Imagination as a facet of Openness/Intellect: A new scale differentiating experiential simulation
and conceptual innovation

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Word Count: 4631

Submission Date: 11/11/2022

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Abstract

Previous research has investigated the nature of imagination as a construct related to multiple forms of higher-order cognition. Despite the emergence of various conceptualizations of imagination, few attempts have been made to explore the structure of imagination as a trait in the context of existing hierarchically-nested personality dimensions. We present the Dual Facet Imagination Scale (DFIS) for measuring trait imagination that distinguishes between *experiential simulation* and *conceptual innovation*, aligned with the two major subfactors (aspects) of the Big Five dimension Openness/Intellect. In two samples ($N = 210$ & 5771), we provide evidence of a consistent factor structure distinguishing experiential and conceptual descriptions of imagination, as well as validity as measures of facets of Openness and Intellect. The DFIS provides a trait measure of two major forms of imagination in line with mainstream models of the hierarchical structure of personality.

Keywords: Imagination, Openness/Intellect, Experiential Simulation, Conceptual Innovation

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Imagination has long been regarded as a fundamental component of human experience. Various philosophical treatments have characterized imagination as among the most defining and pervasive elements of our cognition, loosely converging on the consensus of imagination as the generative capacity to produce novel ideas and experiences within or beyond the limits of reality (Descartes, 1642; Kant, 1781; Strawson, 1970; Stevenson, 2003). This capacity for modulating information between actuality and possibility has been suggested as a fundamental feature of human conscious experience, by permitting a greater capacity to generate hypothetical states that can be reconciled with current conscious states (DeYoung, 2015a, 2015b; Safron, 2021) and to navigate the pervasive ambiguities of language, symbolism, and complex social behavior (Bronowski, 1979; Carruthers, 2002; Walton, 1990). The involvement of imagination in creative processes makes it a crucial component of cultural evolution through art, philosophy, and scientific innovation (Feist, 1998), but it is similarly influential in its contributions to everyday problem solving and future planning (Jing et al., 2016; Schacter, 2012).

Individual Differences in Imagination

The sheer scope of human behavior that is modulated by imaginative capabilities is evident in early psychological research. This empirical work has helped to distinguish between the characterization of imagination as a universal human capacity and imagination as a dimension of variability in this capacity. Early reports of variability in imagination has been presented in the context of other consequential psychological phenomena including memory, empathy, and features of sensation and perception (Galton, 1880; Markey, 1935). More recent behavioral and psychometric research has elaborated extensively on this variability, with the role

of individual differences in imagination often being incorporated in discussions of related elements of higher-order cognition, including mental imagery (Dijkstra et al., 2021; Abraham, 2016; Pearson, 2019), creativity (Jankowska & Karwowski, 2015; Runco et al., 2011; Guilford, 1951) and divergent thinking (Addis et al., 2016). This evidence supports the interpretation of imagination as a trait reflecting variability in the broad cognitive mechanisms that influence the capacity for complex information processing in general (DeYoung, 2015b).

Measuring Imagination

The growing body of literature characterizing imagination through the perspective of individual differences has repeatedly attempted to identify the factor structure of various dimensions of imagination. This approach has led to the investigation of individual variation in behaviors relating to fantasy, thoughtfulness, and daydreaming (Singer & Antrobus, 1963; Naylor & Simonds, 2015), as well as absorption and hypnotic experiences (Tellegen & Atkinson, 1974). Additional research has led to the development of scales that characterize imagination through multiple different dimensions including imaginative capability (Liang & Chia, 2014) and cultural contributions (Feng et al., 2017), as well as aspects relevant to personality traits and other associated cognitive abilities (von Stumm & Scott, 2019).

One recent scale assessing multiple dimensions of imagination is the Four-Factor Imagination Scale (FFIS; Zabelina & Condon, 2020). This scale recognizes four empirically-derived dimensions corresponding to individual differences in frequency, complexity, emotional valence, and directedness of imagination. The dimensions of the FFIS have been validated across multiple samples, and exhibit convergent and discriminant validity with a variety of cognitive and personality measures (Zabelina & Condon, 2020).

Imagination and Openness/Intellect

Given the variety of existing scales measuring individual differences in imagination, one might wonder why we are proposing another one. One primary reason for developing this scale is to capture the tendency to be imaginative in a way that reflects the location of imagination within a hierarchical taxonomy of personality traits, as captured by the five factor model or Big Five. The Big Five are intended to represent the major dimensions of covariation among all more specific trait descriptions, and lexical research has found “imaginative” to be one of the strongest indicators of Openness/Intellect (John et al., 2008). Saucier (1992, 1994) even proposed “Imagination” as an alternative label for this dimension. One motivation for proposing a new label was the old debate about whether “Openness to Experience” or “Intellect” was a better label for that dimension of the Big Five. Saucier noted that “Imagination” seemed to capture what was overlapping between both Openness and Intellect.

More recently, DeYoung et al. (2007) provided empirical evidence for the existence of Openness to Experience and Intellect as the two major subfactors of the broader Openness/Intellect dimension (thereby justifying the ungainly compound label). Factor analysis of 15 different facets of Openness/Intellect yielded a two-factor solution, clearly corresponding to Openness and Intellect. What the two share, represented by the Big Five trait Openness/Intellect, can be regarded as the tendency to seek out, detect, appreciate, understand, and utilize information (DeYoung et al., 2012; DeYoung, 2015a). The Openness aspect of this trait, centered around aesthetics, sensation, and fantasy, describes the tendency to engage with spatial and temporal patterns in sensory or perceptual information, whereas the Intellect aspect, centered around intellectual confidence and interest, describes the tendency to engage with logical or causal patterns in abstract information (DeYoung, 2015b).

In the construction of the scales used to measure Openness and Intellect separately, the Big Five Aspect Scales (BFAS; DeYoung et al., 2007), items were excluded if they exhibited strong but similar factor loadings on both aspects of a particular trait. In the case of Openness/Intellect, this criterion prohibited the inclusion of items directly describing imagination (e.g., “Have a vivid imagination”), providing more empirical support for the notion that imagination is a central feature of Openness/Intellect.

