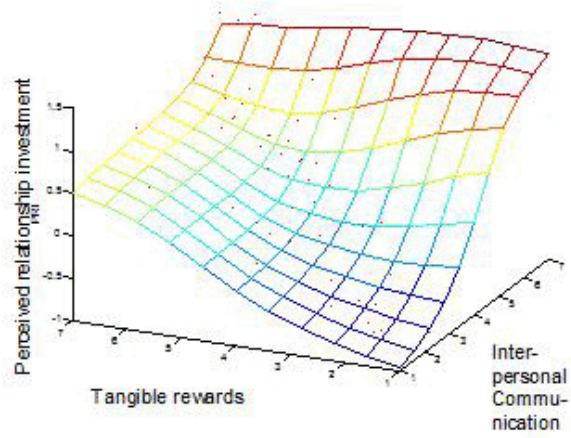
Imagine, …

… your research field is service quality in service centers. You build a theoretical model, estimate it in AMOS – but you are not satisfied with the fit as well as with some contradicting results. You apply an alternative method and retrieve the results below. You discover that a lot of paths are **degressive** (NLd). This makes perfect sense to you, since a lot of variables are known in the literature as "**hygienic factor**" – a specific level is needed but not more. Others turn out to be **progressive** (NLp) which point to the fact that they can be viewed as "satisfaction factors". Most interesting, **you find new meaningful paths.** Especially, the classic models state that satisfaction influence Word-Of-Mouth, Cross-Buying and Willingness-To-Pay directly and independently. You find out that you need willingness for Word-Of-Mouth to foster Cross-Buying and you need Cross-Buying-Willingness to enable for Willingness-to-Pay. You go back to Amos and find out that indeed **your fit increases** when introducing this new structure. Despite of having applied an unsystematic trial&error search, you achieved these findings by a systematic approach which only considers theoretically supportable paths. How would these results stand you out of all the other PhD students your supervisor has evaluated before?



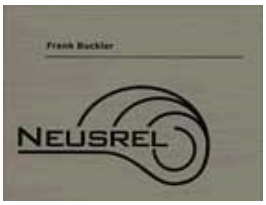
Imagine, …

… a retail store chain is sponsoring your research survey. With the data you build an advance causal model. You find out that perceived relationship investment is a main prerequisite for repetitive purchases. With your analysis you show…

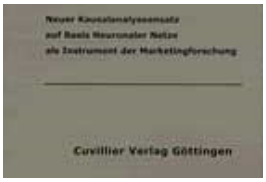


… that excellent interpersonal communication with customers is doing all the work. Expensive "tangible rewards" (especially free gifts as shoe polish) are only an alternative but a less effective tool. Just by skipping that, you cut 1,5% of overall costs, which boosted profits by almost 30%. After that this company is likely to offer you an attractive job or at least further research support.

Which methodology can do this all?



The answer is Universal Structural Modeling (USM): The foundation for USM was laid out in a five-year research project conducted in cooperation with Harun Gebhardt - a project in which we developed a stock forecasting system based on Neural Networks. In 1999 we launched Profit-



Station.com. The proven hit rates can still be experienced today on a daily basis. In the same year I started my doctorial studies with the ambitious goal to reinvent Structural Equation Modeling - the crown jewels of social sciences. In 2001 I published the book "NEUSREL" which introduced a new causal analysis method based on the same Neural Networks that have already made Profit-Station successful. In successive years the method was applied and refined in research and consulting projects. Furthermore it matured in elaborate scientific discussions with globally leading researchers. Important improvements were stimulated thru Professor Hennig-Thurau. As a result the methodological group "Universal Structural Modeling" (USM) for NEUSREL was formed.

How does USM work? Causal-effect networks are built in two steps:

1. The measurement level, where survey data get compressed to latent variables
2. The structural level, where causal-effect relation between latent variables are analyzed

At the measurement level USM uses principal component analyses to compute the latent variables. At structural level a specific Neural Network is trained for every dependent latent variable, determining the influence of all latent variables. The type of Neural Network used ensures that irrelevant effect path' are eliminated. The black box problem is mainly tackled by a methodology introduced by Plate in 1998. It allows visualizing the separate causal effects. That's it.

If you like to know more, the best way is to consult my latest scientific article published in "*Marketing – Journal of Research and Management*" which I co-authored with Professor Hennig-Thurau.

