A good fit can be evidence to prove a theory

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Roberts and Pashler argue that the use of a good fit as evidence for a theory is wrong[1]. They have three problems with that.

The first problem is that what the theory predicts is unclear. The free parameters could be set to fit the data and should therefore be varied over their entire range in all possible combinations, but often this is not done. An example is the 'Air Traffic Controller' model, presented by Taatgen and Lee[2]. The model uses the ACT-R cognitive architecture and in that architecture a lot of free parameters exist. They do not vary these over their entire range. Taatgen and Lee claim however that they use the default ACT-R parameters for their experiments. And these default values could be seen as part of the architecture and therefore the critique of Roberts and Pashler will not hit them. Anderson et al. however, do set two ACT-R parameters to optimize the data fit other than their default ACT-R values in their 'Anti-Air Warfare Coordinator'-model[3].

The second problem is related to the first one; the variability of the data is unclear. Especially the variability on the constrained dimensions is important. Anderson et al. fail to make the variability of the data clear. The variability of data can only be made clear when the predictions of the theory are defined. Again, the model of Taatgen and Lee pass the critique because their model does not hold free parameters.

The third problem is about the a priori likelihood that the theory will fit whether or not the theory is true. Roberts and Pashler describe that has to be shown that there are plausible results that theory cannot fit, in order to prove that the theory does not any plausible result. Taatgen and Lee, as well as Anderson et al. do not do this. They do however both present not only a fit for a whole task, but also for various components of the task. While this method is not described by Roberts and Pashler, the chances that a theory accidentally is a good fit are a lot smaller when the theory not only predicts a whole task, but also the components of the tasks.

I partly agree with Roberts and Pashler's critique that a good fit as evidence is wrong. Just partly, because I do think a fit can be evidence to prove a theory. But a good fit can only be evidence if the chosen parameters are justified properly and the chance that a good fit is the result of an untrue theory is minimized.

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[1] Theoratical Notes, How Persuasive Is a Good Fit? A comment on Theory Testing, S.Roberts,H.Oashler, University of California, 2000

[2] Production Compilation: A Simple Mechanism to Model Complex Skill Acquisition, N.Taatgen, F.J.Lee, University of Groningen, 2003

[3] An Integrated Theory of the Mind, J.R.Anderson e.a., Carnegie Mellon University, 2004