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The Four-Factor Imagination Scale (FFIS): A measure for assessing frequency, complexity, emotional valence, and directedness of imagination

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Abstract

Recent findings in psychological research have begun to illuminate cognitive and neural mechanisms of imagination and mental imagery, and have highlighted its essential role for a number of important outcomes, including outcomes relevant for the study of psychopathology and psychotherapy. Scientific study of imagination, however, has been constrained by the virtue of being framed mainly as an ability for mental imagery. Here we propose that imagination is a widespread phenomenon that we all engage in, and which affects a wide range of important outcomes beyond more commonly studied constructs like creativity. Thus, the Four-Factor Imagination Scale (FFIS) focuses on features of the imaginative process, and measures imagination in terms of individual differences in those features, including Frequency, Complexity, Emotional Valence, and Directedness of imagination. Study 1 consisted of construct elicitation and generation of a large pool of candidate survey items. Study 2 (N = 378) conducted exploratory quantitative analysis on the preliminary pool of candidate items in a larger sample, revealing four distinct factors of the designed items. Study 3 (N = 10,410) confirmed the structure of the preliminary items, and reported internal consistency and unidimensionality, as well as convergent and discriminant validity of the resultant scales. The FFIS confirms that imagination is multifaceted in nature, and is better approached as a constellation of more narrowly measurable constructs.

Keywords: imagination; assessment; individual differences; personality; creativity

The Four Factor Imagination Scale (FFIS): A measure for assessing frequency, complexity, emotional valence, and directedness of imagination.

At a young age, we spend much of our time in fantasy and pretend play, imagining ourselves in various circumstances, and experimenting with the possible social and emotional roles of life (Russ, Robins, & Christiano, 1999). As we grow older, critical thinking skills tend to take over, and we may gradually progress beyond the world of fantasy to the practical and mundane tasks of adulthood. With age, we are prone to become more efficient and skilled, yet less open to new ideas, less flexible, and less exploratory (Gopnik, Griffiths, & Lucas, 2015; Roberts & Mroczek, 2008). Thus in the pursuit of proficiency and expertise, we may trade the limitless, fearless, and playful imagination of our youth for sensible realism.

One of the first documented studies of *imagination* – i.e., the formation of new ideas, images, or concepts in one’s mind’s eye – dates back to the 19th century (Galton, 1880). Galton was particularly interested in the vividness of mental imagery in recalling familiar scenes from memory. The bulk of subsequent research in this domain has generally either ignored Galton’s findings altogether, or followed his framework of imagination as the extent to which one is able to generate a sensory experience from information stored in memory, or as ‘mental imagery’ (Kosslyn, Ganis, & Thompson, 2001; Shepard & Metzler, 1971).

There are three noteworthy exceptions, though each differs from one another considerably. The first was the now-classic 344-item *Imaginal Processes Inventory* (IPI; Singer & Antrobus, 1963; Singer & Antrobus, 1966). Singer and his colleagues were pioneers in employing a more refined examination of imagination, although mostly focusing on daydreaming, which they defined as “a reported train of thought, imagery, or interior monologue that may occur as a shift of attention away from an ongoing task or the external perceptual situation (p. 188).” In their factor analysis of constructs such as daydreaming, attention, and curiosity, the authors reported the emergence of twelve factors, including *General Daydreaming*, *Neurotic Self-Conscious*

Daydreaming, and *Autistic Daydreaming*. Although *General Daydreaming* may be the factor most relevant to the current study, yet it still appears quite broad, and encompasses questions relating to “modified aggressive daydreams,” “achievement-oriented daydreams,” and “improbable daydreams.”

Another questionnaire was more recently developed to examine imagination in a cross-cultural context (Feng, Logan, Cupchik, Ritterfeld, & Gaffin, 2017). The questionnaire consists of five factors: expressive imagination, openness to variations, instrumental imagination, past/future mindedness, and conventionality. The *expressive imagination* factor is most closely related to the construct of imagination, and surveys individual differences in intrinsic motivation to create vivid imaginings based on mental representations.

Finally, although not tapping the same construct, the Tellegen Absorption Scale (TAS; Tellegen & Atkinson, 1974) examines the degree to which people find themselves entirely absorbed in their perceptual or imaginative experiences. The Fantasy Absorption subscale in particular taps into imagination, however its focus remains on absorption. For example, the TAS item ‘If I wish, I can imagine (or daydream) some things so vividly that they hold my attention in the way a good movie or story does’ appears to prioritize the holding of attention, thus conflating vividness of imagination and absorption in it.

Recent findings in psychological research have begun to illuminate cognitive and neural mechanisms of imagination and mental imagery, and have highlighted its essential role for a number of important outcomes. These findings suggest that the ability to imagine is beneficial during the learning process (Thomas & Brown, 2011), for cognitive development (Thomas & Brown, 2011), for experiencing empathy (Gaesser & Schacter, 2014), greater social understanding (Taylor, Carlson, Maring, Gerow, & Charley, 2004), skill acquisition during vocational training (Arcavi, 2003), and creativity (LeBoutillier & Marks, 2003) and innovation (Samli, 2011). Additionally, imagination contributes to the process of envisioning our “future selves,” such as

when predicting our emotional reactions to future events (Wilson & Gilbert, 2005), or our ability to save money for future spending (Hershfield, Goldstein, Sharpe, Fox, Yeykelis, Carstensen, & Bailenson, 2011).

