

**Toward an Integrative Model of Creativity & Personality:  
Theoretical Suggestions and Preliminary Empirical Testing**

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## Abstract

The present work examines personality traits related to creativity. We hypothesized that three high-order personality factors predict two main process factors, which in turn predict intensity and achievement of creative activities. The personality factors are: *Plasticity* (high openness, extraversion, energy, and inspiration), *Divergence* (low agreeableness and conscientiousness, high non-conformism and impulsivity), and *Convergence* (high ambition, precision, persistence, and critical sense). The process factors are *Generation* (idea production and originality) and *Selection* (idea evaluation and formalization). It was specifically hypothesized and found that: (1) Plasticity and Divergence predict positively Generation; (2) Convergence predicts positively Selection; (3) Generation, Selection, and their interaction predict positively both intensity and achievement of everyday creative activities.

*Keywords:* everyday creativity, personality, structural model, generation, selection.

## **Toward an integrative model of creativity and personality: Theoretical suggestions and preliminary empirical testing**

The aim of this paper is to propose a synthetic model of creativity and personality based on the review of the extant literature (e.g., Batey & Furnham, 2006). Using a few short measurement scales, we also provide preliminary empirical evidence in favor of this model.

### **The big 5 of personality and creativity**

In this first section, we quickly review the relations between creativity and the Big Five personality factors. Then we will progressively move toward a more synthetic organization of these traits (section 1.2).

*Openness* (O) appears to be strongly associated with all kinds of creativity; indeed, according to Costa and McCrae (1997), openness is one of the fundamental dimensions related to artistic temperament. Empirically, the general O factor and many of its underlying traits (e.g., fantasy, flexibility, curiosity, wide interests) are positively related to virtually all types of creativity, at all levels of achievement (Batey & Furnham, 2006; Feist, 1998; McCrae, 1987). Moreover, according to Batey & Furnham (2006), O consists of both an attitudinal openness to new experience and an inability to inhibit irrelevant information (a perceptual openness), which can be related to access to original, unexpected ideas; the former being the most classic and specific attribute of O whereas the latter was only highlighted more recently (Peterson & Carson, 2000)<sup>1</sup>.

*Extraversion* (E) is generally conceptualized as a high order factor embracing high energy, positive affect, sociability, enthusiasm, novelty seeking, dominance, self-confidence, and assertiveness (Pervin & John, 1999). Except for the specific case of sociability, all these

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<sup>1</sup> Such a perceptual openness (or low latent inhibition) is also classically an attribute of the factor Psychoticism (see next section “More parsimonious views of creativity and personality”).

traits (especially dominance and positive affect) have been found to be positively associated to virtually all kinds of creativity (Baas, De Dreu, & Nijstad, 2008; Batey & Furnham, 2006; Feist, 1998). Sociability, a facet of extraversion, has shown mixed relationships with artistic and scientific creativity, especially for high creative achievers, who supposedly need a lot of time alone for thinking and elaborating ideas (Feist, 1998). Sociability can, however, be positively related to everyday creativity (Batey & Furnham, 2006).

For *Neuroticism* (N), domain or field specificity appears to be important. According to Feist (1998) artists are more anxious, emotional and sensitive—traits at the core of the N factor—whereas scientists are more likely to be affectively stable. However, it is unclear if N has just an influence on the preference for certain domains of creativity, leading neurotic people to choose an artistic field to express themselves (Eysenck, 1993), or if N is really a facilitator in art, leading to higher achievement, through higher sensitivity to emotional stimuli and communication of emotional ideas in a work of art (Batey & Furnham, 2006).

*Conscientiousness* (C) seems negatively related to artistic creativity and positively related to scientific creativity, but the reality is more subtle. First, whereas scientists are higher on C than the general population or than artists, highly creative scientists, when compared to less creative scientists, are lower on C (Feist, 1998). Second, it is likely that the C factor masks important specificities. Indeed, on the one hand, C is positively related to energy, organization and work efficiency (Pervin & John, 1999), which are favorable to creativity (especially to high creative achievement). However, on the other hand, C is negatively related to psychoticism and inhibition (see next section for further details), both of which are also positively related to creativity (Eysenck, 1993; Merten & Fischer, 1999). Hence C is ambiguously related to creativity.

*Agreeableness* (A) is most often negatively associated with creativity; creative people, especially artists, but also scientists, are more likely to be hostile, asocial, unconventional, and

norm rejecting (Feist, 1998). Batey & Furnham (2006) also reviewed several studies showing that creative people have tendencies toward low A, being less deferent and team oriented, less socialized, self-controlled, tolerant and concerned with good impressions.

### **More parsimonious views of creativity and personality**

In a more parsimonious perspective than the *Big 5*, some authors have focused on fewer higher order factors, such as *Plasticity* and *Stability* (DeYoung, 2006; Digman, 1997), or *Psychoticism* (Eysenck, 1992a). This section investigates how these higher-order traits, or “super-factors,” are relevant to our general goal of providing a synthetic model about personality and creativity.

