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Short Communication

Measures of flow proneness mainly assess the general factor of personality

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ABSTRACT

The hypothesis that the association between flow proneness and the Big Five personality traits is primarily at the level of the general factor of personality (GFP) was tested. By reanalyzing data from a previous study, and analyzing data collected from a convenience sample, support was found for the hypothesis. The results suggest that flow proneness may be an additional construct that could be added to the nomological network of constructs that are strongly associated with the GFP.

1. Introduction

In a recent article, Marty-Dugas and Smilek (2019) introduced a refined definition of flow (Csikszentmihalyi, 2000), tested the psychometrics of two new measures of flow propensity, and examined how personality traits correlated with flow propensity. Colloquially, flow is the phenomenon of "losing oneself" in an especially engaging task. Although flow refers to a momentary state, there is also a line of research aimed at assessing trait differences in the tendency to experience flow, or in short, flow proneness. In this tradition, Marty-Dugas and Smilek (2019) formally defined flow as deep and effortless concentration and constructed scales designed to measure individual differences in flow proneness that arise either from internal (e.g., concentrating on one's own thoughts) or external sources (e.g., concentrating on a task).

In testing the validity of the two flow proneness measures they examined their correlations with the Big Five personality traits of openness, conscientiousness, extraversion, agreeableness, and neuroticism. Marty-Dugas and Smilek (2019) found significant correlations between both measures of flow proneness with each of the Big Five. The pattern of associations was such that the measures of flow were positively correlated with openness, conscientiousness, extraversion, and agreeableness and negatively correlated with neuroticism. Additionally, the effect sizes ranged from medium to large indicating substantial overlap between the measures of flow proneness and personality.

Although Marty-Dugas and Smilek (2019) discuss the associations between the measures of flow proneness and each individual personality trait, we posit that the pattern and strength of correlations suggest that the relationship between flow and personality is most accurately described at a higher latent level. To point, Ullén et al. (2016) also examined the relationship between flow proneness and several individual differences including the Big Five. They found the same pattern as Marty-Dugas and Smilek (2019); flow proneness was positively correlated with openness, conscientiousness, extraversion, and agreeableness and negatively correlated with neuroticism. Ullén et al. (2016) even speculated that the correlation pattern with the Big Five may be due to the association between flow proneness and the higher-order personality trait called the General Factor of Personality (GFP; e.g., Musek, 2017). The GFP represents the shared variance between lower-order personality factors such as the Big Five. Though the GFP appears to be in part the result of measurement error (e.g., response bias), it also appears to represent a substantive personality trait (Dunkel et al., 2016). Importantly, while Ullén et al. (2016) discussed the possibility of flow and personality being linked at the level of the GFP, they did not directly test their hypothesis. Thus, although the importance and nature of the GFP remains in question (e.g., Revelle & Wilt, 2013), given the strong association between the GFP with other psychological constructs (e.g., Van der Linden et al., 2017) and the hypothesized correlation of the GFP with flow as presented by Ullén et al. (2016), we believe it may be valuable to examine the relationship between flow and the GFP.

Accordingly, as Marty-Dugas and Smilek (2019) uploaded the data of their study in the supplementary material we reanalyzed their findings to test the hypothesis that flow and personality are primarily associated at this higher-order latent level. In their study, Marty-Dugas and Smilek (2019) not only included their own measures of flow proneness, but, for validation purposes, also used the more established Swedish Flow Proneness Questionnaire (SFPQ; Ullén et al., 2012), which allows us to compare the different instruments. These results, along with data we collected to test the replicability of the findings are reported in the

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present research note.

2. Method

First, we reanalyzed the data provided by Marty-Dugas and Smilek (2019) that can be accessed at https://osf.io/cgvfk/. See Marty-Dugas and Smilek (2019) for a description of the sample (subsequently referred to as sample 1) and methods. Of special interest in the study were the new measures of flow- deep effortless concentration internal (DECI; Marty-Dugas & Smilek, 2019) and, deep effortless concentration external (DECE; Marty-Dugas & Smilek, 2019). The items of each measure were designed to be similar with the exception of the source of flow; which can be internal (e.g., thinking) or external (e.g., playing sports). Both the DECI and DECE contain eight items in a seven-point Likert-type format.