Moreover, imaginative functioning is relevant for the study of psychopathology and psychotherapy. For example, imagination in the context of psychopathology could involve catastrophizing cognition, anticipatory anxiety over threat, distorted schemas, dissociation, and paranoia. Imagination in psychotherapy treatment could involve the patients' capacity to imagine new or different outcomes, envision getting better, or engage in particular interventions that include visualizations (e.g., imaginary exposures, autogenic training for biofeedback, and virtual reality). Indeed, in the initial stages of exposure therapy, which has been shown to be effective for reducing the symptoms of a number of anxiety disorders, patients are asked to engage in imaginary exposures concerning the source of their anxiety (Stewart et al., 2016). Furthermore, imagining worrisome events in more (compared to fewer) detail results in lower levels of worry, and increased subjective probability of a good outcome (Brown, MacLeod, Tata, & Goddard, 2002; Jing, Madore, & Schacter, 2016). Thus, considering imagination in the clinical context can be especially fruitful.

The neuroimaging literature provides further evidence for the relevance of imagination in clinical assessment science and practice. For instance, striking similarities are reported between remembering the past and imagining the future, with the brain's "core" network implicated in both memory and imagination (Benedek et al., 2018; Schacter, Addis, Hassabis, Martin, Spreng, & Szpunar, 2012). Indeed, according to the constructive episodic simulation hypothesis, mental simulation may be the integral part of both memory and imagination, where details from episodic memories are retrieved and recombined in the service of imagination (Schacter & Addis, 2007). Given the relevance of memory in conditions such as dementia and post-traumatic stress disorder, imaginative functioning can provide additional avenues for future exploration. Finally, the

personality trait of Openness to experience – trait that is generally associated with imagination and creativity, can be characterized by the increased functional coupling between default mode and the executive control networks (Beaty, Chen, Christensen, Qiu, Silvia, & Schacter, 2017), akin to creative thinking (Zabelina & Andrews-Hanna, 2016).

The context of these many related findings has led to a dramatic increase of interest in imaginative functioning. It is our view, however, that the scientific study of imagination has been constrained by virtue of being framed mainly as an ability to conjure mental imagery. From this perspective, imagination constitutes the ability to visualize an image of an object in the absence of external stimuli (for review, see Pearson, Naselaris, Holmes, & Kosslyn, 2015). This ability to form mental imagery is typically situated alongside other cognitive abilities like problem solving or verbal ability. For example, some measures of mental imagery and creative imagination assess the ability for imagery with measures akin to divergent thinking tests (e.g., Torrance, 1974). These measures instruct participants to generate images from incomplete figures, with responses scored for vividness, originality, and transformative ability (Jankowska & Karwowski, 2015). Another self-report instrument attempts to quantify participants' evaluations of their own imagination, encompassing satisfaction, implementation, learning, and process (Jung, Flores, & Hunter, 2016). What these and other measures of imagination (e.g., Marks, 1973) have in common is that they assess imagination as a component of creative ability.

These approaches fall short when it comes to assessing the extent and manner in which individuals engage in “imagining” on a daily basis, including the many mundane and uncreative imaginings we all have about the small details of our lives, such as anticipating conversations, aspirations for the future, and dreams about our future achievements. These types of scenarios are common, yet they do not necessarily require creative thinking. The IPI (Singer & Antrobus, 1966) established that fantasy and daydreaming are typical, wide-spread human phenomena. The more recently developed Fantasy Questionnaire approaches imagination as the propensity for creative

and imaginative fantasy (Weibel, Martarelli, Häberli, & Mast, 2018), although the creative fantasy factor of the Fantasy Questionnaire is once again focused on the creative aspect of one's ideas.

Here we propose a dimensional trait model of imagination, by suggesting that imagination is a widespread phenomenon that we all engage in – one which is likely to encompass features beyond vividness of imagination, and is likely to affect a wide range of important outcomes independent of ability-based constructs like creativity and intelligence. We posit four features of the imaginative process, and measure imagination in terms of individual differences in these features. The proposed features include (1) frequency – the amount of time an individual spends in an imaginative state; (2) complexity (or vividness) – how specific or detailed someone's imagination tends to be; (3) emotional valence – the extent to which one's imaginings are largely positive or negative; and (4) directedness – the degree to which imaginings are oriented towards specific goals or outcomes.

The proposed factors were hypothesized following examination of the literature on related constructs. For example, certain aspects of imagination may be akin to mind wandering, with recent work suggesting a dissociation between deliberate and spontaneous mind wandering (Seli, Carriere, & Smilek, 2015); thus, the directedness feature of imagination was considered. Frequency and complexity (vividness) features were hypothesized given the classic studies focusing on these two aspects of imagination (e.g., Singer & Antrobus, 1963). Finally, the emotional valence feature was included given frequent mention of imagination in the literature on constructs like rumination (Trapnell & Campbell, 1999).

By way of illustration: frequency of imagination solely refers to the *quantity* of one's imaginative states, and does not take into account the content or quality of one's imaginings. Complexity of imagination refers to the elaborative details (vividness) of one's imaginings, irrespective of their quantity. Emotional valence is the emotional tone of one's imaginings (positive versus negative). Finally, directedness is the conscious, goal-directed imaginative state

engaged in for a particular goal or purpose, in contrast with the uncontrolled, or non-directed imagination. In order to form a basis for testing and elaborating upon these four features of imagination, it is the aim of the current work to develop a Four-Factor Imagination Scale (FFIS) for defining, operationalizing, and measuring imagination.

The development of the FFIS began with construct elicitation and cognitive interviewing of a focus group to assess the face validity of the original item pool (Study 1). Once the factors and the scales items were identified, we conducted an exploratory study assessing the factor structure of the FFIS (Study 2). Upon the revision that followed, we conducted a psychometric evaluation and validation of the FFIS, by examining how different ways in which people imagine relates to various personality and cognitive outcomes. This was done using data from a large international data collection platform (the SAPA Project; <https://sapa-project.org>; Study 3). The development of the FFIS represents an initial step in a line of research evaluating features of the imaginative process and measuring imagination in terms of individual differences in these features.

