Reply to Guo et al. and Credé:

The Grit Scale Only Measures Perseverance and not Passion, and Its Supposed Subfactors Are Merely Artifactors

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We (1) proposed that evidence linking grit and performance is mixed because the measure used to assess grit—the Grit-S scale (2)—only captures perseverance, but not passion, whereas the definition of grit encompasses both perseverance and passion (3). Our studies found that the combination of perseverance (measured through the whole Grit-S scale) and passion (measured through the Passion Attainment scale) predicted higher performance.

In their letters, Guo *et al*. (4) and Credé (5) suggest that the Grit-S scale should be treated as reflecting two factors. Credé (5) subsequently advocates for and Guo *et al*. (4) conducts separate analyses for each supposed sub-facet of the Grit-S scale (called "perseverance of effort" and "consistency of interests").

In this response, we provide additional evidence that the Grit-S scale is unidimensional. That is, there is no validity to the Guo *et al*. (4) and Credé (5) letters' claim that the Grit-S scale is composed of two sub-factors. As a result, the analyses advocated by both letters are inappropriate. Instead, the Grit-S scale should be treated as unidimensional, which is how we conducted our original analyses (1).

A careful examination of Grit-S scale items reveals two important points. First, closely reading the scale items reveals that the Grit-S scale captures perseverance alone, and not passion. Passion, defined as "a strong feeling toward a personally important value/preference that motivates behaviors to enact that value/preference" (1), is not captured in any of the Grit-S scale items (see Table 1). For example, Guo *et al*. (4) and Credé (5) claim that the items "I often set a goal but later choose to pursue a different one" and "New ideas and projects sometimes distract me from previous ones" capture passion. Yet, a careful reading of the items in the Grit-S scale reveals that there is not a single item in the Grit-S scale that reflects the theoretical concept of passion. Rather, each item in the Grit-S scale reflects perseverance.

Second, a careful examination of Grit-S scale items shows that all items for the perseverance of effort sub-facet are positively worded, while all items for the consistency of interests sub-facet are negatively worded (see Table 1). It is well known that participants respond differently to positively- and negatively-worded items (6). For this reason, reverse-coded items are commonly evenly counterbalanced within rather than across factors. In the case of the Grit-S scale, this design flaw can lead to the spurious finding that the Grit-S scale loads on two factors. This does not, however, reflect a true underlying two-factor structure, but instead reflects a mere statistical artifact, so-called "artifactors," (7) that produce a spurious multiple-factor structure.

Indeed, an independent research team recently published a paper which highlighted this flaw in the Grit-S scale construction, stating that, "the two-factor structure of the grit scale appears to be a method artifact, due to the use of both positively and negatively worded items" (8). Thus, it is most appropriate to collapse the whole Grit-S scale into a single measure of perseverance, which is how we employed this scale in our original analysis (1).

To further demonstrate the Grit-S scale's uni-dimensionality—i.e., that it only captures perseverance but not passion—we wrote and tested two versions where all items were positively-worded (N=958) or negatively-worded (N=781) (see Table 2; https://osf.io/cz4n9/?view_only=8206859c95ff44409e3b96ea9b6c0665 for data and additional information). We then explored the factor structure of each measure by comparing the average variance extracted (AVE; i.e., the average variance that a latent factor explains in indicators as represented in the squared factor loadings) to the shared variance (SV) of the two latent factors (i.e., the squared latent correlation; 9). A two-factor structure is only present if both AVEs are larger than the SV (10).

We first conducted a CFA on the responses to the all-positive version of the Grit-S scale and modeled the two correlated subfacets ($\chi2(19) = 185.65$, $RMSEA = 0.10$, $CFI = 0.96$,

SRMR = 0.04). Both subfacets correlated at *r* = .95 (*p* < .01). Thus, the SV was .90, while the AVEs for consistency of interests and persistence of effort were .55 and .47, respectively. Since the SV was greater than both AVEs, our results highlights that both factors do not have sufficient discriminant validity (9, 10) (see Table 3).

We find similar results when conducting a CFA on the responses to the all-negative version of the Grit-S scale, modelling the two correlated subfacets ($\chi2(19) = 291.0$, *RMSEA* = 0.14, *CFI* = 0.93, *SRMR* = 0.06). This time, both factors correlated at *r* = .90 (*p* < .01), resulting in a SV of .81. The AVEs for consistency of interests and persistence of effort were .50 and .71, respectively. Once again, the SV was greater than both AVEs, highlighting that both factors do not have sufficient discriminant validity (9, 10) (see Table 4).

These new results further demonstrate that both sub-facets should not be treated as unique factors, but instead should be considered as overlapping facets loading on a single construct. These data make clear that the Grit-S scale only measures perseverance, but not passion. This empirical evidence, together with the theoretical reasons highlighted above, highlight that one reason for the mixed findings in prior literature between the grit scale and performance has occurred because it only captures perseverance, but does not capture passion (1).

In sum, the evidence presented here and in our original paper reveal three points that render the analyses advocated by Guo *et al*. (4) and Credé (5) moot. First, the Grit-S scale only measures perseverance, and none of its items conceptually capture passion. Second, an apparent two-factor structure of the Grit-S scale is the result of a statistical artifact based on reverse-coded items; thus, it is most appropriate to collapse the whole Grit-S into a single measure of perseverance, which is how we employed the scale in our original analysis. Third, our original conclusion that it is only the combination of both perseverance *and* passion that predicts performance remains valid (1).

References

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