Send me an email to receive the article as a PDF: USM(at)neusrel.com
Please state your name, phone and organisation.

How you profit from USM?

A lot of readers asked me how they could profit from USM in their research. In order to enable a quick and cheap start, first-time users can use my analysis service. You fill an Excel-template with data and option settings – and I run the calculations and send you the results per Email. For frequent users of USM I provide a software license**.**

What **experts** say about USM:

- "I had the chance to read the book NEUSREL in 2001 as an early draft. Within the scientific tradition of data-mining, I believe that both NEUSREL and Universal Structure Modeling (USM) add a powerful instrument to uncover hidden, more complex, and perhaps meaningful relationships among variables."
  Prof. Dr. Dr. Rene Weber, University of California at Santa Barbara, USA
- "I use USM whenever I am working on a problem that falls within its capabilities, for example, to estimate structural equation models with many nominal variables such as gender. In the field of customer confusion we found that confusion is particularly prevalent among medium-income consumers, whereas low- and high-income consumers employ buying heuristics that shield them from confusion. A simple finding, however one we would have never found without USM",
  Professor Dr. Gianfranco Walsh, Strathclyde Business School, University Glasgow & University of Koblenz

- "We are planning to apply USM for communication controlling and planning in the advertising-intensive food industry. We estimate to save companies a considerable part of their communication spending",
  Professor Dr. Holger Buxel, University of Applied Science Muenster
- "I used to be a strong advocate of Structural Equation Modeling methods. After many long fruitful discussion nights with Frank, I have to admit: USM is simply what was missing - not only in science. It is the missing link which brings causal analysis into practical applications",
  Professor Dr. Alexander Klee, University of Applied Science Flensburg
- "With NEUSREL Dr Buckler introduces an outstanding contribution to marketing research, that has the potential to close a major research gap"
  Professor Dr. Klaus-Peter Wiedmann, University of Hanover

Here some **reference users** that already used USM:

- **GFK Trustmark**
  (GFK is Europe's largest market research firm)
- **Strategy & Marketing Institute GmbH**
  (this is the consultancy founded by my doctorial supervisor Professor Wiedmann)
- **B2Con**
  (specialized management consultancy for nutrition industry)
- **Brandezza AG**
  (Specialist for brand techniques)

Quotes from users:
"... congratulations on creating a wonderful product--I am going to be recommending it at places that I already have connections with."
John Steele, M. S., ABD, Kansas State University & Army Research Institute (ARI)

"... with the aid of NEUSREL we were able to uncover important nonlinear effects in the field of psychological brand impact."
Gregor Waller, lic.phil. Head of Research , Brandezza AG

Let me summarize what USM delivers:

Today's causal analysis methods are design to test existing theories and are not designed to explore new paths, unknown nonlinearities and moderating effects. But exactly this is needed to be useful in practical applications.

A solution to this problem was not developed so far since scientific community did mainly ignored the practical issue. Furthermore it was necessary to pursue a methodically new approach. The foundation to this new approach where just developed in the last years. A method as USM was only possible since these recent years.

USM (Universal Structural Modeling) is a new causal analysis using artificial neural networks, that plays for the following advantages ...

1. **Exploration:** Needs less a-priori knowledge
2. **Nonlinearity:** Explores (even unknown) nonlinear relationships
3. **Interactions:** Finds, shows and quantifies interactions between causes
4. **Universality:** Makes use of arbitrary distributed variables. Especially nominal scaled variable as gender, profession, brand name, etc. And: it is able to model circular causal networks – no need to distinguish between endogen and exogenous variables.
5. **Quantification:** Quantifies every important property, no matter if for path strength, linear path coefficient, interaction strength or significance figures.

6. **Simplicity** – Is very easy to use - no need for detailed option settings.

Numerous success stories show the huge value USM delivers. With the aid of my analysis service and a test of a software license, you have the chance to experience the potential of USM on your own data. This is your step towards amazing scientific discoveries.

Contact me and we will evaluate together the value USM will deliver to you.

Frank Buckler
Email: Buckler(at)neusrel.de

p.s. New: Within the "NEUSREL PhD Program" a limited number of PhD students get the opportunity to use the NEUSREL-Software at no costs.

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disclaimer