Secondly, in order to check the replicability of the first analysis we collected data on the Big Five and flow proneness using a university convenience sample (subsequently referred to as sample 2). Sample 2 totaled 128 participants between the ages of 17–26 ($M = 19.35$; $SD = 1.59$). The sample included 84 females and 44 males. Of the 128, 70 were White, 33 Black, 16 Hispanic, eight "Other", and one Asian-American. In exchange for course credit the participants were administered three measures which were answered on-line. The three measures were DECI, DECE, and the Big Five Inventory – 2 (Soto & John, 2017). Informed consent was obtained from all participants.

3. Results

To test for the robustness of the findings we conducted three types of analysis. First, we calculated the GFP by extracting a general factor from the Big Five using Principal Axis Factoring (PAF). We then simply correlated the GFP with the flow measures, but also considered the relations with a general flow factor (based on the specific flow measures). Secondly, we ran various structural equation models (SEMs) in which a latent GFP (above the Big Five) related to the flow measures. Thirdly, we ran parallel SEMs, but this time used a GFP that was based on the Big five intercorrelations as reported in the large meta-analysis of Van der Linden et al. (2010) that comprised 212 studies with an overall *N* of 144,117 participants. The idea behind the latter analyses is that the Big Five intercorrelations based on meta-analytic values provide better estimates of the true values. In evaluating the SEMs characteristics we used the guidelines of Hu and Bentler (1999). In order to test the viability of the GFP in both samples, we also tested the general factor saturation using Omega-hierarchical (ωh; Revelle & Wilt, 2013; using the 'Psych' package in R). This method uses the general factor loadings of factor analysis that includes Schmid-Leiman transformations.

The PAF analyses confirmed the existence of the GFP in both samples. In sample 1, the general factor explained 39.92 % of the Big Five variance, with factor loadings of 0.50, 0.69, 0.56, 0.63, and −0.77, for O, C, E, A, and N, respectively. Factor saturation ωh = 0.70. In sample 2 the explained variance was 31.72 % and the factor loadings 0.26, 0.67, 0.54, 0.50, −0.50, for O, C, E, A, and N, respectively; ωh = 0.65. Sample 1, included the DECI/DECE flow measures, as well as the SFPQ. As these were strongly intercorrelated, we also extracted a general flow factor. The flow factor explained 62.40 % of the variance in the three flow measures, and the factor loadings were 0.83, 0.85, and 0.68, for DECI, DECE, and the SFPQ, respectively. In sample 2, to create a flow factor we simply standardized (i.e., transformed into *z*-scores) the DECI and DECE scores and added the values.

Table 1 shows the correlations between the GFP and flow proneness measures in samples 1 and 2. In both samples, the GFP-flow correlations were moderate to high according to Cohen's classification of effect sizes, and were as high or higher as those of the specific Big Five dimensions. Table 1 shows that the GFP and the general flow factor were strongly correlated. Note that for the results presented in Table 1 for both samples the GFP was determined by the first unrotated factor of the PAF, while in sample 1 the general flow factor was determined by the first unrotated factor of the PAF for sample 2 the general flow factor was the summed *z*-scores.

Table 1
Correlations between the GFP and measures of flow.

	Sample 1	Sample 2
	GFP	GFP
DECE	0.58	0.36
DECI	0.54	0.40
SFPQ	0.60	
Flow factor	0.65	0.43

Note. All correlations are significant at p < .001. The GFP in both samples was measured by the first unrotated factor of the PAF of the Big Five. In sample 1 the flow factor was measured by the first unrotated factor of the PAF of the SFPQ, DECI, and DECE while in sample 2 the flow factor was the sum of the *z*-scores of DECI and DECE.