*Plasticity*, a high-order factor defined by high E and O (DeYoung, 2006; Digman, 1997), appears as a powerful predictor of creativity: as detailed in the above sections, E and O are overall positive predictors of different kinds of creativity, so it seems reasonable to suppose that their joint contribution should have good predictive power for creativity. Although empirical studies on Plasticity and creativity are still quite rare, recent results have indeed shown that Plasticity is highly and positively related to various measures of everyday creativity (Silvia, Nusbaum, Berg, Martin, & O'Connor, 2009). Plasticity (or at least E) is also related to positive affect, also known to contribute positively to idea generation, exploration and risk taking (Schwarz, 1990; Vosburg, 1998). Moreover, it seems very likely that Plasticity is positively related to inspiration, also central to creativity. In particular, Thrash and Elliot (2003, 2004) have found several positive and high correlations between O, E, positive affect, intrinsic motivation and creativity on the one hand, and inspiration<sup>2</sup> on the other.

In a different perspective, Eysenck (1993) made interesting suggestions for an integrative theory of personality and creativity based on the concept of *Psychoticism* (P). P is

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<sup>2</sup> Thrash and Elliot (2003) conceptualized inspiration as an evoked, transcending motivation (i.e., non-directly initiated and beyond ordinary preoccupations).

composed of several lower-order traits, such as “aggressive,” “cold,” “antisocial,” and “impulsive” (Eysenck, 1992a), and can be more simply conceived as a combination of the inverse of the A and C factors of the *Big 5* (Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993). Eysenck has argued that P constitutes a genetic advantage for creativity, principally through its relation with low cognitive and behavioral inhibition, which consequently leads to higher ideational fluency and originality, as well as to higher independent and norm challenging behavior. Many details about both the conceptualization of P have been vigorously debated (e.g., Costa & McCrae, 1992; Eysenck, 1992b) but this parsimonious theory has however provided insightful lines of research and has led to many supporting empirical results (Acar & Runco, 2012; Batey & Furnham, 2006).

Finally, *Stability*, defined by low N as well as high A and high C (DeYoung, 2006; Digman, 1997), represents a quite ambitious synthesis of three of the *Big 5* factors that also encompass the concept of P (which correspond to low A and low C, as already mentioned). For our purposes, it appears that this factor holds great potential for synthesizing many relations. For example, *Stability* should be negatively related to artistic creativity. Being “unstable” (i.e., nervous, not agreeable, and not conscientious), should provide an advantage in the arts. However, for scientific creativity the pattern would not be as simple: scientists are often low on N but also low on A and high on C—conflicting results that cannot be summarized using the *Stability* factor.

### **A synthetic model: summary and hypothesis**

In this section, we focus on the second-order factors of personality and their expected relations with cognitive or processes variables. Here we rely on Bink and Marsh (2000) synthesis on cognitive regularities in creative activity. The basic idea being that there are two wide classes of complementary sub-processes relevant for creativity: (a) *Generation*: idea production and association (encompassing divergent thinking); (b) *Selection*: critic,

evaluation, formalization of ideas. These two sub-processes work in a constant cooperation to lead to creative ideas; both are necessary (see also Finke, Ward, & Smith, 1992; Treffinger, Isaksen, & Stead-dorval, 2006).

Generation in general (and divergent thinking in particular) is often found to be positively related to Extraversion and positive affect (Batey & Furnham, 2006; Vosburg, 1998). Additionally, Openness also has a positive impact on idea production (Batey & Furnham, 2006; McCrae, 1987). Indeed, Openness is by definition related to curiosity and variety of experience, which imply higher knowledge and number of elements available in long term memory (Ashton, Lee, Vernon, & Jang, 2000), this means more “fuel” for Generation and perhaps also more criteria for Selection. Hence, Plasticity (Extraversion and Openness) is expected to be positively correlated to Generation.

Additionally, high Psychoticism, or low Agreeableness and Conscientiousness, are also known to have a positive impact on Generation; an impact probably due to low inhibition (cognitive and behavioral), which eases unusual, loose, and original idea associations (Eysenck, 1993; Stavridou & Furnham, 1996). Therefore we propose that a second-order factor of Divergence (low Agreeableness and Conscientiousness, high non-conformism) should be correlated to Generation as well.

Concerning Selection processes and personality, there is little specific literature. However, based on the reviews discussed above, it seems that supposedly important motivational traits and work habits such as “ambitious,” “persistent” or “demanding” are not very well represented in the Plasticity factor nor in the Psychoticism factor. These motivational traits are specific descriptors of Conscientiousness (Pervin & John, 1999), whose overall effect on creativity is most often found to be negative. But it is likely that they should be positively related to the Selection process, which requires intense work and deep

evaluation. We suggest that for the specific purpose of creativity research, it might be necessary to distinguish and model these motivational traits and work habits separately.

In sum, in light of the above developments, we make the following main hypotheses: (1) Plasticity and Divergence positively predict Generation; (2) Convergence positively predicts Selection; (3) Generation and Selection, and most importantly their interaction, positively predict the creative product, activities or achievement. These hypotheses have been tested in two main studies; which are reported and discussed below.

## **Method and results (two studies)**

### **Study 1**

#### **Participants and procedure**

The sample consisted of 112 first-year undergraduate psychology students at the University of Geneva (88% of women; mean age of 21.3 years,  $SD=3.3$ ). Students participated voluntarily and without payment. Paper questionnaires were distributed at the beginning of a mandatory course and collected immediately after completion. The total duration of the data collection was about 20 minutes.

#### **Measures<sup>3</sup>**

**Personality.** The classical *Big 5* personality factors were measured with a short adjective check list, with 8 items for each factor (4 scored positively and 4 scored negatively). The *Big 5* scales were a French adaptation of the best marker in English (John & Srivastava, 1999; Saucier, 1994). Recent retesting of these scales in an independent undergraduate sample ( $n=254$ ) showed good convergent validity with the NEO-FFI (Costa & McCrae, 1989): the

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<sup>3</sup> All scales presented here were developed in previous studies (Fürst, 2012) and/or and pre-tested in a specific pilot study. All items are available on demand.



correlations between the analogous factors of the two scales were about .90 (except for Extraversion, which correlated at .75, perhaps due to the NEO FFI's stronger focus on energy).

