Why are smart people curious? Fluid intelligence, openness to experience, and interest.

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Paul J. Silvia & Camilla Sanders (2010). Why are smart people curious? Fluid intelligence, openness to experience, and interest. *Learning and Individual Differences, 20(3),* 242–245.

Abstract:

The experience of interest is central to intrinsic motivation for learning, so it is important to understand the nature of interest and its sources. Individual differences in fluid intelligence (Gf) predict finding things more interesting, but it is possible that this effect is merely due to the overlap of Gf with openness to experience, a strong predictor of interest across many domains. The present research measured Gf, the Big Five traits, and the interestingness of contemporary poems and visual art. Latent variable models found that Gf predicted interest in both poems and pictures, even when openness and gender were included as predictors. Moreover, Gf and openness did not interact, indicating main effects rather than joint effects. The relationship between Gf and interest thus appears robust.

Keywords: interest | fluid intelligence | openness to experience | learning motivation | personality | psychology

Article:

The experience of interest is fundamental to intrinsically motivated learning. Interest motivates seeking knowledge for its own sake, so it has been a central concept in the study of learning motivation since the time of the field's early theorists (e.g., Arnold, 1910 and Dewey, 1913). Contemporary educational research has shown widespread effects of interest on several aspects of learning (see Silvia, 2006, for a review). In the domain of reading, for example, people who find a text interesting use deeper processing strategies; as a result, they connect the material more thoroughly to other knowledge and thus remember it better (Sadoski & Paivio, 2001 and Schiefele, 1999). Similarly, college students get higher grades in courses they find interesting (Schiefele, Krapp, & Winteler, 1992), in part because they use deeper study strategies for interesting courses than for boring courses (Krapp, 1999).

Many researchers have searched for individual differences in the tendency to find things interesting. Openness to experience (McCrae, 1994) and trait curiosity (Kashdan, 2004) are the

most straightforward ones; many studies show that people high in openness and trait curiosity find things more interesting (Kashdan & Steger, 2007 and Silvia, 2008b). Other individual differences include domain knowledge (Alexander et al., 1994 and Durik & Matarazzo, 2009) and a stable interest (sometimes known as personal interest or individual interest) in the topic (Renninger, 1992, Renninger, 2000 and Schiefele & Krapp, 1996).

In the present research, we consider the role of fluid intelligence (Gf)—the ability to solve novel problems, particularly those requiring deductive and inductive reasoning (McGrew, 2005)—in the experience of interest. Gf has received relatively little attention in the study of interest and learning; this is surprising, given the obvious role of traits related to reasoning and executive processes in educational outcomes. Nevertheless, several studies have found that Gf predicts finding things interesting, based on both self-reported interest and behavioral measures of exploration (Coie, 1974, Langevin, 1971, Maw, 1971 and Maw & Maw, 1970), so this relationship is worth examining in more detail.

Why might Gf predict interest? Past work, for the most part, has been exploratory—to date, there is little theoretical guidance for why people high in Gf would be more likely to find things interesting. One likely possibility, based on recent research on personality and intelligence (Chamorro-Premuzic & Furnham, 2006), is that Gf overlaps with openness to experience. Many studies have found that people high in openness find a wide range of things more interesting, particularly things that are new, complex, or unconventional (see Feist & Brady, 2004 and Silvia, 2006). Of the five factors in the Big Five, openness to experience has the strongest positive correlations with Gf (Ashton et al., 2000, DeYoung et al., 2005 and Moutafi et al., 2006), and several structural models emphasize this link. In Ackerman's (1996) PPIK model of individual differences, for example, openness to experience falls within the same trait complex as crystallized intelligence and ideational fluency, which overlaps with the trait complex associated with Gf. In DeYoung's model of personality structure, openness to experience and intelligence are facets in a broader Openness/Intellect factor (DeYoung, 2006 and DeYoung et al., 2009). Given their consistent covariance, it is worth taking seriously the possibility that the effects of Gf on interest are due to the “third variable” of openness to experience.

The present research thus examined the unique roles of Gf and openness to experience on interest. To do so, we presented young adults with material from two domains: the verbal domain of contemporary poems and the visual domain of visual art. People were asked to rate how interesting they found each poem and picture. Most interest research typically explores the interestingness of only one domain; including two domains allowed us to appraise the generality

of the effects. Measures of Gf and personality traits were collected to examine the influence of these individual differences on the experience of interest.