The fact that imagination loads highly on both aspects of Openness/Intellect suggests the potential importance of considering two different types of imagination, corresponding to the two aspects. Psychologists have tended to associate imagination with fantasy and the production of novel mental imagery (McMillan et al., 2013; Singer, 1975). In common language, however, the word imagination more generally refers to mental representations of things that are not present to the senses. Particular types of mental representations can reasonably correspond to two distinct dimensions of cognitive function that imagination is used to describe: the mental simulation of sensory experiences that one is not currently having, or *experiential simulation*, and the production of novel ideas that are not obviously cued by the current context, or *conceptual innovation*. These two dimensions of imagination may potentially correspond with the unique characteristics of Openness and Intellect, respectively, which would explain why descriptions of people as “imaginative” would be strongly related to both traits and central to the Big Five domain. People will describe themselves or others as imaginative either because they can vividly picture non-existent scenes or because they can readily come up with original ideas.

Most existing imagination scales, including the FFIS, do not measure the disposition toward conceptual innovation that seems to be important to the most general meaning of imagination. If the relations between imagination and its hypothesized subdimensions mirror

those between Openness/Intellect and its two aspects, there may be utility in designing a scale that captures this experiential-conceptual duality at the facet level. The goal of the present research was to develop and validate a scale of imagination that effectively captures not only the general tendency toward imagination but also variation in conceptual innovation and experiential simulation as two distinct subdimensions. Through this scale, this research intends to ground the measurement of imagination in existing personality theory in a manner that captures the hierarchical nature of Openness/Intellect. Our specific hypothesis was that, among items assessing the tendency to be imaginative, we would find a bifactor structure, with all items loading on a general imagination factor, but some being good indicators of a distinct conceptual innovation factor related to Intellect and others being good indicators of a distinct experiential simulation factor related to Openness.

Study 1: Scale Development

Methods

Sample. An undergraduate sample was collected from the University of North Carolina Greensboro using the university's psychology research pool. The 210 participants (160 females) used in the present analyses were primarily young adults ($M = 18.95$ years old, $SD = 3.04$; 58.5% White, 33.5% African American). Participants provided informed consent, and the study was approved by the university's institutional review board.

Initial item selection and generation. In a pilot study by the senior author (CGD), scale items were selected from the International Personality Item Pool, a set of personality items in the public domain (IPIP; Goldberg, 1999). Items from the IPIP were selected if they were judged by the senior author to describe imagination generally, including behaviors or tendencies related to either conceptual innovation or experiential simulation, and if they exhibited their strongest

correlation with either Openness or Intellect relative to the other aspects of the BFAS. These criteria yielded a set of 17 items. Preliminary factor analysis by the senior author using 404 participants (238 female) from the Eugene-Springfield Community Sample (ESCS; Goldberg, 1999) led to the removal of 5 items due to poor loadings on the first unrotated factor and semantic redundancy. In addition to the remaining 12 items from the IPIP, 47 items were created by the third author and the individuals listed in the acknowledgements. These new items were written to describe imagination and related phenomena very generally (following best practices for scale construction, which include starting with an over-inclusive item pool; Clark & Watson, 2019), as well as conceptual innovation and experiential simulation more specifically.

Analyses. Exploratory factor analysis was performed on the set of 59 items followed by Direct Schmid-Leiman (DSL) transformation using the BiFAD function from the fungible package in R version 3.6.2 (R Core Team, 2018; Waller, 2018; Waller, 2019). The use of the DSL transformation was applicable for the present analysis for several reasons. The DSL transformation tends to perform better than a conventional Schmid-Leiman solution (Schmid & Leiman, 1957) by generating a loadings matrix with a smaller RMSR when compared to bifactor solutions from simulated data with a known population factor structure. The use of a DSL transformation is also desirable on account of the fact that this method can approximate bifactor solutions through the use of a target matrix when only the pattern, but not sizes, of associations of the factor loadings are hypothesized. Additionally, the DSL transformation produces a unique solution and has been demonstrated to be the best method for recovering a hierarchical bifactor solution among many competing methods across a range of sample sizes (Giordano & Waller, 2020; Waller, 2018).

For two group factors corresponding to experiential simulation and conceptual innovation, a factor loadings matrix was extracted using the unweighted least squares criteria and standardized using Kaiser's method. Factors were then rotated using the oblique geominQ rotation algorithm, using 100 random starts to prevent convergence on local minima (Hattori et al., 2017). Salient loadings were defined as values greater than or equal to .2 in magnitude and were dichotomized in order to create an empirically generated target matrix of signed ones and zeros, representative of the hypothesized pattern of loadings on the group factors. A vector of ones was appended to this matrix to represent the hypothesized loadings on the general factor and a vector of zeroes was appended to the loadings matrix. The loadings matrix was then rotated to the empirically generated target matrix using an orthogonal Procrustes rotation to generate a DSL solution (Waller, 2018). Items that described a lack of imagination were reverse coded for ease of interpretation of factor loadings.

Results

The factor analysis showed a strong general factor as well as two group factors clearly reflecting the distinction between experiential simulation and conceptual innovation. The empirically defined target matrix and DSL factor loadings matrix using all 59 items are reported in the supplementary material. In order to construct the Dual Facet Imagination Scale (DFIS), 14 items were removed due to lack of significant loadings on the general factor or for being inadequately explicit in describing imagination (e.g. "I rarely use metaphors," "I experience others' emotions as if they are my own"), and the analyses were repeated with the smaller item pool. To reach a reasonable scale length, 25 additional experiential simulation items were removed for exhibiting comparatively small loadings on the group factor or for inadequately describing experiential simulation (e.g. "My imagination feels limitless," "I have an imagination

that stretches beyond that of my friends”). Finally, an additional 4 conceptual innovation items exhibiting comparatively small loadings on the group factor were removed to achieve an equal number of items indexing experiential simulation and conceptual innovation. Exploratory factor analyses followed by DSL transformations were then conducted again with the remaining 16 items using the same specifications described previously. The items utilized a 5-point Likert scale ranging from “strongly disagree” to “strongly agree.” Summary statistics and measures of reliability for the DFIS and its subscales are reported in Table 1. The empirically defined target matrix and DSL factor loadings matrix are reported in Table 2 (See Table 5 for item text).

Study 2: Structural Replication

To validate the factor structure derived from the first sample, the scale items were tested in a second sample.