Six additional traits were also assessed to extend and specify the conceptualization of the second order factor of personality: *Inspiration/Energy* (4 items scored positively; supposed to load positively on the Plasticity factor with O and E), *Non-conformism*, and *Distraction* (3 items scored positively; supposed to load positively on the Divergence factor, itself loading negatively on A and C), *Persistence*, *Precision*, and *Critical Sense* (3 items for each trait, 8 scored positively and 1 scored negatively; supposed to load positively on the Convergence factor). For all these personality items, participants were asked whether the adjectives describe them well or not, using a scale from 1='not very much' to 5='very much'.

***Creativity.*** *Generation* and *Selection* were measured with 12 items, 6 for each factor, all scored positively. For each item describing a supposedly prototypical sub-process (e.g., for Generation: "Having a lot of ideas", "Make original associations of ideas"; for Selection: "Criticize, evaluate my work", "Verify, correct imperfections") participants were asked to tell how frequently it applied to their work, using a scale from 1='almost never' to 5='very often.'

Everyday creativity was measured using two scales: *intensity* of practice in 11 prototypical creative activities (e.g., writing, painting, drawing, producing music, dancing, acting), evaluated through mean time (in hours) spent per week on each of them, and self-rated practice (Verhaeghen, Joorman, & Khan, 2005); overall *achievement* in these activities was evaluated with 7 items (e.g., "People have commented my talent is this domain", "I have won a prize in this domain"), rated on a five-point scale, ranging from 1='never' to 5='very often.' These items were translated and adapted from the Creative Achievement Questionnaire (CAQ; Carson, Peterson, & Higgins, 2005).

## Data analyses

In the current analyses we proceeded in two steps. First, we applied separate confirmatory factor analyses to all first-order factors. This allowed testing each measurement model and assuring that personality and creativity constructs are adequately represented by their items (Bollen, 1989). Moreover, in this first step, each participant's factor scores was estimated to be used in subsequent, higher-order models (second step). For reasons of space, the details of these models are not reported. However, Table 1 contains each factor's mean and standard deviation, as well as its items' mean loading. In the second step, we applied structural equation modeling to test the relations between all first and second-order factors. Classical fit indices of these models (and sub-models) are detailed in Table 2. This two-step procedure is indicated when the simultaneous estimation is not feasible because of the high number of items relative to the total sample size (Chou, Bentler, & Pentz, 2000) making the estimation of many parameters difficult. All analyses were conducted with *Mplus* 5.2 (Muthén & Muthén, 2007).

Insert Table 1 about here

## Results and discussion

Table 1 details the descriptive statistics and mean loading of each factor's estimated scores. With very few exceptions (A and O factors) mean factor loadings were higher than 0.5. Some Cronbach's alphas were a bit low, very likely because the scales were measuring complex construct with a limited number of items<sup>4</sup>.

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<sup>4</sup> For example, the Openness scale reliability is low because it has to compromise between "openness" (e.g., open to change) and "intellect" (e.g., like abstract ideas)—the dual nature of this factor and subsequent issues measuring it are well-known in the personality literature (e.g., John & Srivastava, 1999). Moreover, the low reliability is also likely due to the low number of items. For example, by applying the Spearman-Brown formula (Allen & Yen, 1979) to the *Critical Sense* scale we can see that, all things being equal, if we increase the number of items from three to six, the obtained reliability estimate increases from .51 to .76.

In the second analytical step, we tested with Structural Equation Models (SEM) three sub-models (i.e., personality factors, process factors and everyday creativity factors) and ultimately this final model itself, represented in Figure 1. We started with the higher order personality factors: Plasticity (E, O, and Inspiration), Convergence (C, precision, persistence, and critical sense) and Divergence (A, C, non-conformism, and distraction)<sup>5</sup>. The fit of this model was not very good (see Table 2), mostly because of some residual correlations<sup>6</sup>. The two other sub-models (Process and Everyday Creativity) were simpler and had better fit (second and third lines of Table 1).

Insert Table 2 about here

Insert Figure 1 about here

In the end, 15 variables were included in the overall model, as depicted in Figure 1. This final model tests the hypotheses proposed at the end of the introduction by specifying the relations among the 10 personality factors, the Generation and Selection factors, and the intensity and achievement factors. Limited by the weak personality sub-model discussed above, the fit of this final, overall model was not very good (last line of Table 2). However, relations between factors make sense and are in line with our initial hypotheses. (See study 2 for modifications and improvements of this model.)

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<sup>5</sup> An alternative conceptualization of the Divergence factor was also tested (N, A, C, non-conformism, and distraction). This model resulted in a very poor fit, and this conceptualization of the Divergence factor predicted neither Generation nor Selection processes in the subsequent overall model. Hence, we redefined this factor by excluding the N scale in the following analyses.

<sup>6</sup> For instance, modification indices suggested to add a cross loading (letting A load on Plasticity) or a residual covariance between O and non-conformism. Unfortunately, setting these parameters free led to estimation issues, notwithstanding the theoretical changes it could have implied in the factor definition. Hence we kept the original specification in further analyses. Note that we let however C load both on Divergence and Convergence, because the dual-nature of this variable was expected. (As mentioned in the introduction, it is likely that C has a “work efficiency” aspect that loaded here positively on Convergence, and a “non-impulsive” part, that loaded here negatively on Divergence.)