Study 1

Qualitative Data Collection

The first step in the development of the FFIS began with informal discussions between the authors in response to a solicitation from the Imagination Institute (<http://www.imagination-institute.org>). These discussions served as construct elicitation for the assessment of various aspects of imagination. During the construct elicitation process, it became clear that the primary difficulty with assessing imagination is its multi-faceted structure. The aim of this first study thus was the generation of a large pool of candidate self-report survey items that allowed for assessment of the various features of imagination. Items encompassed features from the related constructs of fantasy (Weibel et al., 2018), daydreaming (Singer & Antrobus, 1963), mind wandering (Seli et al., 2015), and rumination (Trapnell & Campbell, 1999).

Methods

Eighty-seven items were written and administered to a convenience sample focus group ($N = 17$; 7 male, 10 female). Participants included a range of psychology graduate students, post-docs, and faculty in early to middle adulthood. Examples of items include “I find myself daydreaming often,” and “Imagining my future makes me feel blue.” Each item was administered with six response choices: “very inaccurate”, “moderately inaccurate”, “slightly inaccurate”, “slightly accurate”, “moderately accurate”, “very accurate”. Participants were encouraged verbally and in writing to provide feedback about the item content. These prompts asked participants for their general impression of the items as a set (e.g., “Do these questions make sense?”), whether they could identify the nature and purpose of the construct(s) being assessed (e.g., Do these items relate to a salient and important concept?), and whether they found any items to be awkward or confusing (e.g., “Did you find any questions strange or difficult to answer?”). Highly exploratory quantitative analyses were also performed on these items, though these analyses were not intended to provide a meaningful indication of replicable structure due to the small sample size. The quantitative analyses – for this and all subsequent studies – were performed using R version 3.3.2 (R Core Team, 2017) and the psych package version 1.7 (Revelle, 2017).

Results & Discussion

Participant feedback was largely consistent in that most participants recognized that the survey was designed to evaluate different features of imagination. Visual inspection of the correlation plots indicated that two concepts (complexity and emotional valence) were more clearly defined by the original 87 items than were the other two concepts (frequency and directedness; page 2 of the Supplementary Materials). Several items were deemed confusing or unclear. Following the revision, replacement, and addition of new items, the pool of item candidates for use with subsequent data collection contained 84 items.

Study 2

Binning and Winnowing of the Preliminary Item Pool

The primary goal of Study 2 was to conduct exploratory quantitative analyses on the preliminary pool of 84 candidate items from Study 1 in a larger sample. This was conducted with the intention of winnowing the item pool into a smaller, more manageable subset. No formal hypotheses were made regarding the empirical factor structure because it was not clear that four distinct factors would emerge.

Methods

Participants

The 84-item preliminary item pool was administered between April 18, 2016 and May 11, 2016 to 447 U.S. participants who were recruited through Amazon's Mechanical Turk (MTurk) data collection platform. Participants were compensated \$.50 for completion of the survey and the MTurk assignment was advertised with the request that participants "tell us about various aspects of [their] imagination." Participation in the survey was only offered to MTurk workers who had a minimum job approval rating of 99%, who were qualified as MTurk Master workers, and who had completed more than 5000 jobs. Workers were prohibited from participating in the survey more than once. Twenty-four participants were removed from the data based on an average response time of less than 2 seconds per item answered. An additional 45 participants were removed from the data based on failure to respond correctly to one of the three items added to the survey to ensure that participants were paying attention (note that only 7 of the participants removed missed more than one of the attention-check items). This resulted in a final sample of 378 participants. Due to a programming error, age and gender information for these MTurk workers was not retained. On average, 54.9% of MTurk jobs completed during these dates by workers from the U.S. were completed by female workers with a mean age of 35.6 years (Ipeirotis, 2010).

Procedure

Following recruitment through MTurk, participants were directed to a survey in Qualtrics that administered a 45-item survey to each participant. This included the 3 attention check items and a random subset of 42 items from the preliminary 84-item pool. This planned missingness design was used to ensure that participants were able to maintain attention throughout the survey. The same six response choices used in Study 1 were used for each item.

Analyses

The first step was to evaluate the stability of the correlations among the 84-item set. To do this, bootstrapped estimates of the standard errors were derived based on 1,000 iterations. Then, exploratory factor analyses (EFA) were conducted at several levels of extraction (from 1 to 10) using ordinary least squares to find the minimum residual solution, allowing for oblique solutions (using an oblimin rotation). Fits for the EFA were compared based on many statistics provided from the 'nfactors' function in the psych package (Revelle, 2017). Following comparison of the factor solutions, the factors in the most clear solution were sorted to identify items with primary loadings greater than ± 0.5 and with secondary loadings less than ± 0.2 .

Results & Discussion

All of the statistical code and analytic output and information about accessing the data is provided in the Supplemental Materials file. Each item was administered a mean of 182 times ($SD = 11.1$), and the number of pairwise administrations was 86.7 ($SD = 8.9$). The distribution of the standard errors of the correlations as estimated through a 1,000-iteration bootstrapping procedure are shown in Figure 5 of the Supplemental Materials ($m = .12$; $\min = .082$; $\max = .21$). This was deemed sufficiently stable for the use of exploratory factor analyses to organize and reduce the item pool.

Fit statistics for the exploratory factor analyses are given for all levels of extraction in the Supplemental Materials file. Most of the fit statistics did not converge, even at 10 factors of

extraction, though Velicer's MAP criterion (Velicer, 1976) and the item complexity plot both pointed towards four factors. Both the BIC and the standardized root mean square residual coefficients suggested that the 4 factor solution was notably better than the 3 factor solution and not much worse than 5, providing further support for the four-factor solution. The factors of the four-factor solution were correlated in magnitude between 0.00 and 0.33 (page 10 of the Supplemental Materials file). The overall evidence for four factors was only moderately strong, but there was little evidence to support any of the other solutions.

