Chapter 8

Using WarpPLS in E-Collaboration Studies: Mediating Effects, Control and Second Order Variables, and Algorithm Choices

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ABSTRACT

This is a follow-up on two previous articles on WarpPLS and E-collaboration. The first discussed the five main steps through which a variance-based nonlinear structural equation modeling analysis could be conducted with the software WarpPLS (Kock, 2010b). The second covered specific features related to grouped descriptive statistics, viewing and changing analysis algorithm and resampling settings, and viewing and saving various results (Kock, 2011). This and the previous articles use data from the same E-collaboration study as a basis for the discussion of important WarpPLS features. Unlike the previous articles, the focus here is on a brief discussion of more advanced issues, such as: testing the significance of mediating effects, including control variables in an analysis, using second order latent variables, choosing the right warping algorithm, and using bootstrapping and jackknifing in combination.

INTRODUCTION

This article is a follow-up on two previous articles on the use of WarpPLS in E-collaboration studies, and can be seen as the third of a set of related articles. The first article in the series discusses the five main steps through which a nonlinear structural equation modeling (SEM) analysis could be conducted with the software WarpPLS (Kock, 2010b). The second article in the series discusses specific features related to grouped descriptive statistics, viewing and changing analysis algorithm and resampling settings, and viewing and saving various results (Kock, 2011).

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This and the previous articles focus on version 1.0 of the software, and use data from the same E-collaboration study as a basis for the discussion of important WarpPLS features. While the articles use an E-collaboration study as a basis, the discussions are very generic and apply to areas unrelated to E-collaboration. In fact, the discussions are pertinent to research in many different fields. At the time of this writing, published examples of the use of WarpPLS existed in marketing, management, finance, accounting, anthropology, psychology, and nursing.

Unlike the two previous articles in the three-article set, the focus here is on a brief discussion of more advanced issues, such as: testing the significance of mediating effects, including control variables in an analysis, using second order latent variables, choosing the right warping algorithm, and using bootstrapping and jackknifing in combination.

**THE E-COLLABORATION STUDY**

Several screen snapshots and composites are used here to illustrate important WarpPLS features. These snapshots and composites were generated based on a study of E-collaboration in virtual teams. Overall, 209 teams were studied. The teams carried out product innovation and development tasks in a variety of economic industries and sectors. The study focused on five main latent variables, referred to here as “ECU”, “ECUVar”, “Proc”, “Effi”, and “Effe”.

“ECU” and “ECUVar” are technology-related variables. “ECU” refers to the extent to which electronic communication media, in addition to face-to-face communication, were used by each team. “ECUVar” refers to the variety of different electronic communication media used by each team, or the number of electronic communication media with different features (e.g., E-mail, teleconferencing, telephone) used by each team.

“Proc”, “Effi”, and “Effe” are non-technology-related variables. “Proc” refers to the degree to which each team employed established project management techniques, referred to in the study as “procedural structuring” techniques, hence the name of the variable. “Effi” refers to the efficiency of each team, in terms of task completion cost and time, assessed against previously planned task completion cost and time. “Effe” refers to the effectiveness of each team (a team can be effective but not efficient, and vice versa), in terms of the actual commercial success of the new goods or services that each team developed.

**TESTING THE SIGNIFICANCE OF MEDIATING EFFECTS**

Using WarpPLS, one can test the significance of a mediating effect of a variable M, which is hypothesized to mediate the relationship between two other variables X and Y, by using Baron and Kenny’s (1986) criteria. The procedure is outlined below. It can be easily adapted to test multiple mediating effects, and more complex mediating effects (e.g., with multiple mediators). Please note that we are not referring to moderating effects here; these can be tested directly with WarpPLS, by adding moderating links to a model.

First two models must be built. The first model should have X pointing at Y, without M being included in the model. (You can have the variable in the WarpPLS model, but there should be no links from or to it.) The second model should have X pointing at Y, X pointing at M, and M pointing at Y. This is a “triangle”-looking model. A WarpPLS analysis must be conducted with both models, which may be saved in two different project files; this analysis may use linear or nonlinear analysis algorithms. The mediating effect will be significant if the following criteria are met:
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