Specifically, results detailed in Figure 1 show that, as expected, both Plasticity and Divergence predict positively Generation ( $\beta=.58$  and  $.34$ , respectively; overall  $R^2=.45$ ), whereas Convergence is very closely related to Selection ( $r=.78$ ,  $R^2=.61$ ). Furthermore, Convergence correlates  $.67$  with Plasticity ( $R^2=.45$ ). We can also see that the scales we proposed here as a complement to the classical *Big 5* factors are very relevant, as their loadings on the higher order personality factors are among the strongest found. Last, Generation appeared as the only significant predictor of Intensity of everyday creativity ( $\beta=.35$ ,  $R^2=.12$ ). Generation also predicted Achievement of everyday creativity ( $\beta=.34$ ), along with the interaction between Generation and Selection ( $\beta=.18$ , overall  $R^2=.15$ ).

This interaction, modest in size but important in theory, is graphically represented in Figure 2. The main positive effect of Generation on Creative Achievement for an average value of Selection is depicted by the grey continuous line in Figure 2. This effect was stronger when Selection was high (black continuous line,  $2\ SD$  above the average) but virtually disappeared when Selection was low (dotted black line,  $2\ SD$  below the average). Conversely, we could also say that Selection had a positive impact on Achievement when Generation was high, and a detrimental one when Generation was low.

Insert Figure 2 about here

## Study 2

Study 2 was designed to replicate and extend results of study 1. Specifically, the changes and extensions were the following: (1) personality scales were slightly modified in order to try fixing some of the problems of study 1 (cross loadings and residual correlations), and ultimately obtain a simpler model with a better fit; (2) a measure of divergent thinking (fluency) was added. More details about these changes are described in the following sections.

## Participants and procedure

The sample consisted of 99 first-year undergraduate psychology students at the University of Geneva (85% of women; mean age of 22 years,  $SD = 5.4$ ). Students participated voluntarily and without payment. This study took place in a computer lab. Participants arrived at the lab by groups of 4 to 12, they first answered to the questionnaires (personality, creative process, everyday creativity) and then completed the tasks of divergent thinking. All tasks and questionnaires were computerized. The session lasted approximately 20 minutes.

## Measures

**Personality.** The personality variables were the same as in study 1, although some significant changes were implemented. First, only two items were used to measure each basic trait, essentially for time constraints reasons; for most scales, the selected items were the items identified as the best markers (i.e., with highest loadings) in study 1. Exceptions are the following: (1) the Extraversion items were more focused on dominance rather than sociability (the items here were “is reserved, withdrawn” (reversed) and “is self-confident, assertive”); (2) the conscientiousness scale was not used; instead a short impulsivity scale was introduced (items were “is impulsive, lacks self-control” and “easily loses one’s temper, can be rude or aggressive”). By implementing these changes, we first hoped to diminish the social dimension of Plasticity, which may have caused the tendency of A to load on this factor—sociability, warmth, and agreeableness are actually traits close to each other’s (John & Srivastava, 1999). Second, we also wanted to clarify the relations between Conscientiousness, Divergence and Convergence: unlike Conscientiousness, the new impulsivity short scale was supposed to load only on the Divergent factor (and not on Convergence).

**Creativity.** The measures of *Generation* and *Selection* were identical to study 1. As in study 1, everyday creativity was measured using *intensity* of practice (one item in terms of both seriousness and time spent, i.e., “I practice seriously this activity, I spent a lot of time on

it”) and *achievement* (using the five best items of study 1). In comparison to study 1, only 7 activities (the most frequently practiced) were included in this questionnaire.

Additionally, two divergent thinking tasks were used to assess ideational fluency. The first was an unusual uses task (“all of the original and creative uses for a brick”; Guilford, Christensen, Merrifield, & Wilson, 1978) and the second an instances task (“all of the original and creative instances of things that are round”; Wallach, & Kogan, 1965). Participants were explicitly instructed to be creative and to give the maximum numbers of ideas that they can generate. Time was not limited.

### **Data analysis**

We proceeded as in the previous study: (a) three sub-models were separately tested (i.e., personality, process, and creative activity); (b) factor scores of these models were estimated and modeled in a final, integrative structure.

### **Results and discussion**

First, the personality sub-model was improved as compared to study 1; the fit indices of this model are detailed in Table 3. The structure of this model was simpler and showed a better fit. The ambiguity between E and A persisted, although to a lesser extent; one residual correlation was set free between “is reserved, withdrawn” of the E scale and “is cold, distant with people” of the A scale ( $r=.57$ ;  $p<.001$ ). Additionally, the Distraction proneness scale was not included in this model because it did not load on Divergence anymore; this may be a consequence of a redefinition of Divergence without conscientiousness and with impulsivity instead (see the final discussion for further details). Additionally, the correlation between Divergence and the two other personality factors was not zero here: Divergence had a small positive correlation with Plasticity ( $r=.22$ ) and a small negative correlation with Convergence ( $r=-.23$ ). These correlations between personality factors may be due to the changes

implemented in the variables included in the model. For example, the Extraversion subscale of Plasticity was more oriented toward dominance, which might explain the positive correlation with Divergence. Indeed, the Extraversion and the Non-Conformism subscales of Divergence correlated positively ( $r=.30, p=.003$ ).