The items were then sorted by primary factor loading based on the four-factor solution in order to identify the items with the highest primary loadings (absolute values above .5) and low secondary loadings (absolute values below .2). A total of 33 items met these thresholds: 10 items delineating the frequency of one's imaginings, 9 items relating to emotional valence of imagination, 6 items describing directedness of one's imaginings, and 8 items relating to complexity of imagination. The item pool was then trimmed to these 33 items in Study 3.

Study 3

Psychometric Evaluation and Validation of the FFIS

Study 3 had several goals. First, to confirm the structure of the preliminary item set in a large online sample and, as needed, further reduce the item set. Second, to report the psychometric properties of the resultant scales in terms of their internal consistency and unidimensionality. Third, we aimed to report on their convergent and discriminant validity.

Several hypotheses were related to this third aim. Based on prior literature, we reasoned that frequency of imagination should relate to a profile of maladaptive outcomes. This prediction is based on the literature suggesting that the frequency of mind wandering, a construct loosely related to imagination, predicts lower levels of happiness (Killingsworth & Gilbert, 2010) and higher levels of depression (Kaiser, Andrews-Hanna, Wager, & Pizzagalli, 2015). With regards to the complexity of imagination, previous studies show a marked decline of specificity in the

construction of future events with the onset of neurogenerative diseases, which reduce mental functioning (Irish, Addis, Hodges, & Piquet, 2012). Thus, we expected more complex imaginings to relate to better cognitive functioning, including better performance on measures of cognitive ability and intellect. We expected emotional valence of one's imagination to be directly related to daily mood states, long-term affective traits, and a profile of adaptive outcomes in light of evidence that positive mood predicts success across multiple life domains (Lyubomirsky, King, & Diener, 2005). Finally, directedness of imagination was expected to be linked with higher scores on measures of intellect and introspection, as earlier studies show that deliberate (versus spontaneous) mind wandering is linked with fewer memory failures and fewer attention-related cognitive errors (Carriere, Seli, & Smilek, 2013).

Methods

Participants

Participants were 10,410 individuals who completed an online survey at the SAPA-Project.org in exchange for customized feedback about their personalities. Data were collected between February 7, 2017 and April 17, 2017. 70.4% of these participants reported being from the United States (137 countries were represented in total; 14 of these countries had more than 50 participants each), and 63.7% percent were female. Self-reported ages ranged from 13 to 82 with a mean of 23.8 years and a median of 20 years ($SD = 9.9$). The sample was widely characterized with respect to numerous demographic variables, including marital status, employment status, race/ethnicity, and educational attainment levels (70% had a high school degree and/or were currently in college; 8% had an associate's degree or had not completed a 4 year college degree; 11% had a college degree; the remainder had completed or were currently pursuing a graduate degree). Complete information about the demographics of this sample and instructions for accessing the data are reported in Condon, Roney, and Revelle (2017).

Procedure

In addition to the 33 imagination items, participants were administered a random subset of items relating to many other domains of individual differences, including demographics, temperament, interests, values, and health-related information. The sampling of items administered to each participant followed the standard procedures used in SAPA designs (Revelle, Condon, Wilt, French, Brown, & Elleman, 2016) based on the aggregation of several large public domain item pools and qualifies as missing completely at random (MCAR). The item pools included the International Personality Item Pool (Goldberg, 1999) and the International Cognitive Abilities Resource (ICAR; Condon & Revelle, 2014). Participation in the survey was completed voluntarily and motivated by participants' desire for feedback about their personality.

Analyses

Given the preliminary results of Study 2, exploratory factor analysis was used again to evaluate the structure of the correlations among items in a larger and more stable participant sample. Again, the ordinary least squares method was used to find the minimum residual solution, allowing for oblique solutions (using an oblimin rotation). We then sought evidence of low primary loadings, high cross-loadings, and/or low inter-item correlations in order to identify items that might be redundant or inconsistent with the specified scales, pending subsequent content evaluation. If none of the items were flagged for removal, it was our intention to report fit statistics based on the confirmatory factor analysis (Rosseel, 2017) using the structure identified in Study 2. It is not generally useful or recommended to conduct both EFA and CFA on the same data set, but the EFA was viewed as a necessary first step given the relatively low stability of the correlations reported in Study 2. If there was evidence to support the removal of items, it was our intention to report the fit based on exploratory factor analysis of the final item set as the model from Study 2 would no longer be relevant. In either case, we planned to evaluate the evidence for

a hierarchical general factor solution by conducting an omega analysis (Revelle & Zinbarg, 2009; Zinbarg, Yovel, Revelle, & McDonald, 2006) with all the remaining items. Internal consistency measures were assessed by using Pearson correlations between items in each of the resulting scales to calculate α , $\omega_{\text{hierarchical}}$ (Zinbarg, Revelle, Yovel, & Li, 2005), and explained common variance (ECV, Reise, 2013) coefficients. In the last step, correlations were used to evaluate both convergent and discriminant associations among the resultant scales scores for imagination, personality scales (John & Srivastava, 1999; Condon, under review), cognitive ability scales (Condon & Revelle, 2014), and other self-reported health and demographic variables.

Results

All of the statistical code and analytic output and information about accessing the data is provided in the Supplemental Materials file. Each item was administered a mean of 2,469 times (median = 2,466, $SD = 42$), and the number of pairwise administrations was 758 (median = 756, $SD = 26$). The distribution of the standard errors of the correlations as estimated through a 1,000-iteration bootstrapping procedure are shown in Figure 11 of the Supplemental Materials file (mean = .040; min = .035; max = .057). This was deemed sufficiently stable for the use of factor analysis to organize and reduce the item pool and to compare the structure of the correlations at various levels of extraction.

