

To the Editor, *Nursing Research*:

We appreciate Mr. Cron's comments regarding methods for testing mediation. We agree that as a result of advances in statistical programs and bootstrapping methods, additional options for testing mediation are available to researchers. However, we maintain our position that of the three methods that controlled Type I error rate (and were sufficiently powerful), the joint significance test of  $\alpha$  and  $\beta$  is superior to other methods due to its computational ease and versatility of use.

In his letter, Mr. Cron referred to the "bootstrapping method." In response, we focus on one specific bootstrapping method, the test of the products using the percentile bootstrap. It is a powerful test that adequately controls Type I error rate (Cheung & Lau, 2008; MacKinnon, Lockwood, & Williams, 2004), a feature not shared by all bootstrapping procedures. For example, in Preacher et al. (2008), a preference is stated for the bias-corrected and accelerated methods. However, in certain conditions these methods can become quite liberal with alphas exceeding .08 (Briggs, 2006; Cheung & Lau, 2008; MacKinnon et al., 2004; Williams & MacKinnon, 2008). Mr. Cron noted that SPSS and SAS software programs for mediation analysis, such as those created by Preacher and Hayes (2004, 2008), allow researchers to "easily" use bootstrapping methods to test for mediation effects. We agree that such programs narrow the gap between bootstrap methods and the joint significance test of  $\alpha$  and  $\beta$ , but we maintain that the joint significance test of  $\alpha$  and  $\beta$  continues to be easier to use. The joint significance test of  $\alpha$  and  $\beta$  is an attractive method because it can be computed using any standard statistical package, such as SPSS or SAS. In contrast, neither SPSS nor SAS has the intrinsic capability to conduct the test of the products using the percentile bootstrap. Rather, researchers would need to utilize macros and scripts such as those developed by MacKinnon

(<http://www.public.asu.edu/~davidpm/ripl/mediate.htm#download>) as we stated or those developed by Preacher and Hayes as stated by Mr. Cron. All else being equal, it seems easier to use a method that is intrinsically available in SPSS or SAS.

In terms of versatility Mr. Cron noted that, “the bootstrapping procedure does not require a normal distribution for the mediated, or indirect effect, and thus provides the versatility of a nonparametric procedure” and correctly notes that programs are available for testing multiple mediators. As mentioned in our article, the joint significance method also provides the versatility of a nonparametric method through the use of nonparametric regression analyses, for example via the Serlin-Harwell aligned ranks procedure (Serlin & Harwell, 2004) that is easily employed using SPSS or SAS without macros. Furthermore, any multiple mediator model other than those analyzed by the Preacher and Hayes or the MacKinnon macros (for example, models with three or more steps in the mediation path) will require a specific macro that researchers will need to create (or perhaps hire someone else to write). In contrast, the joint significance method easily handles multiple X's and M's and numbers of steps (and Y's, if ever needed).

In summary, although we maintain our position that the joint significance test of  $\alpha$  and  $\beta$  is superior to other methods due to its computational ease and versatility of use, we are grateful to Mr. Cron for his letter. We are similarly excited about advances in methods for testing mediation and thank Mr. Cron for mentioning several of those advances in his letter.

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