1. Method

1.1. Participants

A total of 135 people enrolled in General Psychology participated and received credit toward a research option. Six non-native speakers of English were excluded, leaving a final sample of 129 people (96 women, 33 men).

1.2. Procedure

People participated in small groups (3 to 8 people). Each person was seated at an individual desk and was unable to see the other participants' questionnaires and tasks. The study began with the assessment of Gf, which involved three tasks: (1) the odd-numbered items from the Ravens Progressive Matrices (18 items, 12 min); (2) a Paper Folding task, which involved identifying how a piece of paper would look after being folded, punched with holes, and then unfolded (10 items, 4 min); and (3) a Letter Sets task, which involved identifying which set of letters failed to follow to same rule as other sets (16 items, 4 min). The Paper Folding task and Letter Sets task were taken from the Kit of Factor-Referenced Tests (Ekstrom, French, Harman, & Dermen, 1976). This group of tasks had been used in our past work (Silvia, 2008a).

Following the Gf tasks, people completed measures of individual differences. Three measures of the Big Five traits were used: a 50-item scale from the International Personality Item Pool (IPIP) and two 10-item brief scales (Gosling et al., 2003 and Rammstedt & John, 2007). People responded using a 1–5 response format (1 = strongly disagree, 5 = strongly agree). Although fairly new, these brief scales have performed well in past work in our lab (Silvia, Nusbaum, Berg, Martin, & O'Connor, 2009).

Finally, people read 11 poems followed by 11 pictures. The poems, taken from books and literary journals, represented a range of contemporary styles—the poets included John Ashbery, Daniel Davidson, W. B. Keckler, and Anne Sexton. The pictures were black-and-white, non-representational works taken from books and journals of experimental language art—the artists included Tim Gaze, Gustave Morin, Spencer Selby, and Andrew Topel. The images had been used in our past work (e.g., Silvia, 2005 and Silvia, 2008b). For each poem and picture, people rated their feelings of interest using 7-point semantic differential items—interesting–

uninteresting and boring–exciting—as in our past work. These items were rescored and averaged so that higher scores indicate more interest.

2. Results

2.1. Data reduction and model specification

The analyses were conducted with Mplus 5.21 using full-information maximum likelihood estimation. All predictors (except gender) were grand-mean centered. Table 1 reports the descriptive statistics for the observed variables. Reliabilities for the latent variables were estimated via maximal reliability (H), a measure of construct reliability for latent variables that is analogous to Cronbach's alpha (Drewes, 2000 and Hancock & Mueller, 2001). Gf (H = .92) was modeled as a latent variable with the Ravens, Paper Folding, and Letter Sets tasks as indicators; the path to the Ravens scores was fixed to 1. Openness to experience (H = .78) was modeled as a latent variable with the three scales as indicators; the path to the IPIP scores was fixed to 1. Latent Picture (H = .79) and Poem (H = .85) variables were created by forming three parcels each from the individual items; the factor variances were fixed to 1. A confirmatory factor analysis of these four latent variables fit well: $\chi 2(48) = 50.874$, $p = .36$; CFI = .994; RMSEA = .022; SRMR = .044.

Table 1. Descriptive statistics and Pearson correlations.

	M	Variance	1	2	3	4	5	6	7	8	9
1. Ravens	9.36	12.82	1								
2. Paper Folding	6.24	5.37	.596	1							
3. Letter Sets	7.98	4.88	.337	.472	1						
4. O-IPIP	3.41	.48	.143	.192	.181	1					
5. O-VBM	4.09	.56	.109	.172	−.009	.502	1				
6. O-BFI	3.64	.98	.069	.196	.056	.571	.508	1			
7. Interest in pictures	4.25	.87	.174	.175	.107	.113	.000	.050	1		
8. Interest in poems	4.06	.70	.064	.268	.128	.340	.246	.424	.403	1	
9. Gender	.74	.19	−.129	−.207	−.117	−.183	−.129	−.115	.194	.078	1

Note. O-IPIP = International Personality Item Pool Openness scale; O-VBM = Gosling et al.'s (2003) “very brief measure” Openness scale; O-BFI = Rammstedt and John's (2007) brief Big

Five Inventory Openness scale. For Gender, the mean represents the proportion of women in the sample (0 = man, 1 = woman).

2.2. Predicting interest in pictures and poems

Our first model included Gf as a predictor and interest in the pictures and poems as outcomes, yielding a multivariate model. Gf significantly predicted interest in both the pictures (β = .22, p = .042) and the poems (β = .29, p = .002). Consistent with past research, then, we found that Gf was associated with finding things more interesting; moreover, this effect appeared across both domains.