Exploratory factor analysis using all 33 items pointed to a four-factor solution based on several fit statistics (VSS1, VSS2, Velicer's MAP, and the standardized root mean square residual). Evaluations of the inter-item correlations in each scale using all of the items from Study 2 suggested that 3 items should be dropped. Subsequent evaluations of the factor loadings pointed to removal of 4 additional items due to significant cross-loadings and/or low primary loadings.

Following the removal of these 7 items, the remaining 26 items showed a clear four-factor structure. Table 1 shows the content and loadings for each item. None of the items have primary loadings below 0.40 or secondary loadings greater in magnitude than ± 0.20 . Table 2 shows that

all of the factors have small to moderate correlations. Results of the omega analysis are shown in Figure 1. The Frequency factor is indistinguishable from the general factor, while each of the remaining three factors have only moderate loadings on the general factor (0.2 - 0.4). The omega hierarchical value for the full item set (0.75) suggests reasonable unidimensionality, but that there is also some evidence of lower level structure. Internal consistencies for each of the specific scales are shown in Table 3. The alpha values were moderate to high (.76 - .93). The omega hierarchical values (for each of the factors/scales) suggested high unidimensionality for the Frequency factor, and only moderate unidimensionality for the remaining 3 factors. Evaluations of internal consistency did not differ across genders or country of origin (U.S. or non-U.S.).

Convergent and discriminant validity

To examine convergent and discriminant validity, the FFIS scores were correlated with many additional measures administered to participants in the SAPA-Project sample. Figure 18 in the Supplementary Materials file shows the distribution of the estimated standard errors of these correlations based on bootstrapping of the correlations with 100 iterations. Correlations greater in magnitude than $r = \pm .04$ are significant ($p < .001$).

Table 4 shows correlations among the four FFIS factors, as well as correlations between the four factors and measures of personality and cognitive abilities. These values include both the point estimates of the correlations and the 95% confidence intervals (in parentheses). None of the Imagination scales showed evidence of statistically significant differences by sex or country of origin (results for all comparative analyses are shown in the Supplementary Materials). In general, the FFIS factors showed little association with the measures of cognitive ability (ICAR 60-Item General Measure, ICAR Letter and Number Series, ICAR Matrix Reasoning, ICAR Three-Dimensional Rotation, ICAR Verbal Reasoning); the highest correlations were with FFIS Complexity ($r = .05$ to $.12$). The pattern of associations between the FFIS scales and the cognitive

ability measures was consistent between genders and among participants within and outside the U.S.

Associations of the FFIS with personality traits was highly similar across the two sets of five-factor scales (the Big Five Inventory and the SPI-5). Frequency was most highly associated with Conscientiousness ($r = -.28$ in the BFI; $r = -.31$ in the SPI-5), Neuroticism ($r = .23$ and $r = .28$), and Openness ($r = .24$ and $r = .32$). Emotional Valence was most highly associated with Neuroticism ($r = .42$ and $r = .48$), though associations with Conscientiousness ($r = -.26$ and $r = -.25$), Agreeableness ($r = -.22$ and $r = -.23$), and Extraversion ($r = -.23$ and $r = -.25$) were also prominent. Complexity was only strongly associated with Openness ($r = .32$ and $r = .40$). The highest associations for Directedness were with Conscientiousness ($r = .14$ and $r = .20$) and Openness ($r = .14$ and $r = .24$), though these associations differed slightly among the two measurement frameworks. The pattern of associations between both measures of the Big Five and the FFIS was consistent across genders and participants from within and outside the U.S.

As for associations with the lower-order personality traits (based on the SPI-27), Frequency was most related to Industry ($r = -.31$), Introspection ($r = .29$), Well-Being ($r = -.28$), Order ($r = -.25$), Anxiety ($r = .24$), Emotional Stability ($r = -.23$), Easy-Goingness ($r = .23$), Creativity ($r = .23$), Impulsivity ($r = .21$), and Art Appreciation ($r = .20$). Emotional Valence was highly related to Well-Being ($r = -.55$) and Anxiety ($r = .43$), and less strongly related to Industry ($r = -.29$), Emotional Stability ($r = -.29$), Irritability ($r = .26$), Charisma ($r = -.25$), Adaptability ($r = -.24$), Sociability ($r = -.22$), Honesty ($r = -.21$), and Trust ($r = -.20$). Complexity was most associated with Creativity ($r = .37$), Conformity ($r = -.28$), Introspection ($r = .25$), and Art Appreciation ($r = .24$). Directedness had relatively fewer strong associations – Perfectionism ($r = .22$), Introspection ($r = .22$) and Creativity ($r = .21$). The pattern of associations among these lower-order traits and the FFIS scales was consistent across genders for all traits and consistent across participants from within and outside the U.S. for all but two traits. Among participants from

outside the U.S., all of the FFIS scales were more highly associated with Anxiety (differences in r s = .05) and less highly associated with Trust (differences in r s = .05).

Figures 13 and 14 in the Supplemental Materials file show plots of the correlations between the FFIS factors and many additional variables, including a wide range of self-reported health outcomes (Figure 13) and demographic characteristics (Figure 14). The Emotional Valence factor was notably correlated with several of the self-reported health variables, including associations with overall health ($r = -.24$), exercise frequency ($r = -.13$), sleep quality ($r = -.25$) and time spent sleeping ($r = -.11$), and stress levels ($r = .28$). The pattern of associations with health variables was similar, but lower in magnitude for the Frequency scale; Complexity and Directedness were generally uncorrelated with health. Other notable associations included the Frequency scale with age ($r = -.22$), and the Frequency and Emotional Valence scales with socioeconomic status ($r = -.09$ to $-.13$). Again, the pattern of associations did not differ across gender or country of origin.