Methods

Sample. The 16 scale items identified in the first study were sampled from data collected through the Synthetic Aperture Personality Assessment project (SAPA; <https://sapa-project.org/>). SAPA utilizes a planned missingness design called Massively Missing Completely at Random (MMCAR) to estimate covariance structures with up to a 99% level of missingness (Revelle et al., 2016; Revelle et al., 2021). The present study used a subset of responses collected from 6895 participants. The final sample of 5771 individuals (4069 females) ranged from 11 to 90 years old ($M = 21.57$, $SD = 8.02$) and reported English as their native language or spoke English fluently. Participants in this sample represented a wide range of educational attainment and countries of origin. Correlations and confidence intervals among each of the 16 scale items, as well as their pairwise administration counts are described in the supplementary material.

Analyses. Exploratory factor analysis of the 16 scale items, followed by the application of the DSL transformation, was conducted using the BiFAD function. Again, two group factors were specified, for experiential simulation and conceptual innovation. The item labels assigned in the first study were used in this sample to assist in determining factor loading correspondence across samples. Since the target matrix for the DSL transformation is intended to represent a known bifactor structure or an approximation of the true relationship between factors, the DSL loadings matrix from the first study was used as the target matrix for the present sample. The use of the loadings matrix from a previous sample provides a more rigorous test of replication than generating a target matrix empirically from the new sample and also facilitates the comparison of loadings across samples. The same specifications for the BiFAD function were utilized in this sample, including a salient loading threshold of .2, unweighted least squares factor extraction, Kaiser standardization, and a geominQ oblique rotation with 100 random starts to prevent the convergence on local minima.

Results. Cronbach's alpha and ω_t measures of reliability for the DFIS are reported in Table 1. The DSL loadings matrix produced after rotating toward the previous study's loadings is shown in Table 3. The RMSR value comparing solutions across samples was .05, indicating good fit between factor structures across samples. Tucker's congruence coefficients denoting factor similarity across samples are reported in Table 4. Items exhibited similar patterns and magnitudes of loadings across samples. Considering the possible role of sample size in the precision of the empirically derived target matrix, we repeated the analyses using loadings derived in Sample 2 as the target matrix for Sample 1. Altering the order of the samples did not produce appreciable differences in the overall pattern and magnitude of loadings. Items were

assigned to Conceptual Innovation and Experiential Simulation subscales according to their loadings on the group factors. DFIS items and subscale assignments are reported in Table 5.

Study 3: Personality Taxonomy and Discriminant Validity

To assess the location of the DFIS in the personality hierarchy and the discriminant validity of its subscales, we computed correlations with various measures of Openness/Intellect and its facets. We expected to find that all three DFIS scores would be strongly correlated with total Openness/Intellect scores, but that Conceptual Innovation would correlate more strongly with the Intellect aspect (and its constituent facets) than with Openness, whereas Experiential Simulation would correlate more strongly with the Openness aspect (and its constituent facets) than with Intellect. Further, given evidence that positive schizotypy or psychoticism may be understood as a pathological variant of Openness specifically (and not Intellect) (DeYoung et al., 2012, 2016; Straub & Kerns, 2020), we expected that Experiential Simulation would be more strongly associated than Conceptual Innovation with features of schizotypy and involuntary sensory experiences.

Methods

Sample. The present study used the same samples described in Studies 1 and 2.

Measures. In addition to the DFIS, Sample 1 completed Openness/Intellect scales from the BFAS, the HEXACO-100 (Lee & Ashton, 2004), the NEO PI-3 (McCrae et al., 2005), and the Openness to Experience Scale (Woo et al., 2014a). Additionally, Sample 1 completed the Wisconsin Schizotypy Scales, which assess four facets of positive and negative schizotypy: Magical Ideation, Perceptual Aberration, and Physical and Social Anhedonia (Kwapil et al., 2008), as well as the Involuntary Musical Imagery Scales (IMIS; Floridou et al., 2015). Involuntary musical imagery (INMI) refers to the spontaneous, involuntary repetition of

particular selections of music, phrases, or rhythms in one's mind, known as "earworms." We assessed associations between the DFIS and a variety of features of INMI, including the frequency and duration of experiences of INMI, and the length of the section of music experienced as INMI. We also assessed individual differences in negative evaluation, physical movement, perceived usefulness, and personal responses to the INMI experience.

Sample 2 completed Openness/Intellect scales from the BFAS, the IPIP-HEXACO (Ashton et al., 2007), the Openness to Experience Scale (Woo et al., 2014), and the 135 item version of the SAPA Personality Inventory (SPI; Condon, 2017). To address the MMCAR data structure from the second sample, scale scores were computed using the `scoreItem` function from the `psych` package in R (Revelle, 2021).

Analyses. For Sample 1, we assessed the significance of the difference in magnitude of the correlations of each DFIS dimension with each of the other measures, controlling for the association between Experiential Simulation and Conceptual Innovation using William's test through the `r.test` function from the `psych` package in R (Revelle, 2021). In Sample 2, to compare associations while addressing the methodological complications of different sample sizes for each correlation incurred by the MMCAR design, we computed bootstrapped 95% confidence intervals of the correlation of each Openness/Intellect scale with the Experiential Simulation, Conceptual Innovation, and General Imagination scores. In both samples, we also compared the strength of association of the Openness and Intellect scales from the BFAS with each of the DFIS subscales.

Results. Cronbach's alpha and ω_t measures of reliability for each Openness/Intellect scale are reported in Table 1. Correlations of DFIS scales with Openness/Intellect and its facets in Sample 1 are reported in Table 6, and correlations in Sample 2 are reported in Table 7. In

Sample 1, consistent with the hypothesized structure of imagination and its relation to the Big Five hierarchy, Conceptual Innovation was more strongly associated than Experiential Simulation with components of Openness/Intellect associated with engagement with new ideas, including BFAS Intellect, the Ideas and Actions facets of the NEO-PI-3, and the Intellectual Efficiency, Curiosity, and Ingenuity facets from the Openness to Experience Scale. Experiential Simulation was more strongly associated than Conceptual Innovation with the Fantasy and Feelings facets of the NEO-PI-3. Further, when controlling for the association between BFAS Openness and Intellect, Experiential Simulation was significantly more strongly associated with Openness than Intellect ($t_{207} = -2.92, p = .003$), and Conceptual Innovation was significantly more strongly associated with Intellect than Openness ($t_{207} = 4.37, p < .001$).

