

The Torrance Tests of Creative Thinking - Figural or Verbal: Which One Should We Use?

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ABSTRACT

Kim's CATs framework (2016) identified creative climates (C), attitudes (A) and thinking (T) skills for innovation. Creativity can be measured by testing and non-testing methods. Testing methods include creativity tests for climate, attitude and thinking skills. Among the creativity tests available, two versions of the Torrance Tests of Creative Thinking - Figural and Verbal (TTCT-F and V) are most commonly used. I examined the relationships between the two versions as well as their reliability across gender. From preschool children to adults, 994 participants' scores on the two versions were used. The results showed that scores on the two versions are significantly related, yet TTCT-F is a more comprehensive, reliable and valid measure of creativity than the TTCT-V.

INTRODUCTION

Innovation requires a particular set of conditions, which are measured by the Torrance Tests of Creative Thinking - Figural (TTCT-F) and Verbal (TTCT-V). The CATs framework (Kim, 2016) illustrated these conditions as the three steps to achieve innovation (see Figure 1): Cultivate creative **C**limates (Step 1); nurture creative **A**ttitudes (Step 2); and apply creative **T**hinking skills (Step 3). The framework categorizes the first two steps into sun, storm, soil, and space (4S climates and attitudes: see later sections). Creative climates include interpersonal relationships, developmental environments and processes, and atmospheres and practices, which provide individuals with the nourishment and support to reach their maximum potential. As the basis of the pyramid suggests (Figure 1), cultivating creative climates is fundamental and results in the positive development of individuals' creative attitudes. Creative attitudes are notable innovators' typical characteristics, beliefs, visions and/or habits, which enable creative thinking skills. Creative thinking skills include inbox, outbox, and newbox (ION) thinking, which are applied at necessary times during the creative process that can lead to innovation.

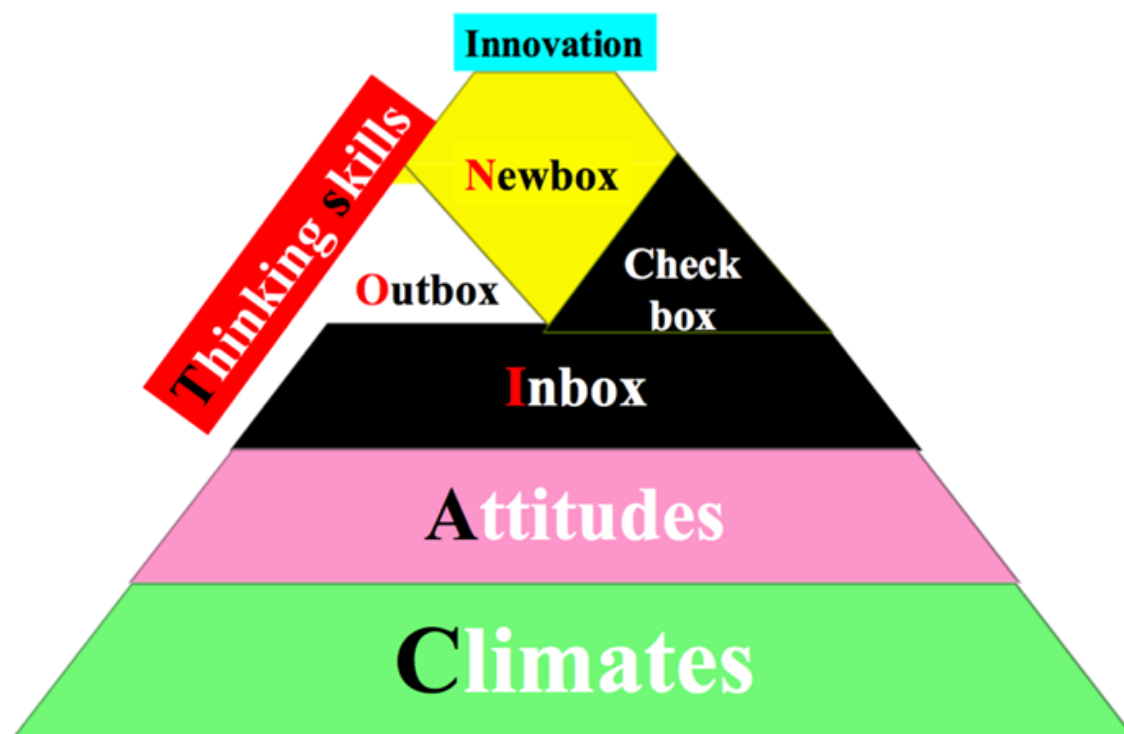


Figure 1. CATs: Creative **C**limates, Creative **A**ttitudes and Creative (Inbox, outbox & newbox: ION) **T**hinking skills