General Discussion

The goal of the current work was to develop a self-report measure for assessing individual differences in features of imagination. We demonstrated the possibility of measuring four distinct features of imagination, namely frequency, complexity, emotional valence, and directedness. The FFIS factors showed high overall internal and factor-specific consistency, and served as good predictors of creative behaviors, appreciation for the arts, and openness to experience, indicating solid convergent validity. None of the four features of imagination correlated highly with intellect or with measures of cognitive ability, thus pointing to discriminant validity of the FFIS. While intellect was a self-report measure, the cognitive ability measure (ICAR; Condon & Revelle, 2014) was performance-based, thus future studies will need to confirm the discriminant validity of the FFIS with cognitive abilities.

As demonstrated, imagination appears to be linked with a wide range of important outcomes beyond the constructs with which it is normally associated (like creativity). The evidence for this stems from associations between the FFIS factors, the Big 5 scales, and the lower-order personality traits. While the associations with lower-order traits logically follow from the five-factor associations, they help to identify the underlying mechanisms. For example, it is notable that the association between Directedness and Conscientiousness is driven more by Perfectionism than by Industry, Order, or Self-Control. Similarly, the association between Complexity and Openness is not driven by Intellect, but it does tap most features of openness to new experience: Creativity, Introspection, Art Appreciation, and a lack of Conformity. Associations with Frequency were negatively associated with features of Conscientiousness (Industry and Order) and positively associated with features of Neuroticism (Anxiety, lower Emotional Stability, lower Well-Being). No causal relations can be claimed, but these associations are consistent with the adage that more time spent mind-wandering leaves less time for productive behaviors. Additionally, there were no strong associations between the FFIS and biological sex, suggesting that the FFIS framing of imagination is not biased towards either males or females.

The FFIS has potentially meaningful implications for clinical science and practice. Given the associations between the frequency of one's imaginings and anxiety and impulsivity, further studies are needed to investigate whether decreasing the amount of time spent in imaginative states results in decreased anxiety and impulsivity symptomology. Emotional tone and concreteness of imaginative functioning in psychopathology represent important avenues for future research. For instance, worry and depressive rumination have been characterized by reduced concreteness of thought that interferes with successful emotional processing via reduction of imagery (Goldwin & Behar, 2011; Stöber & Borkovec, 2002). The FFIS allows for the assessment of individual differences in imaginative concreteness with a few short statements. Psychotherapy treatments can also benefit from evaluating people's imaginative functioning with the use of the FFIS.

Although a number of measures exist that assess constructs similar to imagination, these measures generally approach imagination as the ability to conjure mental imagery, or view imagination as a component of creative ability (e.g., Jankowska & Karwowski, 2015, Marks, 1973). One of the exceptions is the *Imaginal Processes Inventory* (Singer & Antrobus, 1966), however its administration is time-consuming (344 items), and some of its features may not be entirely relevant to imagination (e.g., acceptance and distractibility). To our knowledge, this is the first scale that examines individual differences in the four features of imagination with a few short items (26 items).

Limitations and Future Directions

One of the primary limitations of the current work is the possibility that there may be additional features of imagination that are not well measured by the FFIS. This would be indicated by evidence of incremental validity from other measures when used alongside the FFIS to predict imagination-related criterion. Future studies will need to investigate the extent to which the utility of the FFIS stems from its associations with other important psychological constructs. For example, it is possible that a more general measure of emotional valence (e.g., the PANAS; Watson, Clark, & Tellegen, 1988) explains a substantial portion of the variability in the emotional valence of imagination. If the FFIS Emotional Valence sub-scale does not independently describe a meaningful proportion of variance, this might suggest relatively little context-specific variability in the emotional valence of one's imaginings.

As is the case with all self-reported instruments, the results of FFIS administration need to be interpreted with caution. The FFIS will need to be further validated against variables that are more closely linked with the construct of imagination, including divergent thinking, real-world creative accomplishments, absorption, and mind-wandering. Additional data collection is also needed to evaluate the generalizability of measurement with the FFIS with the goal of better understanding the ways that imagination (and its various component processes) differ across a

wide range of demographic and psychosocial variables, including age, socioeconomic status, culture, language, educational attainment levels, and occupations. Further, future efforts should be directed towards examining whether any long-term outcomes, such as health, professional success in various domains, and/or social or relationship outcomes can be predicted by imagination or any of its features. Once these outcomes have been identified, subsequent studies can consider ways that the FFIS can be used to advance theory, improve predictions, and develop interventions that may improve outcomes in these domains. For example, the evidence that specificity in the construction of events declines with the onset of neurodegenerative disease (Irish et al., 2012) may suggest that the Complexity factor of the FFIS could relate to mild cognitive impairment – a precursor to cognitive impairment and Alzheimer’s disease. Similarly, changes to the Emotional Valence of imagination might become a therapeutic target for various emotional disorders. Directedness of imagination may be useful for counseling or sports psychology. Finally, Frequency of imagination might be useful for vocational counseling if future studies find evidence that it is more heavily associated with creative achievement or with professional success in some careers.

Conclusion

In conclusion, here we present a new self-report measure of imagination, which assesses imagination in terms of its four features: Frequency, Complexity, Emotional Valence, and Directedness. We provide evidence that “imagination” is not a single construct, and is not easily measurable as such. Rather, imagination is multi-faceted in nature, and is better approached as a constellation of more narrowly measurable constructs.

Compliance with Ethical Standards

This project was funded by the Imagination Institute Grant from the Templeton Foundation (grant number RPF-15-04) to DLZ and DMC. The authors have no conflict of interest pertaining to the *Psychological Research* submission. The authors have full control of all primary data and agree to allow the journal to review their data if requested. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and research committee, and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. All participants gave their informed consent prior to their participation in the study.

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Table 1

Four-Factor Item Loadings for the Four-Factor Imagination Scale (FFIS).

