Is this the end for Cronbach's alpha?

¿Es el final del alfa de Cronbach?

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In 1951, Lee Cronbach proposed the alpha coefficient (α) as an estimate of the proportion of variance of a measurement instrument caused by the common factor among items. The impact of his proposal has been such that a recent search in Google Scholar® confirms it has been cited 35,915 times. Tentative explanations for the ubiquity of α include the ease with which it can be calculated using popular statistical programs; the absence of postgraduate courses that delve into different ways of analyzing reliability (Aiken, West & Millsap, 2008) and that thesis supervisors or magazine editors are not yet familiar with other reliability estimates (Cho & Kim, 2015).

Adicciones recognizes the importance of incorporating sophisticated methodological advances in its studies, specifically with regard to three aspects: design, measurement of variables and data analysis (Fonseca, 2017). Following the incorporation of the omega coefficient (ω, Merino-Soto & Blas, 2017) and estimation of its confidence intervals (Ventura -León, 2017) in contributions to the journal, the present letter to the editor aims to provide a reflection on the use of the Cronbach's alpha coefficient.

A variety of reliability estimates are currently used in Classical Test Theory. These include ordinal alpha, Armor's theta, coefficient β, coefficient H and the GLB coefficient, and in Item Response Theory the test information function and standard error of measurement are used as reliability estimates (Muñiz, 2010). In this context, the question needs to be asked: Is this the end for Cronbach's alpha? Is this estimate finished? The debate has been taking place at an international level, and has generated detractors of Cronbach's alpha with expressions such as: "A fatally flawed estimate of [...] reliability" (Peters, 2014, p 56).

However, the problems attributed to α are not intrinsic to it, but are based on the misinterpretations and the indiscriminate use by some researchers who do not check the basic assumptions that must be fulfilled for the use of this coefficient such as: tau-equivalence, which requires items measuring the same trait to have the same or a similar degree of precision (Cho, 2016); non-correlation of errors, since it is assumed that they are completely independent of each other (Cortina, 1993); one-dimensionality, that is, that all the items measure a single latent trait and that continuous measurement is required (Elosua & Zumbo, 2008).

Thus, to overcome the violation of some of its assumptions, modifications to α have been developed such as: α for correlated errors (Raykov, 1998), ordinal α based on polychoric matrices (Elosua y Zumbo, 2008), methods to test for tau-equivalence (Zhang & Yuan, 2016) and confidence intervals with certain levels of significance.

The tau-equivalent measurement model is essential in this regard because if it is violated, other estimates based on structural equation models may represent a better choice (Cho & Kim, 2015), with the omega coefficient (ω) being one example. This line of argument has recently been corroborated by a data simulation which indicated that if tau-equivalence is assumed, α and ω converge (Trizano-Hermosilla & Alvarado, 2016).

What follows is a data simulation using program R, specifically with the *psych* library (Revelle, 2017). First, a

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tau-equivalent measurement model is set up using the following code:

```
library(psych)
set.seed(42)
tau <- sim.congeneric(loads=c(0.7,0.7,0.7,0.7),N=500,
categorical = TRUE, short = TRUE, low=-3, high=3)
```

Second, Cronbach's alpha and omega are calculated:

```
alpha(tau)
omega(tau)
```

This yields quite similar alpha and omega values (α = .75; ω = .76).

In a second step, a congeneric measurement model is generated with the following code:

```
library(psych)
set.seed(42)
cong <- sim.congeneric(c(0.9,0.8,0.7,0.5),N=500,
categorical = TRUE, short = TRUE, low=-3, high=3)
```

The alpha and omega coefficients are then calculated using the congeneric measurement model:

```
alpha(cong)
omega(cong)
```

This yields results with a clearer difference between alpha and omega coefficients (α = .77; ω = .80).

In sum, it must be said that it is not α *per se* that is reaching the end, but rather the practices associated with its indiscriminate use. It seems to be seen as the "reliability coefficient par excellence", even though tau-equivalence has not been established or it has not been considered whether the variables in question are continuous (Elosua & Zumbo, 2008). For this reason, it is important to emphasize that there is no single best reliability coefficient, but that it all depends on the characteristics of the data being analyzed. Recognition of this fact will ensure that data analysis provides methodologically sound results for researchers in future instrumental studies for *Adicciones*.

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