Similar associations were found in Sample 2, where Conceptual Innovation was more strongly associated than Experiential Simulation with Intellect scores in both the BFAS and SPI, as well similar facets in the Openness to Experience Scale like Intellectual Efficiency, Curiosity, and Ingenuity. Further, Conceptual Innovation exhibited particularly strong correlations with the Creativity facets of both the IPIP-HEXACO and the SPI. As hypothesized, Experiential Simulation was more strongly associated with BFAS Openness than with BFAS Intellect, and Conceptual Innovation was more strongly associated with Intellect than with Openness. However, unexpectedly, BFAS Openness was more strongly associated with Conceptual Innovation than with Experiential Simulation.

Associations of imagination subscales with measures of schizotypy and INMI are reported in Table 8. Experiential Simulation was positively associated with Magical Ideation, Perceptual Aberration, and Social Anhedonia, and these associations were significantly greater than those for Conceptual Innovation. Additionally, both subscales were positively associated

with movement during INMI experiences, as well as the perceived utility of these experiences. Experiential Simulation was also weakly positively associated with both the frequency and duration of INMI experiences, whereas the Conceptual Innovation associations with these variables were near zero (nonetheless, they did not differ significantly in magnitude from the ES associations).

General Discussion

The present research attempted to create and validate a trait scale of imagination that distinguishes between experiential and conceptual forms of imagination as facet-level markers of the Big Five trait Openness/Intellect and its two distinct aspects, Openness and Intellect. Imagination has long been considered a central facet of Openness/Intellect (e.g., Saucier & Ostendorf, 1999), and we suggest that it can be fractionated further, into two subfacets of experiential simulation and conceptual innovation. A replicable factor structure across two large samples provides evidence for a meaningful distinction between these two forms of imagination, while also showing that they share considerable variance as manifestations of a general imaginative tendency. The replicable association between general imagination scores and domain level measures of Openness/Intellect provides further support of the notion of imagination as a core facet of Openness/Intellect (DeYoung et al., 2012; Schwaba et al., 2020).

Additionally, analyses of discriminant validity provides evidence supporting the theoretical distinction between experiential simulation and conceptual innovation as unique forms of a larger dimension of imagination. In both samples, Experiential Simulation was more strongly associated with BFAS Openness than with BFAS Intellect, and Conceptual Innovation was more strongly associated with BFAS Intellect than with BFAS Openness, which is consistent with the initial source of inspiration for the conceptual distinction between the two

subscales. Results from Sample 1 showed clear discriminant associations of Experiential Simulation with facets subsumed within the Openness aspect, including Fantasy and Feelings, as well as discriminant associations of Conceptual Innovation with the Intellect aspect and related facets like Creativity, Curiosity, Ingenuity, and Intellectual Efficiency. Across samples, the preferential associations of Intellect and related facets with Conceptual Innovation were more pronounced, whereas the associations of Openness with the two dimensions of imagination were more similar in magnitude. Although the similarity of these correlations may be indicative of a potential lack of discriminant validity for Experiential Simulation and Conceptual Innovation in relation to Openness, nonetheless some facets considered components of the Openness aspect were more strongly linked to Experiential Simulation than Conceptual Innovation, and this included features of positive schizotypy. Magical ideation and perceptual aberration have both been demonstrated as good markers of Openness (DeYoung et al., 2012, 2016).

Preferential associations of Experiential Simulation with features of INMI involving involuntary internal auditory experiences were also consistent with this pattern. Many aspects of musical imagery have been consistently associated with Openness/Intellect, especially Openness facets such as Fantasy and Aesthetics (Liikkanen & Jakubowski, 2020; Beaty et al., 2013; Cotter et al., 2016). It may be the case that the item content of Experiential Simulation makes it more similar to relatively extreme forms of Openness, like fantasy proneness or positive schizotypy, compared to more typical measures of Openness that focus on aesthetic and artistic appreciation (Blain et al., 2020a; DeYoung et al., 2012). At any rate, these associations provide support for discriminant validity between Experiential Simulation and Conceptual Innovation. To the degree that the two subscales are similarly strongly associated with Openness facets related to

aesthetics, we view this as a potentially interesting discovery, rather than evidence of a weakness of the DFIS.

By grounding imagination in the conceptual and empirical structure of the personality hierarchy, the DFIS provides opportunities for future research to explore associations between individual differences in imagination and other constructs that have demonstrated associations with Openness/Intellect and its aspects, including divergent thinking, creative achievement, semantic memory, and intelligence, as well as constructs in other domains that are likely to involve imaginative processes, such as empathy and theory of mind (Allen et al., 2017; Christensen et al., 2018; DeYoung et al., 2012; Kaufman et al., 2016; Puryear et al., 2017; Silvia, 2008; Woo et al., 2014b). It may also be useful for investigating neural processes involved in imagination. Neuroimaging research has demonstrated differences between the neural substrates of Intellect and Openness, with Intellect sharing correlates with IQ and Openness sharing correlates with proneness to psychosis (Blain et al., 2020b; DeYoung et al., 2009; DeYoung, 2015b; Grazioplene et al., 2016). It seems highly likely that different neural processes are involved in experiential simulation and conceptual innovation. The brain's default network is a strong candidate as the basis of individual differences in experiential simulation (Abraham, 2016; Andrews-Hanna et al., 2014), while the neural roots of conceptual innovation are more uncertain.

Although this research provides an initial exploration of a scale that characterizes imagination as a facet of Openness/Intellect, we did not compare our scale to other measures of imagination. This limitation invites further investigation into the nomological network of the DFIS. Additionally, our findings would benefit from additional replication to clarify the degree of differential association of experiential simulation and conceptual innovation with Openness

and related constructs. Test-retest reliability would also be good to assess. Despite these remaining questions, this scale provides a more nuanced specification than previous scales of a central facet of Openness/Intellect and offers potential new avenues for future research to integrate the literatures on imagination and personality, as well as providing a tool to investigate the distinction between more conceptual and more experiential forms of imagination.

Another potential limitation of the scale is that it does not capture all phenomena related to imagination that are assessed by other measures. In the FFIS, for example, the Frequency and Complexity scales contain similar content to our Conceptual Innovation subscale, but its other two scales do not have clear counterparts in our scale. We would argue, however, that the Emotional Valence and Directedness scales from the FFIS are not measuring the disposition to imagination per se, but rather qualities of imagination that may vary no matter how prone one is to imagination in the first place. In support of this conclusion, we note that Emotional Valence (with items like, “I become depressed when imagining my future”) was associated with Neuroticism rather than Openness/Intellect and that Directedness (with items like, “My daydreams have a clear goal”) converges with Conscientiousness as much as with Openness/Intellect. This is by no means a weakness of the FFIS, but it indicates a different measurement goal. The purpose of our new scale is simply to measure the general disposition toward imagination, in a way consistent with its location in the Big Five.