Second, the process sub-model had an acceptable fit (Table 3), although not as good as in study 1, and we had to estimate two additional parameters: a residual correlation between “Evaluate the potential of an idea” and “Formalize an idea” ( $r=.54; p<.001$ ), as well as a cross loading—item “Search for improvement” loaded both on Selection and Generation (respectively .68 and .37, both  $p<.001$ ).

Finally, the fit of the creative activity sub-model (Table 3) was similar to its equivalent in study 1. However, there are slight differences between this model and the one retained in study 1. The first difference, of course, is the presence of the divergent thinking factor. The second difference is the very high correlation between intensity and achievement of creative activities ( $r=.89; p<.001$ ). This may be due to the simplification of the intensity scale (i.e., one item covering both degree of engagement and time spent instead of two items in study 1). Consequently, we defined a common “everyday creativity” factor based on the intensity and achievement constructs.

Insert Table 3 about here

Insert Figure 3 about here

This final model is depicted in Figure 3 and fit indices are detailed in the last line of Table 3. As in study 1, on the left part of the model (i.e., personality and process), Plasticity and Divergence predicted positively Generation ( $\beta=.34$  and  $\beta=.32$ , respectively; overall  $R^2=.27$ ) and Convergence predicted positively Selection, though with a much smaller effect size ( $\beta=.23, R^2=.05$ ) as compared to study 1. Overall, in this part of the model, it seems that the predictive validity was a bit lower than in study 1. This may be due to the smaller number

of items we used to estimate the personality factors or to the changes we made in the factors' specifications. Despite these limitations, the major results of study 1 were well replicated.

The right-hand portion of the model (i.e., process and creative activity) showed important replications as well: Generation had a positive impact on everyday creativity ( $\beta=.22$ ;  $p<.05$ ); Selection alone had a small positive effect that hardly reached significance ( $\beta=.15$ ,  $p=.09$ ); the interaction between Generation and Selection had a clear positive effect on everyday creativity ( $\beta=.23$   $p<.01$ ) and can be interpreted as in study 1 (i.e., both high Generation and Selection are necessary to achieve high creativity).

Additionally, Generation positively predicted divergent thinking ( $\beta=.43$ ,  $p<.001$ ), which is an important result in favor of the validity of the Generation scale. Moreover, divergent thinking also had a positive effect on everyday creativity ( $\beta=.21$ ;  $p<.05$ ). Overall, the  $R^2$  for everyday creativity was .21. It is worth mentioning that the effect of Generation on everyday creativity was significant over and above the prediction of divergent thinking, which is an important argument in the favor of the discriminant validity of this scale. In other terms, the Generation scale is positively related to divergent thinking (convergent validity) but it brings important additional information (discriminant validity).

## **General discussion**

### **Personality factors**

In this paper we have first suggested that three “super-factors” of personality might be of particular relevance for creativity research. These factors are Plasticity, Divergence and Convergence. We now review their specification and meaning in light of the two studies we pursued to investigate their validity.

As a traditional higher-order factor of the *Big 5*, Plasticity is generally defined by high Extraversion and Openness (DeYoung, 2006; Digman, 1997) and has already been found to



relate to creativity (Silvia et al., 2009). In this paper, we proposed a slight extension of Plasticity, which also encompassed the concept of inspiration, known to be positively related to Extraversion, Openness, and positive affect (Thrash & Elliot, 2003, 2004). As the inspiration subscale had the highest loading on Plasticity in both studies, we believe that such an extension was highly appropriate.

The specification of the Divergence factor was not as straightforward as for Plasticity. This factor was mainly defined as close to Psychoticism, which roughly means low Conscientiousness and low Agreeableness. Our results were indeed in line with these findings: conscientiousness loaded strongly and negatively on the Divergence factor in study 1 and Agreeableness loaded negatively in both studies. Moreover, in both studies, the non-conformism scale had a very high loading, suggesting that this trait is central to Divergence, along with impulsivity, which also loaded highly on Divergence in study 2. Unfortunately, the role of the distraction subscale remains unclear. First, it appeared as an important indicator of Divergence along with conscientiousness in study 1. But then, in study 2, when we replaced Conscientiousness by impulsivity to simplify the model and avoid cross loadings, distraction no longer loaded significantly on Divergence. With two studies only, it is hard to tell which conception of the Divergence factor may be preferred or what the definitive conclusion about the ambiguity of Conscientiousness should be. In either case, such ambiguities have been known for a long time; some authors have even suggested that paradoxical personality traits (Csikszentmihalyi, 1996) or variability (Vartanian, 2009) actually are one of the most important characteristics of creative people.

Furthermore, the Divergence factor was also inspired by the Stability factor of higher-order factors of the *Big 5* (i.e., low Neuroticism, high Agreeableness and Conscientiousness). In study 1, we tested a Stability factor and concluded that it was not very relevant for our purposes: the model fit was very poor and the predictive validity for creativity was null.

Hence we excluded N from the Divergence factor. Although N was not included in the Divergence factor, we could argue that some traits of N were indirectly represented, such as irritability, anger-hostility and impulsivity (especially in study 2). According to McCrae & Costa (1999), those traits are supposed to load mainly on Neuroticism, but Zuckerman et al. (1993) have shown that anger-hostility had a strong negative loading on an Agreeableness factor, whereas impulsivity had a strong negative loading on a Conscientiousness factor (along with psychoticism).