MEASURING CREATIVITY

The three steps of the CATs framework can be measured with both testing and non-testing methods. Non-testing methods include a part by a third party, such as an expert evaluation. Testing methods for the CATs framework include 1) **C**limate tests, such as a cultural climate test, organizational climate test and family climate test; 2) **A**ttitude tests, such as the TTCT-F, the Group Inventory for Finding Talent, the Group Inventory for Finding Interests, the Khatena-Torrance Creative Perception Inventory, What Kind of Person Are You?, Something About Myself, and the Behavioral Characteristics of Superior Students; and 3) **T**hinking tests, such as the Wallach and Kogan Divergent Thinking Tasks, Thinking Creatively with Action and Movement, and both the TTCT-F and the TTCT-V. Among the available tests that measure creative attitudes or creative thinking skills, the TTCT-F is the most commonly used creativity test (Plucker & Renzulli, 1999). There has been a controversy concerning whether it is a valid creativity test or only a divergent thinking test (Kim, 2011a, 2011b), but a meta-analysis study of creativity tests, including divergent thinking tests, concluded that the TTCT-F is the best predictor of creative achievement among the tests included in the study (Kim, 2008b). In the present study, both the TTCT-F and the TTCT-V were explored in-depth first, as few understand what the TTCTs really measure, and then the relationship between the two were studied.

THE COMPONENTS OF THE TTCT-F AND THE TTCT-V

The method of response on the TTCT-F and the TTCT-V are expressed in two different modalities. The responses on the TTCT-F responses are drawn, and those on the TTCT-V are written or given orally. Both the TTCT-F and the TTCT-V have two forms, respectively: Form A and Form B.

The TTCT-V consists of six activities. The stimulus for each activity starts with a picture, and the test taker responds to the picture in writing. The scoring components include the *Fluency*, *Originality* and *Flexibility* subscales. *Fluency* is measured by the number of relevant ideas to the picture. *Originality* is measured by the unusualness of the ideas. *Flexibility* is measured by the variety of different types of ideas (see Kim [2006a] for more details).

The TTCT-F consists of three activities of picture construction, picture completion and repeated figures of lines for Form A and of circles for Form B. The TTCT-F is comprised of five norm-referenced measures, which means that the number of points earned are relative to the norm group. The subscales include *Fluency*, *Originality*, *Elaboration*, *Abstractness of Titles* and *Resistance to Premature Closure*. Additionally, 13 criterion-referenced measures of *Creative Strengths* assign credits if they appear in the test-taker's response. The TTCT-V measures only outbox imagination, but the TTCT-F measures creative attitudes and creative thinking skills of Kim's CATs (2016), as Table 1 shows. This indicates that the TTCT-F is not just divergent thinking or outbox imagination and is a comprehensive measure of creative potential (Kim, 2006a, 2007, 2008a, 2011a, 2011b).

Table 1
TTCT Figural Subscales in Relation to Creative Thinking Skills and Creative Attitudes

XCreative Thinking skills & Attitudes				TTCT Figural Subscales		
Creative Thinking skills	Inbox	Expertise development & Critical thinking				
	Outbox	Fluent imagination		Fluency		
		Flexible imagination		*Unusual or Internal visualization		
		Original imagination		Originality		
	Newbox	Synthesis	Boundary-crossing		*Extending or breaking boundaries	
				Metaphorical-thinking	*Synthesis of lines or circles & *Synthesis of incomplete figures	
		Pattern-finding & Dot-connecting	Nonverbal-thinking	*Internal visualization		
			Five-sense-thinking	*Colorfulness of imagery		
			Body-thinking	*Movement or action		
		Transformation	Elaboration	Elaboration		
			Refinement	*Richness of imagery		
			Simplicity	Abstractness of titles		
		Promotion	Storytelling & Articulation		*Storytelling articulateness	
			Naming		*Expressiveness of titles	
Creative Attitudes	Open-minded		Resistance to premature closure			
	Playful		*Humor			
	Emotional		*Emotional expressiveness			
	Daydreaming		*Fantasy			

Note. X: For more information, see Kim (2016)

*: The 13 checklists of Creative Strengths.