Our second model added openness to experience and gender (scored 0 for men, 1 for women) as predictors. As expected from past work, Gf and openness correlated significantly (β = .264, p = .008), indicating some overlap. Openness significantly predicted interest in the poems (β = .51, p < .001) but not in the pictures (β = .07, p = .52). Furthermore, Gf continued to predicted interest in both pictures (β = .25, p = .023) and poems (β = .21, p = .019), which indicates that openness did not explain its relationships with interest. Finally, gender significantly predicted interest in both the pictures and poems. For these effects we used *Y*-standardized coefficients, which represent the standard deviation change in the outcome when the binary predictor changes from one value to the other (Long, 1997). Compared to men, women found the both the pictures (β = .66, p = .002) and poems (β = .51, p = .008) more interesting.

Finally, we considered whether Gf and openness to experience interactively predicted interest. To estimate the interaction of the latent predictors, we used the latent moderated structural relations (LMS) method (Klein & Moosbrugger, 2000) as implemented in Mplus; note that only raw coefficients are available for LMS analyses. To simplify the model and its estimation, gender was removed as a predictor. No significant interactions appeared for either the pictures (b = .10, SE = .094, p = .272) or the poems (b = .05, SE = .092,p = .583). Gf and openness thus had only main effects on interest, not an interactive effect.

3. General discussion

The present research explored the role of Gf in the tendency to find things interesting. Consistent with past work, people high in Gf rated both the poems and the pictures as more interesting. Finding this relationship across two domains—the verbal domain of poetry and the visual domain of visual art—suggests that it is robust. Moreover, Gf's effect sizes were approximately moderate in size, indicating that individual differences in Gf deserve more attention from researchers in the psychology of interest.

Beyond showing an effect, the present research considered whether Gf's effect on interest was due to confounding individual differences, particularly openness to experience (Ashton et al., 2000 and DeYoung et al., 2005). Gf and openness consistently covary, and including openness as a variable can diminish the effects of Gf (e.g., Silvia, 2008a). Although openness appeared to be an intuitive candidate for a “third variable,” including openness as a predictor did not substantially change the effect of Gf on interest—Gf continued to predict interest in both kinds of material. It thus seems unlikely that the overlap of Gf and openness explains Gf's effects on interest.

A task for future research is to explore further the mechanisms by which Gf fosters the experience of situational interest. Gf and interest both play major roles in educational outcomes and learning motivation, so it is critical to understand their intersections. One likely route involves people's crystallized intelligence (Gc). Fluid and crystallized intelligence covary strongly, so people high in Gf also have extensive domain knowledge that they bring to situations. Research shows that domain knowledge fosters the experience of interest (Renninger, 2000), probably because it enables people to form coherent representations of the material and to connect it to other knowledge (see Alexander et al., 1994, Sadoski & Paivio, 2001 and Schiefele, 1999). Gf may thus enhance interest indirectly by virtue of its relationships with Gc. Examining the unique and joint contributions of Gf and Gc to interest in educational materials is an important goal for future work.

Another possibility is that Gf influences some of the cognitive appraisals that foster interest. Emotion research has suggested that two broad appraisals—evaluating something as new and complex and evaluating something as comprehensible—bring about feelings of interest (Silvia, 2005, Silvia, 2006 and Silvia, 2008c). High Gf may contribute to the appraisal process, particularly by influencing appraisals of comprehensibility. It seems reasonable that people high in Gf would appraise some things as more comprehensible, and the increase in understanding should lead to an increase in interest.

It is worth noting some boundaries and limitations of this work, such as the use of a convenience sample of college students (a group that might be atypical in both Gf and openness to experience) and a focus on materials from the arts. Although the arts deserve more attention in mainstream research in learning processes, it would nevertheless be worth examining the roles of Gf and openness in interest in traditional educational materials, such as instructional texts. Future work could also expand beyond self-reported interest. Many non-verbal measures have been used in past work (Silvia, 2006, chap. 1), most of which have been borrowed from research on curiosity (which is viewed as synonymous with interest by most researchers; see Kashdan &

Silvia, 2009 and Silvia & Kashdan, 2009). For example, behavioral measures of exploration (such as viewing time; Silvia, 2005), choice (such as which image to view again or to take home), and reward (such as whether viewing an image can reward a different behavior) have been widely used in past work, and they would be a fruitful way to expand the present research.

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