In sum, we believe that our Divergence factor may be an “augmented” Psychoticism factor that included traits of Neuroticism long known to be ambiguous. For that reason, Divergence may be similar to schizotypy which has both Psychoticism and Neuroticism components (Eysenck, 1992a). Furthermore, we do think that these ambiguous traits of Neuroticism (i.e., impulsivity, irritability, anger, hostility, instability) are more important for creativity than the more “classical” Neuroticism traits such as depression and anxiety. Indeed, a recent study by Silvia & Kimbrel (2010) has shown that depression and anxiety are virtually unrelated to various measures of creativity, whereas cyclothymia and affective disorders based on instability of affect—and not solely on negative affect—are known to be positively related to creativity (Nowakowska, Strong, Santosa, Wang, & Ketter, 2005; Richards, Kinney, Lunde, Benet, & Merzel, 1988).

Finally, we proposed a third factor, Convergence, based on high conscientiousness, persistence, precision and critical sense. We have found that Convergence was strongly and positively correlated with Plasticity, probably because the two share a high-energy component (i.e., inspiration and persistence both imply high-energy level). Nonetheless, this high correlation may question the discriminant validity of the Convergence factor. It is possible that the only unique variance of this factor (i.e., distinct from Plasticity) is achievement motivation and/or critical sense—which may not be enough to construct a meaningful second

order factor. An important question for future research consists of clarifying the legitimacy, specification and relevance of this Convergence factor.

### **Overall model**

In our integrative model, Plasticity and Divergence was hypothesized to predict Generation processes. In both studies, results consistently supported this prediction. We should emphasize that Plasticity and Divergence each predicted a unique part of the variance of Generation. This suggests that there are two different paths to Generation; both are important and specific, with cumulative effects.

Second, Convergence was hypothesized to predict Selection processes. Our results supported this prediction, although the discrepancy of effect sizes between study 1 and 2 was important. The very strong relation found between Selection and Convergence in study 1 might question the discriminant validity of these scales. In this study, it seemed that idea Selection is mostly conative in nature, as it is partly confounded with the personality factor of Convergence. Conversely, the strength of this relation was more modest in study 2, perhaps due to the redefinition of the Convergence factor (i.e., exclusion of C).

Generation and Selection processes were hypothesized as important predictors of everyday creativity. Although the overall prediction of these two scales was modest, the significant and meaningful effects we found indicate their acceptable predictive validity. Generation predicted positively everyday creativity and divergent thinking, whereas the main effect of Selection did not reach significance. But most importantly, and as expected, the interaction between Selection and Generation was a significant predictor of everyday creativity (achievement in particular, as shown in study 1). This interaction was such that high Generation abilities were more relevant for creativity when coupled with high Selection abilities. To our knowledge, this is the first study to test and find such an interactive effect, although many speculations about the importance of the interaction between these two kinds

of processes exist (e.g., Lubart, 2000; Runco, 2003). On the other hand, this interaction means that high levels of Selection are detrimental to creativity when Generation is low. This result is consistent with popular techniques used to enhance creativity such as brainstorming, which recommend lowering Selection in order to achieve higher creativity. The present results moderate, however, the enthusiasm for such practices, suggesting that they are relevant only for people low on Generation. For people high on Generation, based on our results, we would rather recommend strengthening Selection processes to achieve higher creativity.

### **Limitations and possible extensions**

The main limitation of our study is undoubtedly the relatively small samples. As we tested quite complex models, estimations sometimes lacked precision (yielding large confidence intervals). Nevertheless, several parameter estimates were statistically different from zero. Additionally, we must acknowledge that our samples were also quite specific, composed mostly of young undergraduate women, hence not representative of the general population. For these reasons, results found and discussed here require replications. In particular, it would be of great interest to test the proposed model in larger, more “creative” samples, tapping in different domains (e.g., artistic and scientific creativity) as well as at various levels of achievement.

Another limitation is that we use simple, short scales. Though this choice was motivated to avoid detrimental effects due to a very large number of testing batteries, in the future our results should be replicated using more intensive measures, such as various scales of the Big 5. Similarly, more experimental tasks might be incorporated in a replication of these results. For example, it might be expected that the Generation scales correlates negatively with latent inhibition and positively with the Remote Association Task (Mednick & Mednick, 1967). About Selection, predictions are harder to make, but probably this scale should be positively related to problem solving tasks or tasks involving evaluation skills such

the ability to judge relatedness between concepts (Vartanian, Martindale, & Matthews, 2009). More generally, Selection might also just be positively associated with general intelligence, given that general intelligence is related to creativity (Nusbaum & Silvia, 2010) and most certainly useful when it comes to evaluate whether a specific idea is relevant, appropriate or in need of amelioration.

### **Final comments and conclusion**

The overall model proposed here provides a parsimonious and synthetic structure highly inspired by past research. The Plasticity-Divergence-Generation “network” represents most classical known relations between creativity and personality: the positive impact of openness (Feist, 1998; McCrae, 1987), extraversion and dominance (Batey & Furnham, 2006; Feist, 1998), positive affect (Baas et al., 2008; Feist, 1998), inspiration (Thrash & Elliot, 2003, 2004), hypomania (Richards et al., 1988; Schuldberg, 2000; von Stumm, Chung, & Furnham, 2011), psychoticism (Batey & Furnham, 2006; Eysenck, 1993), and schizotypy (Kinney et al., 2001; Schuldberg, 2000). It is very likely the common denominator between all these variables is a reduced latent inhibition, which is related to Plasticity (Peterson, Smith, & Carson, 2002) as well as to Psychoticism and schizotypy (Eysenck, 1992a).