To test the robustness of the findings, regardless of statistical approach, we conducted the parallel analyses with CFA/SEM. In sample 1 we first tested how a general flow proneness factor (based on the DECI, DECE, and SFPQ) related to the GFP directly extracted from the Big Five. In the model, the latent flow proneness factor was correlated no less than 0.85 to the GFP. The fit of the overall model, however, and particularly the RMSEA, was suboptimal ($\chi = 111.10$, $df = 19$, $p < .001$, $CFI = 0.90$, $TLI = 0.86$, $RMSEA = 0.13$). Modification indices indicated that there were a few additional relevant correlations between the unique variances of a range of Big Five dimensions and flow measures. Accordingly, we allowed three additional unique variance correlations (C and A with the unique variance of the SFPQ, and C with E). Note, that such added pathways improve the model's fit because it better reflects the data ($\chi = 45.92$, $df = 16$, $p < .001$, $CFI = 0.97$, $TLI = 0.94$, $RMSEA = 0.08$), but hardly affects the relationship of interest. That is, the GFP-flow proneness factor remained highly correlated ($r = 0.78$).

In sample 2, the same model, but this time with a latent flow factor only based on the DECI and DECE, showed a similar high correlation between the GFP and flow factor. The overall model fit was acceptable, but below the guidelines for good model fit ($\chi = 28.43$, df = 14, p = .01, CFI = 0.91, TLI = 0.86, RMSEA = 0.09). The GFP-flow correlation was $r = 0.65$. When we allowed one additional correlation between A and E, the model fit was good ($\chi = 16.45$, df = 13, p = .23, CFI = 0.98, TLI = 0.96, RMSEA = 0.05) and the GFP-flow correlation was $r = 0.56$.

The SEM approaches described above are based on the sample correlations between the Big Five. An alternative approach is to use a Big Five intercorrelation matrix, based on meta-analytic data. Such intercorrelations are assumed to better reflect the true Big five intercorrelations because individual samples can have considerable fluctuation and error-variance. Accordingly, using sample 1, we conducted parallel SEMs using the Big Five intercorrelation matrix reported by Van der Linden et al. (2010) and that was based on 212 studies and a total N of 144,117 participants. As a summary of these analyses, initial modeling turned out to lead to out-of-range correlational values ($r = 1.19$) due to too much overlap between the GFP and latent flow proneness factor. Therefore, the flow proneness measures had to be modelled separately. An initial model on this had borderline acceptable fit ($\chi = 54.05$, $df = 13$, $p < .001$, $CFI = 0.93$, $TLI = 0.86$, $RMSEA = 0.10$). Allowing the unique variance of openness and conscientiousness to correlate showed a significant improvement in the fit ($\chi = 37.05$, $df = 12$, $p < .001$, $CFI = 0.96$, $TLI = 0.92$, $RMSEA = 0.08$). This latter model revealed that the correlations between the GFP and the flow measures were very high, up to the point where the constructs can be considered almost identical. That is, the correlations with the GFP were ($r = 0.82$) and ($r = 0.85$) for the DECI and DECE, respectively.

4. Discussion

As first suggested by Ullén et al. (2016), it may be that the association between flow proneness and personality primarily occurs at the level of the GFP. This hypothesis was tested by reanalyzing the data from Marty-Dugas and Smilek (2019), and testing the replicability of the results with a convenience sample. In each sample, using several types of analyses, the results supported the hypothesis. In fact, the relationship between the GFP and flow proneness was found to be quite strong.

The strong overlap between flow proneness and the GFP seems to suggest that both constructs emerge from similar psychological processes. As such the present findings may yield subsequent research aimed at revealing the nature of these processes, thereby enhancing our understanding of the constructs. For the bigger picture, it is relevant to point out that there is a growing list of psychological characteristics that exhibit a very strong relationship with the GFP such that there may be a high level of unity among these seemingly disparate constructs (e.g., Van der Linden et al., 2017). It is an intriguing possibility that a wide range of psychological measures largely tap the same underlying source, and testing this would greatly enhance the parsimony in the field of individual differences in personality.

To conclude the list of very strong associations of psychological constructs with the GFP continues to grow and may now include flow. Future research could not only focus on replicating the current findings with larger samples, but seek to extend this possible network of associations among latent variables.

CRediT authorship contribution statement

Curtis Dunkel: Conceptualization, Initial analyses, Writing. Dimitri van der Linden: Analyses, Editing. Megan Bardmass: Data curation, Initial analyses.

Declaration of competing interest

None.

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