Item Label	Items	Factor 1 Freq	Factor 2 Emo Val	Factor 3 Complex	Factor 4 Directed
F1	I am lost in imagination most of the time.	0.90	-0.03	-0.05	-0.04
F6	I find myself lost in imagination very frequently.	0.87	-0.07	0.05	-0.03
F4	I find myself daydreaming often.	0.84	0.02	0.02	0.02
F7	I spend much of my time daydreaming.	0.79	0.07	0.04	0.04
F5	I get lost in my fantasies.	0.78	0.00	0.12	0.05
F3	I get lost in thoughts that aren't related to what's going on around me.	0.78	0.02	-0.1	-0.07
F2	Sometimes it is as though I wake-up from daydreaming.	0.72	0.00	-0.05	0.11
F8	My mind wanders in unpredictable ways.	0.66	0.04	0.02	-0.03
F9	I often fantasize about impossible things.	0.56	0.09	0.07	0.01
EV7	Imagining my future makes me feel blue.	-0.07	0.89	0.05	-0.03
EV2	I become depressed when imagining my future.	0.01	0.88	0.01	-0.01
EV3	Imagining things in the future makes me fearful.	0.00	0.71	-0.06	0.04
EV5	The things I imagine make me sad.	0.04	0.68	0.03	0.01
EV4	My fantasies lead to negative emotions.	0.14	0.56	-0.08	0.03
EV1	I visualize negative outcomes for the future of the world.	0.10	0.47	0.03	-0.01
EV6	My daydreams are unpleasant.	0.11	0.47	-0.16	0.00
C5	My fantasies are less detailed than most peoples'. (R)	0.01	0.03	0.75	0.08
C2	Most people seem to have more complex imaginations than me. (R)	0.02	-0.02	0.73	-0.08
C4	My imaginings are not very complex. (R)	0.09	0.01	0.62	-0.08
C1	My fantasies do not involve many details. (R)	0.05	0.00	0.58	0.13
C3	I have difficulty picturing the details of a situation I have not previously experienced. (R)	-0.12	-0.12	0.41	0.06
D1	My daydreams have a clear goal.	-0.02	-0.05	-0.04	0.75
D3	My daydreams are directed towards a specific outcome.	-0.01	0.09	-0.08	0.70
D4	My fantasies are quite purposeful.	0.00	-0.03	0.13	0.64
D2	There is a purpose for my fantasies.	0.12	-0.03	0.11	0.59
D5	When I imagine my future, I like to plan its details.	-0.06	-0.10	-0.02	0.44

Factor 1: Frequency; Factor 2: Emotional Valence; Factor 3: Complexity; Factor 4: Directedness

Note that the items in the Complexity factor are all reverse scored.

Table 2

Correlations Among the Imagination Factors in Study 3.

	Frequency	Emotional Valence	Directedness
Emotional Valence	0.34		
Directedness	0.20	-0.14	
Complexity	0.39	-0.13	0.25

Table 3

Internal Consistencies For All Items And the Scales.

	Alpha (α)	Omega ($\omega_{\text{hierarchical}}$)
All 26 items	.87	.77
Frequency	.93	.85
Emotional Valence	.87	.73
Complexity	.76	.68
Directedness	.76	.62

Table 4

Correlations Among the FFIS, Personality Traits, and Cognitive Abilities.