In the history of creativity research, the variables underlying the Convergence-Selection axis have received notably less attention than the rest of the model (for a notable exception see Runco, 2003). In this paper, we have shown that Selection indeed had virtually no main direct effect on creativity, but that an important interactive effect with Generation does exist. Though we are far from a complete understanding of these Convergence-Selection variables (their interrelations and their role in creativity), we do believe in their relevance, in particular to better understand high creative achievement or any serious, realistic, functional manifestation of creativity.

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## Tables & Figures

**Table 1. Description of the first-order factors.**

		Factor Mean	Factor S.D.	Items nb.	Mean loading	Cronbach's alpha
<b>Personality</b>						
E	Extraversion	3.316	0.853	8	0.569	0.79
O	Openness	4.103	0.405	8	0.421	0.60
N	Neuroticism	2.836	0.868	8	0.502	0.71
C	Conscientious.	3.913	0.514	8	0.548	0.77
A	Agreeableness	4.331	0.394	8	0.481	0.72
Insp.	Inspiration	3.474	0.395	4	0.539	0.62
N-Conf.	Non-conform.	3.183	0.597	3	0.603	0.62
Distr.	Distraction	3.075	0.624	3	0.525	0.53
Persv.	Perseverance	3.833	0.898	3	0.685	0.68
Ambit.	Ambition	3.737	1.144	3	0.664	0.68
Critic.	Critical Sense	3.782	0.199	3	0.508	0.50
<b>Process</b>						
Gener.	Generation	3.424	0.513	6	0.608	0.77
Select.	Selection	3.800	0.184	6	0.518	0.68
<b>Everyday Creativity</b>						
C-Int.	Intensity	6.340	4.174	2	0.820	0.65
C-Ach.	Achievement	3.479	0.863	7	0.597	0.82

*Note.* All means, standard deviations and loadings were significantly different from 0.

**Table 2. Goodness of fit indices of the components and the overall structural equation model (study 1).**

Component	k	df	param	$\chi^2$	RMSEA (90% C.I.)	SRMR	CFI
Personality	10	31	34	86.51	0.128 (0.096; 0.160)	0.107	0.682
Process	12	53	37	77.28	0.064 (0.028; 0.094)	0.072	0.922
Everyday Creativity	9	24	30	50.48	0.100 (0.061; 0.139)	0.075	0.926
Overall	15	83	52	160.4	0.092 (0.070; 0.113)	0.103	0.739

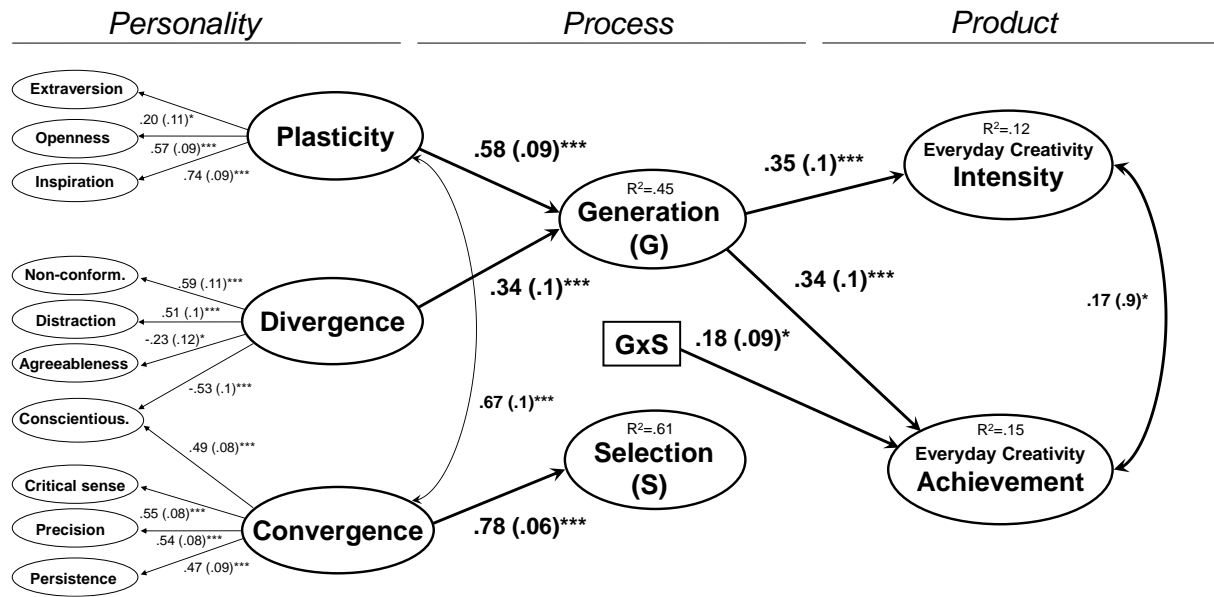
*Note.* k = number of indicators in the model; df = degree of freedom; param = number of estimated parameters; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean squared Residual; CFI = Comparative Fit Index.