Conclusion

The primary aim of the current study was to develop and validate a trait measure of imagination that reflects the hierarchical nature of the Big Five trait Openness/Intellect with its two aspects (DeYoung et al., 2007; DeYoung, 2015b). The proposed model of imagination included two lower-order dimensions, *conceptual innovation* and *experiential simulation*,

reflecting unique variation in imagination that are conceptually related to the aspect-level traits Intellect and Openness, respectively. Factor solutions across two large samples using this imagination scale indicated good recovery of the hypothesized structure. Associations with measures of the Openness and Intellect aspects provided evidence of discriminant validity. The DFIS provides a way to study imagination as a disposition, taking into account two distinct, but related, forms of imagination.

Acknowledgements

We would like to thank Paul Silvia, Katherine Cotter, Scott Barry Kaufman, and Spencer Greenberg for their involvement in the generation of items used in this scale. We also thank Edward Chou for his feedback on this manuscript.

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Table 1

Descriptive statistics for the Dual Facet Imagination Scale as well as other Openness/Intellect and Imagination Scales

	<i>M</i> (<i>SD</i>)	Skew	Range	Cronbach's α	ω_t
Sample 1					
DFIS General Imagination	3.64(.49)	.04	3.06	.86	.90
DFIS Experiential Simulation	3.69(.61)	-.15	3.13	.84	.87
DFIS Conceptual Innovation	3.60(.60)	-.19	3.13	.88	.91
BFAS Openness/Intellect	3.47(.42)	-.17	2.65	.78	.82
Openness	3.63(.54)	-.15	3.40	.71	.78
Intellect	3.30(.51)	-.15	2.50	.76	.80
NEO-PI-3 Openness to Experience	3.42(.38)	.46	2.04	.87	.89
Fantasy	3.48(.54)	-.06	3.75	.66	.75
Aesthetics	3.40(.74)	-.08	3.50	.81	.88
Feelings	3.73(.53)	-.03	2.88	.70	.78
Actions	3.07(.48)	.20	3.13	.61	.72
Ideas	3.39(.58)	-.04	3.25	.72	.82
Values	3.49(.56)	.22	2.50	.70	.76
HEXACO-100 Openness to Experience	3.07(.55)	-.11	3.06	.80	.83
Aesthetic Appreciation	3.11(.84)	-.27	3.50	.64	.67
Inquisitiveness	2.51(.76)	.08	3.25	.60	.61
Creativity	3.32(.81)	-.18	4.00	.71	.74
Unconventionality	3.35(.57)	-.01	3.25	.50	.57
Woo et al. (2014) Openness to Experience	3.38(.37)	.35	2.37	.90	.91
Aesthetics	3.27(.79)	-.10	3.89	.87	.90
Curiosity	3.65(.49)	-.34	2.89	.72	.78
Depth	3.38(.46)	.38	2.78	.63	.74
Intellectual Efficiency	2.96(.60)	.04	3.56	.80	.85
Ingenuity	3.38(.52)	.03	3.22	.74	.80
Tolerance	3.67(.50)	-.16	2.78	.71	.78
Sample 2					
DFIS General Imagination				.86	.91
DFIS Experiential Simulation				.84	.88
DFIS Conceptual Innovation				.89	.92
BFAS Openness/Intellect				.78	.83
Openness				.60	.73
Intellect				.80	.84
IPIP-HEXACO Openness to Experience				.85	.87
Aesthetic Appreciation				.63	.71
Inquisitiveness				.69	.77
Creativity				.74	.84
Unconventionality				.67	.76

Woo et al. (2014) Openness to Experience	.88	.91
Aesthetics	.83	.87
Curiosity	.64	.71
Depth	.49	.75
Intellectual Efficiency	.81	.85
Ingenuity	.79	.82
Tolerance	.47	.56
SPI-135 Openness	.76	.75
Intellect	.78	.83
Creativity	.74	.79
Art Appreciation	.70	.78
Introspection	.64	.72

Note. BFAS = Big Five Aspect Scales. NEO-PI-3 = NEO Personality Inventory-3. IPIP = International Personality Item Pool. SPI = SAPA Personality Inventory. Sample 1 $N = 210$, Sample 2 $N = 5771$. The planned missingness design of Sample 2 prevents the calculation of scale-level descriptive statistics. Sample 2 Cronbach's α values were calculated using the `scoreItems` function from the *psych* package in R.

Table 2

Sample 1 empirically generated target matrix and rotated Direct Schmid-Leiman loadings matrix

Item	Target Matrix			DSL Loadings		
	I	ES	CI	I	ES	CI
1	1	1	0	.45	.43	.03
2	1	1	0	.48	.39	.09
3	1	1	0	.35	.50	-.15
4	1	1	0	.37	.36	.01
5	1	1	0	.51	.54	-.02
6	1	1	0	.42	.57	-.16
7	1	1	0	.34	.40	-.06
8	1	1	0	.47	.49	-.02
9	1	0	1	.45	-.05	.50
10	1	0	1	.48	-.01	.49
11	1	0	1	.54	-.08	.62
12	1	0	1	.47	.04	.44
13	1	0	1	.51	-.04	.55
14	1	0	1	.39	-.01	.40
15	1	0	1	.50	-.02	.53
16	1	0	1	.42	-.12	.53

Note. I = general factor of imagination, CI = Conceptual Innovation, ES = Experiential Simulation. Salient DSL loadings ($\geq .20$) shown in bold.