	FFIS Frequency		FFIS Emotional Valence		FFIS Complexity		FFIS Directedness	
FFIS Emotional Valence	0.26	(0.24, 0.28)						
FFIS Complexity	0.24	(0.22, 0.27)	-0.07	(-0.10, -0.05)				
FFIS Directedness	0.12	(0.09, 0.14)	-0.08	(-0.10, -0.06)	0.16	(0.14, 0.19)		
BFI Agreeableness	-0.11	(-0.14, -0.09)	-0.22	(-0.24, -0.19)	0.03	(0.00, 0.05)	0.06	(0.04, 0.09)
BFI Conscientiousness	-0.28	(-0.31, -0.26)	-0.26	(-0.28, -0.24)	0.03	(0.00, 0.05)	0.14	(0.11, 0.16)
BFI Extraversion	-0.12	(-0.15, -0.10)	-0.23	(-0.26, -0.21)	0.06	(0.04, 0.09)	0.08	(0.05, 0.10)
BFI Neuroticism	0.23	(0.21, 0.26)	0.42	(0.40, 0.44)	-0.03	(-0.06, -0.01)	-0.01	(-0.03, 0.02)
BFI Openness	0.24	(0.22, 0.26)	-0.02	(-0.04, 0.01)	0.32	(0.29, 0.34)	0.14	(0.12, 0.17)
SPI Agreeableness	-0.09	(-0.12, -0.07)	-0.23	(-0.24, -0.20)	0.01	(-0.01, 0.04)	0.04	(0.02, 0.07)
SPI Conscientiousness	-0.31	(-0.33, -0.29)	-0.25	(-0.27, -0.22)	-0.03	(-0.05, -0.01)	0.20	(0.18, 0.22)
SPI Extraversion	-0.11	(-0.13, -0.09)	-0.24	(-0.26, -0.21)	0.07	(0.05, 0.10)	0.08	(0.06, 0.11)
SPI Neuroticism	0.28	(0.26, 0.30)	0.48	(0.46, 0.50)	-0.01	(-0.03, 0.02)	0.02	(0.00, 0.05)
SPI Openness	0.32	(0.30, 0.34)	-0.04	(-0.06, -0.01)	0.40	(0.37, 0.42)	0.24	(0.21, 0.26)
SPI27 Compassion	0.01	(-0.01, 0.03)	-0.05	(-0.08, -0.03)	0.04	(0.01, 0.06)	0.10	(0.07, 0.12)
SPI27 Irritability	0.10	(0.07, 0.12)	0.26	(0.23, 0.28)	-0.04	(-0.06, -0.01)	0.02	(-0.01, 0.04)
SPI27 Sociability	-0.12	(-0.14, -0.10)	-0.22	(-0.24, -0.20)	0.01	(-0.01, 0.03)	0.04	(0.01, 0.06)
SPI27 Well-Being	-0.28	(-0.30, -0.26)	-0.55	(-0.57, -0.54)	0.02	(-0.01, 0.04)	0.11	(0.08, 0.13)
SPI27 Sensation Seeking	0.13	(0.11, 0.16)	-0.01	(-0.04, 0.02)	0.07	(0.05, 0.09)	0.06	(0.04, 0.09)
SPI27 Anxiety	0.24	(0.22, 0.26)	0.43	(0.41, 0.45)	-0.05	(-0.08, -0.03)	0.05	(0.02, 0.07)
SPI27 Honesty	-0.17	(-0.18, -0.15)	-0.21	(-0.23, -0.19)	0.03	(0.01, 0.05)	0.03	(0.01, 0.06)
SPI27 Industry	-0.31	(-0.34, -0.29)	-0.29	(-0.31, -0.27)	0.00	(-0.02, 0.02)	0.14	(0.11, 0.16)
SPI27 Intellect	-0.06	(-0.08, -0.04)	-0.16	(-0.18, -0.14)	0.19	(0.16, 0.21)	0.12	(0.09, 0.15)
SPI27 Creativity	0.23	(0.20, 0.25)	-0.08	(-0.10, -0.07)	0.37	(0.35, 0.40)	0.21	(0.19, 0.23)
SPI27 Impulsivity	0.21	(0.19, 0.23)	0.15	(0.13, 0.18)	-0.03	(-0.05, -0.01)	-0.07	(-0.10, -0.05)
SPI27 Attention Seeking	0.00	(-0.03, 0.02)	-0.05	(-0.07, -0.02)	0.07	(0.04, 0.09)	0.04	(0.02, 0.07)
SPI27 Order	-0.25	(-0.27, -0.23)	-0.17	(-0.19, -0.14)	-0.07	(-0.09, -0.05)	0.11	(0.09, 0.14)
SPI27 Authoritarianism	-0.18	(-0.20, -0.16)	-0.14	(-0.16, -0.12)	-0.14	(-0.16, -0.12)	0.08	(0.05, 0.10)
SPI27 Charisma	-0.13	(-0.15, -0.11)	-0.25	(-0.28, -0.23)	0.14	(0.12, 0.17)	0.14	(0.11, 0.16)
SPI27 Trust	-0.06	(-0.09, -0.04)	-0.20	(-0.22, -0.18)	-0.03	(-0.06, -0.01)	0.01	(-0.01, 0.04)
SPI27 Humor	0.07	(0.05, 0.10)	-0.17	(-0.19, -0.14)	0.09	(0.07, 0.12)	0.08	(0.05, 0.10)
SPI27 Emotion. Express.	-0.09	(-0.12, -0.08)	-0.18	(-0.20, -0.15)	0.11	(0.09, 0.13)	0.08	(0.06, 0.11)
SPI27 Art Appreciation	0.20	(0.18, 0.22)	0.01	(-0.01, 0.04)	0.24	(0.22, 0.27)	0.08	(0.05, 0.10)
SPI27 Introspection	0.29	(0.27, 0.31)	0.02	(-0.01, 0.04)	0.25	(0.22, 0.27)	0.22	(0.20, 0.25)
SPI27 Perfectionism	-0.05	(-0.07, -0.03)	-0.01	(-0.03, 0.01)	0.06	(0.03, 0.08)	0.22	(0.20, 0.25)
SPI27 Self-Control	-0.15	(-0.17, -0.13)	-0.16	(-0.18, -0.13)	-0.06	(-0.08, -0.04)	0.07	(0.04, 0.09)
SPI27 Conformity	-0.14	(-0.16, -0.12)	0.02	(-0.01, 0.04)	-0.28	(-0.30, -0.25)	-0.02	(-0.04, 0.00)
SPI27 Adaptability	-0.03	(-0.05, 0.00)	-0.24	(-0.25, -0.21)	0.13	(0.10, 0.16)	0.03	(0.00, 0.05)
SPI27 Easy-Goingness	0.23	(0.21, 0.25)	0.12	(0.10, 0.15)	-0.06	(-0.08, -0.04)	-0.04	(-0.07, -0.01)
SPI27 Emotion Stability	-0.23	(-0.26, -0.21)	-0.29	(-0.32, -0.27)	-0.09	(-0.11, -0.06)	-0.02	(-0.05, 0.00)
SPI27 Conservatism	-0.11	(-0.13, -0.09)	-0.11	(-0.14, -0.09)	-0.12	(-0.14, -0.09)	0.07	(0.04, 0.09)
ICAR 60-Item g	0.01	(-0.01, 0.03)	-0.04	(-0.06, -0.02)	0.12	(0.10, 0.13)	-0.04	(-0.06, -0.02)
ICAR Letter No. Series	-0.01	(-0.03, 0.02)	-0.04	(-0.06, -0.02)	0.09	(0.06, 0.11)	-0.03	(-0.05, -0.01)
ICAR Matrix Reasoning	0.00	(-0.02, 0.02)	-0.04	(-0.06, -0.02)	0.05	(0.03, 0.07)	-0.01	(-0.03, 0.01)
ICAR 3D Rotation	0.02	(0.00, 0.03)	0.00	(-0.02, 0.02)	0.07	(0.05, 0.10)	-0.02	(-0.05, 0.00)
ICAR Verbal Reasoning	0.03	(0.01, 0.05)	-0.01	(-0.03, 0.01)	0.10	(0.08, 0.12)	-0.01	(-0.03, 0.01)

NOTE: Correlations above +/- .04 are significant $p < .001$. Confidence intervals are shown in parentheses.

Figure 1

Omega Hierarchical for the Four-Factor Imagination Theory Scale (FFIS).