**Table 3. Goodness of fit indices of the components and the overall structural equation model (study 2).**

Component	k	df	param	$\chi^2$	RMSEA (90% C.I.)	SRMR	CFI
Personality	18	131	58	216.5	0.081 (0.061 ; 0.100)	0.102	0.81
Process	12	51	39	90.4	0.088 (0.058 ; 0.118)	0.090	0.91
Creative activity	12	51	46	113.1	0.111 (0.083 ; 0.139)	0.079	0.86
Overall	14	73	46	141.3	0.097 (0.073 ; 0.12)	0.066	0.94

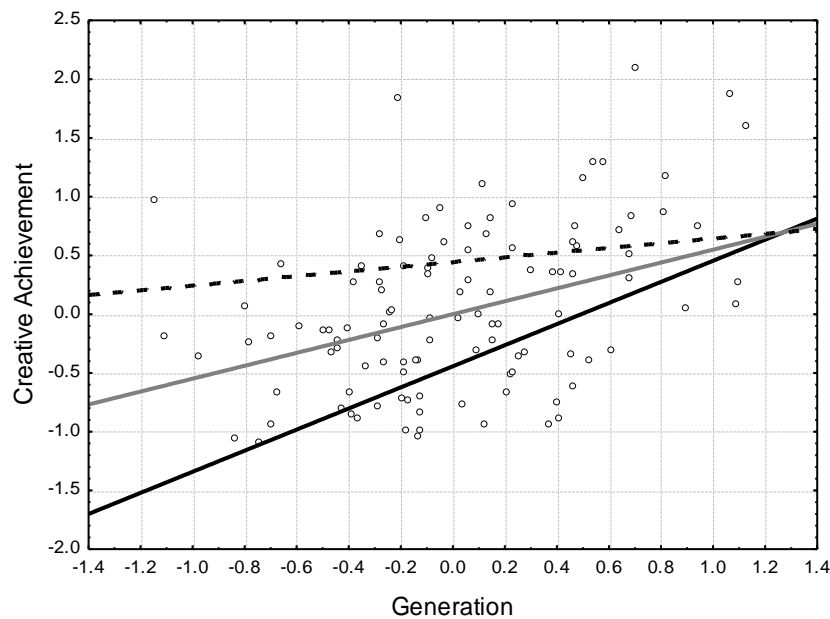
*Note.* k = number of indicators in the model; df = degree of freedom; param = number of estimated parameters; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean squared Residual; CFI = Comparative Fit Index.

**Figure 1. Final overall structural equation model of creativity and personality (study 1).**



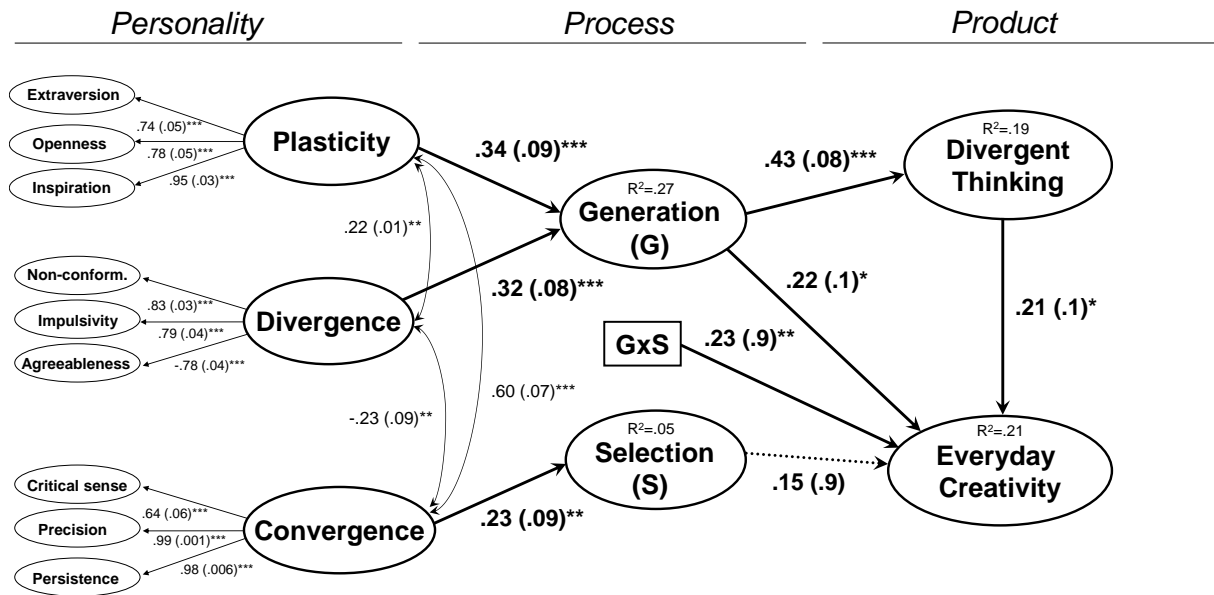
*Note.* All parameters are standardized estimates. Standard errors of estimation are in parentheses. \*,  $p > .05$ ; \*\*\*,  $p > .001$ .

**Figure 2. Interaction graph: effect of Generation on Achievement moderated by levels of Selection.** *The grey, continuous line represents the average main effect of Generation on achievement; the dotted, black line represent the effect of Generation on Achievement for low levels of Selection (2 sd below the mean); the black, continuous line represents the effect of Generation on Achievement for high levels of Selection (2 sd above the mean).*





**Figure 3. Final overall structural equation model of creativity and personality (study 2).**



*Note.* All parameters are standardized estimates. Standard errors of estimation are in parentheses. \*,  $p > .05$ ; \*\*,  $p > .01$ ; \*\*\*,  $p > .001$ .