Table 3*Sample 2 target matrix and rotated Direct Schmid-Leiman loadings matrix*

Item	Target Matrix (Sample 1)			DSL Loadings		
	I	ES	CI	I	ES	CI
1	.45	.43	.03	.46	.54	-.08
2	.48	.39	.09	.44	.43	.01
3	.35	.50	-.15	.40	.55	-.15
4	.37	.36	.01	.43	.41	.03
5	.51	.54	-.02	.48	.42	.05
6	.42	.57	-.16	.44	.59	-.15
7	.34	.40	-.06	.34	.47	-.13
8	.47	.49	-.02	.39	.45	-.06
9	.45	-.05	.50	.44	-.09	.53
10	.48	-.01	.49	.44	-.01	.46
11	.54	-.08	.62	.58	-.02	.61
12	.47	.04	.44	.50	.03	.48
13	.51	-.04	.55	.51	-.07	.57
14	.39	-.01	.40	.34	-.09	.43
15	.50	-.02	.53	.49	-.12	.61
16	.42	-.12	.53	.50	-.09	.59

Note. I = general factor of imagination, CI = Conceptual Innovation, ES = Experiential Simulation. Salient DSL loadings ($\geq .20$) shown in bold.

Table 4*Tucker's congruence coefficients of Dual Facet Imagination Scale subscale factors*

Subscale	General Imagination	Conceptual Innovation	Experiential Simulation
General Imagination	.99	.66	.56
Conceptual Innovation	.69	.99	-.20
Experiential Simulation	.59	-.20	.98

Note. Rows = Sample 1, Columns = Sample 2

Table 5*Dual Facet Imagination Scale items and subscale assignments*

Item Label	Subscale	Items
1	ES	"I spend a lot of time imagining different experiences."
2	ES	"I'm good at imagining strong sensations as if they were actually happening."
3	ES	"I daydream about experiences I've never had."
4	ES	"When I imagine something, it feels almost as real as reality."
5	ES	"My fantasies are rich in detail."
6	ES	"I have many fantasies."
7	ES	"I daydream when I get bored."
8	ES	"I enjoy wild flights of fantasy."
9	CI	"I like to come up with new ways to solve problems."
10	CI	"I'm good at linking different ideas together."
11	CI	"I have lots of new ideas."
12	CI	"Ideas frequently pop into my head."
13	CI	"I like coming up with new ideas."
14	CI	"I often think of how old ideas can be improved."
15	CI	"I quickly think up new ideas."
16	CI	"I am able to come up with new and different ideas."

Note. ES = Experiential Simulation, CI = Conceptual Innovation. We recommend administering the DFIS with a 5-point Likert scale ranging from Strongly Disagree to Strongly Agree and using item averages to compute scale scores. General Imagination scores can be created by averaging ES and CI scores.

Table 6

Product-moment correlations of Dual Facet Imagination Scale and Openness scale scores in Sample 1

Variable	General Imagination	Experiential Simulation	Conceptual Innovation	William's test
DFIS General Imagination	1			
DFIS Experiential Simulation	.82*	1		
DFIS Conceptual Innovation	.81*	.32*	1	
BFAS Openness/Intellect	.49*	.26*	.53*	$t_{207} = -3.88, p < .001$
Intellect	.41*	.09	.58*	$t_{207} = -7.37, p < .001$
Openness	.38	.32*	.28*	$t_{207} = .53, p = .60$
NEO-PI-3 Openness to Experience	.41*	.33*	.33*	$t_{207} = .00, p = 1$
Fantasy	.33*	.48*	.06	$t_{207} = 5.90, p < .001$
Aesthetics	.38*	.31*	.31*	$t_{207} = .00, p = 1$
Feelings	.29*	.32*	.15*	$t_{207} = 2.21, p = .03$
Actions	.13	-.04	.25*	$t_{207} = -3.72, p < .001$
Ideas	.37*	.12	.48*	$t_{207} = -5.02, p < .001$
Values	.05	.06	.02	$t_{207} = .49, p = .62$
HEXACO-100 Openness to Experience	.35*	.16*	.41*	$t_{207} = -3.36, p < .001$
Aesthetic Appreciation	.26*	.13	.29*	$t_{207} = -2.06, p = .04$
Inquisitiveness	.02	-.06	.10	$t_{207} = -1.99, p = .05$
Creativity	.43*	.22*	.49*	$t_{207} = -3.78, p < .001$
Unconventionality	.32*	.20*	.32*	$t_{207} = -1.56, p = .12$
Woo et al. (2014) Openness to Experience	.44*	.19*	.53*	$t_{207} = -4.87, p < .001$
Aesthetics	.30*	.25*	.24*	$t_{207} = .14, p = .90$
Curiosity	.30*	.09	.41*	$t_{207} = -4.31, p < .001$
Depth	.27*	.18*	.27*	$t_{207} = -1.15, p = .25$
Intellectual Efficiency	.19*	-.07	.38*	$t_{207} = -6.14, p < .001$
Ingenuity	.50*	.18*	.64*	$t_{207} = -7.21, p < .001$
Tolerance	.21*	.11	.24*	$t_{207} = -1.65, p = .10$

Note. $N = 210$. * $p < .05$. BFAS = Big Five Aspect Scales. NEO-PI-3 = NEO Personality Inventory-3. William's test results denote the difference in magnitude of the correlation of each Openness scale with Experiential Simulation and Conceptual Innovation, controlling for the correlation between Experiential Simulation and Conceptual Innovation.

Table 7

Product-moment correlations of Dual Facet Imagination Scale and Openness scale scores in Sample 2

Variable	General Imagination	Experiential Simulation	Conceptual Innovation
DFIS General Imagination	1		
DFIS Experiential Simulation	.67 [.65, .70]	1	
DFIS Conceptual Innovation	.73 [.70, .75]	.27 [.21, .32]	1
BFAS Openness/Intellect	.57 [.53, .61]	.23 [.18, .28]	.66 [.62, .69]
Intellect	.48 [.44, .52]	.10 [.04, .15]	.65 [.61, .68]
Openness	.46 [.42, .50]	.31 [.26, .36]	.43 [.37, .47]
IPIP-HEXACO Openness	.66 [.62, .68]	.34 [.28, .39]	.69 [.65, .71]
Aesthetic Appreciation	.41 [.36, .45]	.28 [.23, .33]	.37 [.31, .41]
Inquisitiveness	.42 [.37, .46]	.14 [.07, .20]	.52 [.47, .55]
Creativity	.74 [.71, .77]	.37 [.33, .42]	.79 [.76, .82]
Unconventionality	.35 [.29, .39]	.21 [.14, .26]	.34 [.29, .39]
Woo et al. (2014) Openness to Experience	.59 [.56, .62]	.22 [.17, .27]	.70 [.67, .73]
Aesthetics	.38 [.33, .43]	.25 [.20, .31]	.34 [.29, .39]
Curiosity	.51 [.46, .55]	.17 [.11, .23]	.62 [.57, .66]
Depth	.28 [.22, .34]	.14 [.08, .21]	.30 [.25, .36]
Intellectual Efficiency	.32 [.27, .36]	.02 [-.03, .08]	.46 [.43, .50]
Ingenuity	.62 [.59, .65]	.18 [.13, .23]	.78 [.76, .81]
Tolerance	.30 [.23, .36]	.15 [.08, .22]	.32 [.26, .37]
SPI-135 Openness	.76 [.73, .78]	.41 [.37, .45]	.78 [.76, .80]
Intellect	.41 [.37, .45]	.08 [.03, .13]	.56 [.52, .59]
Creativity	.77 [.75, .79]	.38 [.34, .43]	.83 [.81, .85]
Art Appreciation	.34 [.29, .38]	.22 [.16, .26]	.32 [.27, .36]
Introspection	.52 [.48, .57]	.40 [.35, .45]	.43 [.38, .48]

Note. $N = 5771$. Values in brackets are bootstrapped 95% confidence intervals. Bootstrapped confidence intervals were used to account for the planned missingness design of Sample 2.

BFAS = Big Five Aspect Scales. IPIP = International Personality Item Pool. SPI = SAPA Personality Inventory. Correlations and confidence intervals were calculated using the `scoreItems` and `corCI` functions from the *psych* package in R.

Table 8

Product-moment correlations of Dual Facet Imagination Scale and additional scale scores in Sample 1

Variable	General Imagination	Experiential Simulation	Conceptual Innovation	William's test
WSS-S Magical Ideation	.30*	.34*	.15*	$t_{207} = 2.48, p = .01$
WSS-S Perceptual Aberration	.17*	.23*	.04	$t_{207} = 2.41, p = .02$
WSS-S Physical Anhedonia	-.07	.01	-.12	$t_{207} = 1.62, p = .11$
WSS-S Social Anhedonia	.08	.16*	-.04	$t_{207} = 2.51, p = .01$
IMIS Negative Valence	-.04	.00	-.07	$t_{207} = .87, p = .39$
IMIS Movement	.29*	.31*	.16*	$t_{207} = 1.94, p = .05$
IMIS Personal Reflection	.08	.11	.01	$t_{207} = 1.24, p = .22$
IMIS Help	.24*	.14*	.25*	$t_{207} = -1.40, p = .16$
INMI Duration	.11	.15*	.03	$t_{207} = 1.50, p = .14$
INMI Frequency	.16*	.19*	.07	$t_{207} = 1.51, p = .13$
INMI Section	.00	-.02	.02	$t_{207} = -.49, p = .62$

Note. $N = 210$. * $p < .05$. WSS-S = Wisconsin Schizotypy Scales – Short Form. IMIS = Involuntary Musical Imagery Scales. INMI = Involuntary Musical Imagery. William's test results denote the difference in magnitude of the correlation of each scale measure with Experiential Simulation and Conceptual Innovation, controlling for the correlation between Experiential Simulation and Conceptual Innovation.

Online Supplement

Table A1

Sample 1 empirically generated target matrix and rotated Direct Schmid-Leiman loadings matrix using all 59 items

Item	Target Matrix			DSL Loadings		
	I	ES	CI	I	ES	CI
"I have many fantasies."	1	1	0	.40	.57	-.14
"I love to daydream."	1	1	0	.38	.53	-.12
"I sometimes pretend I'm somewhere different than I really am."	1	1	-1	.30	.52	-.22
"I enjoy wild flights of fantasy."	1	1	0	.44	.50	-.01
"My fantasies are rich in detail."	1	1	0	.47	.49	.04
"I spend a lot of time imagining different experiences."	1	1	0	.44	.48	.02
"I daydream about experiences I've never had."	1	1	0	.33	.46	-.12
"I prefer imagination over reality."	1	1	-1	.25	.46	-.22
"I am often described as having my 'head in the clouds'."	1	1	0	.38	.46	-.04
"I'm known for 'zoning out'."	1	1	0	.28	.45	-.16
"I daydream when I get bored."	1	1	0	.34	.44	-.07
"People notice that I daydream a lot."	1	1	0	.28	.40	-.10
"When I close my eyes, I have rich inner experiences."	1	1	0	.40	.37	.10
"I'm good at imagining strong sensations as if they were actually happening."	1	1	1	.45	.37	.17
"I have an imagination that stretches beyond that of my friends."	1	1	1	.47	.36	.21
"I have a rich inner life within my mind."	1	1	0	.39	.35	.11
"When I imagine something, it feels almost as real as reality."	1	1	0	.36	.35	.06
"Music can take me to a different time or place."	1	1	0	.34	.35	.04
"I almost never fantasize about anything."	1	1	0	.35	.34	.07
"My imagination feels limitless."	1	1	1	.44	.34	.19
"I don't really enjoy fantasizing."	1	1	0	.37	.33	.10
"I'm more imaginative than the average person."	1	1	1	.50	.32	.29
"It's easy to entertain myself with just my thoughts."	1	1	0	.36	.30	.12
"I am sometimes full of thoughts, ideas, and images in my mind."	1	1	0	.37	.30	.14
"I have a vivid imagination."	1	1	1	.48	.29	.30
"I have a tendency to visualize things in my mind."	1	1	1	.41	.29	.20
"I spend a lot of time imagining new things."	1	1	1	.41	.29	.21
"When I imagine a scene, I can really see and hear it."	1	1	1	.38	.27	.19
"I experience others' emotions as if they are my own."	1	1	0	.27	.26	.05
"I can replay past events in detail when I have my eyes closed."	1	1	0	.30	.24	.12
"If I close my eyes, I can easily relive experiences I've had."	1	1	0	.28	.23	.10
"I rarely have fantasies that include intricate details."	1	1	0	.24	.21	.07
"People might say I'm a visionary."	1	1	1	.41	.20	.31
"I have lots of new ideas."	1	0	1	.44	-.04	.63

"I like coming up with new ideas."	1	0	1	.45	.00	.61
"I am able to come up with new and different ideas."	1	0	1	.36	-.08	.58
"I don't have a lot of new ideas."	1	0	1	.34	-.08	.55
"I quickly think up new ideas."	1	0	1	.42	.01	.55
"I'm good at linking different ideas together."	1	0	1	.45	.05	.54
"I like to come up with new ways to solve problems."	1	0	1	.35	-.01	.48
"I am an original thinker."	1	0	1	.31	-.04	.47
"Ideas frequently pop into my head."	1	0	1	.42	.09	.46
"I sometimes have trouble coming up with new ideas."	1	0	1	.28	-.04	.42
"New ideas are a lot of fun for me."	1	0	1	.35	.04	.42
"I often think of how old ideas can be improved."	1	0	1	.31	.03	.38
"I am not an innovator."	1	0	1	.27	.00	.37
"I do not have a good imagination."	1	1	1	.41	.18	.34
"I rarely experience sudden intuitive insights."	1	0	1	.23	.02	.28
"I can clearly see characters and places that I read about in books."	1	0	1	.34	.16	.28
"I have difficulty imagining things."	1	0	1	.30	.12	.26
"I come up with novel solutions."	1	0	1	.19	.04	.21
"I tend to include many details of the scene when telling a story."	1	1	1	.29	.16	.20
"I have a hard time imagining scenes I've never experienced before."	1	1	1	.29	.17	.18
"I have a hard time picturing scenes that aren't actually present."	1	0	1	.20	.08	.17
"I don't often form mental pictures in my mind."	1	0	1	.17	.06	.16
"I rarely use metaphors."	1	0	0	.15	.05	.14
"I invented imaginary worlds or friends as a kid."	1	1	0	.15	.17	.00
"I'm usually satisfied with already existing ideas."	1	0	0	.04	.05	-.01
"I don't usually 'play out' future events in my head."	1	1	0	.07	.18	-.12

Note. I = general factor of imagination, CI = Conceptual Innovation, ES = Experiential Simulation.
Salient DSL loadings ($\geq .20$) shown in bold.

Table A2*Sample 2 Imagination scale item correlations*

Item Label	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1															
2	.41	1														
3	.55	.43	1													
4	.38	.50	.39	1												
5	.45	.43	.32	.42	1											
6	.56	.34	.46	.40	.54	1										
7	.42	.38	.50	.32	.28	.41	1									
8	.38	.31	.43	.28	.37	.56	.34	1								
9	.20	.18	.05	.14	.18	.05	.03	.05	1							
10	.20	.17	.13	.14	.26	.09	.08	.17	.48	1						
11	.17	.25	.13	.27	.29	.16	.12	.18	.53	.50	1					
12	.16	.25	.16	.23	.28	.14	.18	.17	.42	.43	.65	1				
13	.12	.20	.03	.19	.24	.09	.12	.19	.59	.52	.65	.51	1			
14	.07	.15	.08	.16	.12	.00	-.08	.09	.49	.34	.45	.29	.40	1		
15	.16	.11	.04	.20	.23	.06	.01	.09	.52	.52	.66	.62	.54	.45	1	
16	.09	.18	.04	.19	.25	.12	.07	.11	.52	.48	.68	.54	.62	.41	.63	1

Table A3*Sample 2 Imagination scale item confidence intervals*

Item Label	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1	.49	.63	.47	.53	.64	.50	.46	.29	.30	.26	.25	.22	.14	.25	.15
2	.31	1	.51	.58	.52	.45	.47	.40	.28	.26	.33	.33	.30	.25	.18	.25
3	.46	.34	1	.47	.41	.56	.60	.52	.14	.22	.22	.25	.12	.16	.12	.10
4	.28	.41	.30	1	.51	.49	.40	.38	.23	.23	.36	.33	.27	.24	.29	.26
5	.35	.34	.24	.32	1	.62	.37	.48	.26	.35	.39	.37	.34	.19	.32	.31
6	.48	.24	.38	.31	.47	1	.49	.64	.16	.19	.26	.23	.20	.09	.17	.19
7	.32	.29	.43	.23	.20	.32	1	.44	.11	.17	.21	.28	.21	.00	.10	.13
8	.29	.21	.34	.18	.28	.50	.25	1	.14	.26	.26	.27	.28	.18	.19	.18
9	.11	.07	-.05	.06	.09	-.04	-.05	-.05	1	.56	.61	.49	.66	.55	.60	.58
10	.09	.06	.03	.05	.17	.00	.00	.08	.41	1	.57	.51	.58	.42	.60	.54
11	.06	.16	.03	.18	.21	.08	.05	.11	.46	.42	1	.70	.72	.53	.72	.73
12	.06	.16	.06	.14	.18	.07	.08	.08	.33	.34	.59	1	.58	.38	.68	.59
13	.01	.10	-.07	.11	.13	-.01	.03	.10	.51	.44	.59	.43	1	.49	.60	.66
14	.00	.07	-.01	.08	.04	-.09	-.15	-.01	.40	.25	.36	.20	.32	1	.52	.48
15	.07	.03	-.05	.11	.15	-.04	-.09	-.02	.44	.43	.58	.55	.47	.37	1	.69
16	.04	.11	-.03	.13	.20	.06	.01	.04	.46	.42	.63	.49	.58	.33	.58	1

Note. Lower triangle = bootstrapped 95% confidence interval lower bound, upper triangle = bootstrapped 95% confidence interval upper bound. Bootstrapped confidence intervals were used to account for the MMCAR design of Sample 2.

Table A4*Sample 2 Imagination scale item pairwise administration counts*

Item Label	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1447															
2	572	1459														
3	563	554	1443													
4	536	539	556	1454												
5	554	566	542	556	1458											
6	526	559	535	546	550	1396										
7	521	538	513	511	549	510	1410									
8	551	560	552	544	556	538	538	1451								
9	534	550	545	554	558	528	548	548	1423							
10	532	556	554	529	550	537	547	547	564	1430						
11	542	547	520	551	548	529	537	539	530	546	1427					
12	537	544	541	524	545	507	532	561	524	536	529	1425				
13	544	533	536	551	525	502	494	562	538	511	531	555	1397			
14	528	542	523	532	547	538	519	532	543	536	514	503	516	1415		
15	520	516	518	527	510	513	521	510	530	517	507	530	523	500	1378	
16	1003	1009	1011	1015	992	989	980	1019	1023	972	985	986	973	968	951	2808

Note. $N = 5771$. Entries on the diagonal represent the number of participants who completed that item. Entries below the diagonal represent the number of participants who completed both items in that pair.