Creative Attitudes

Kim (2016) identified 27 creative attitudes, which are categorized as the 4S attitudes:

- Sun attitudes: The *optimistic, big-picture thinking, curious, spontaneous, playful* and *energetic* attitudes.
- Storm attitudes: The *independent, self-disciplined, diligent, self-efficacious, resilient, risk-taking, persistent* and *uncertainty-accepting* attitudes.
- Soil attitudes: The *open-minded, bicultural, mentored, complexity-seeking* and *resourceful* attitudes.
- Space attitudes: The *emotional, compassionate, self-reflective, autonomous, daydreaming, nonconforming, gender-bias-free* and *defiant* attitudes.

These attitudes are influenced by creative climates and learned and developed through practice. No creative individual possesses all the 27 attitudes, but the greatest innovators do, and these attitudes predict innovation better than any other traits (such as IQs) in all fields by enabling individuals' creative thinking skills and their desire to use them (Kim, 2016). Among the 27 attitudes, the TTCT-F measures the open-minded, emotional, playful, and daydreaming and nonconforming attitudes (Kim, 2016).

The open-minded attitude. The open-minded attitude considers others' views that are different from one's own. Creative individuals are daring and open to new and broad experiences, and open-mindedness is one of the most consistent attitudes found among creative individuals (da Costa, Páez, Sánchez, Garaigordobil, & Gondim, 2015; Karwowski & Lebuda, 2016; Kim, 2016; Li et al., 2015; Ma, 2009). Open-mindedness allows continuous learning by questioning and changing ingrained beliefs, which strengthens critical thinking (Kim, 2016). The open-minded attitude is measured by the *Resistance to premature closure* subscale.

The emotional attitude. The emotional attitude includes recognizing, understanding and expressing individuals' feelings. Creative individuals communicate their own state of mind and display empathy for others. Emotions affect creativity more than cognitive or other rational factors, and emotions are present in all creative endeavours including science and arts. The emotional attitude is measured by the *Emotional expressiveness* subscale of *Creative strengths*.

The playful attitude. The playful attitude includes approaching situations in exploratory ways and seeing the lighter side of challenges. Creative individuals are humorous and focus on their passion and goal, while using flexible thinking, to structure their work as fun and/or play. Their free flowing, creative thinking helps them find ideas or solutions that might not have been considered with pure logic or common sense. They explore problems or situations for surprising connections or opportunities. The playful attitude is measured by the *Humor* subscale of the *Creative strengths*.

The daydreaming attitude. The daydreaming attitude includes sustaining unrealistic but goal-oriented thoughts while awake. It helps individuals disregard existing norms in their extemporaneous thoughts, but capture useable aspects of ideas, which is beneficial for creative thinking. Creative individuals seek unique ideas and take advantage of daydreams to achieve innovation. The daydreaming attitude is measured by the *Fantasy* subscale of the *Creative strengths*.

The nonconforming attitude. The nonconforming attitude differs from mainstream patterns of thought and behaviour, helping individuals find their uniqueness beyond existing norms. By breaking conventional or traditional ways of thinking, they develop new

concepts, approaches and products; reject limits imposed by others and set their own rules; and find their strengths and pursue their own goal instead of others'. The nonconforming attitude is measured by the *Extending or breaking boundaries* subscale (e.g., test-takers extend their drawings beyond a given box) of the *Creative strengths*.

Creative Thinking skills: The ION

The ION thinking skills (Kim, 2016) are required to achieve innovation (Figure 1). Inbox thinking is narrow and deep, which helps develop expertise (Figure 2). Outbox imagination (or outbox thinking) is quick and broad, which helps imagine numerous and diverse possibilities to develop unique ideas (Figure 3). Deep-inbox thinking (or critical thinking) makes the unique ideas (resulting from outbox imagination) useful (Figure 2). Newbox connection (or newbox thinking) combines elements of inbox and outbox thinking to create something new. It connects and synthesizes ideas resulting from critical thinking, elaborates and transforms them into a new creation, and promotes it (Figure 4).

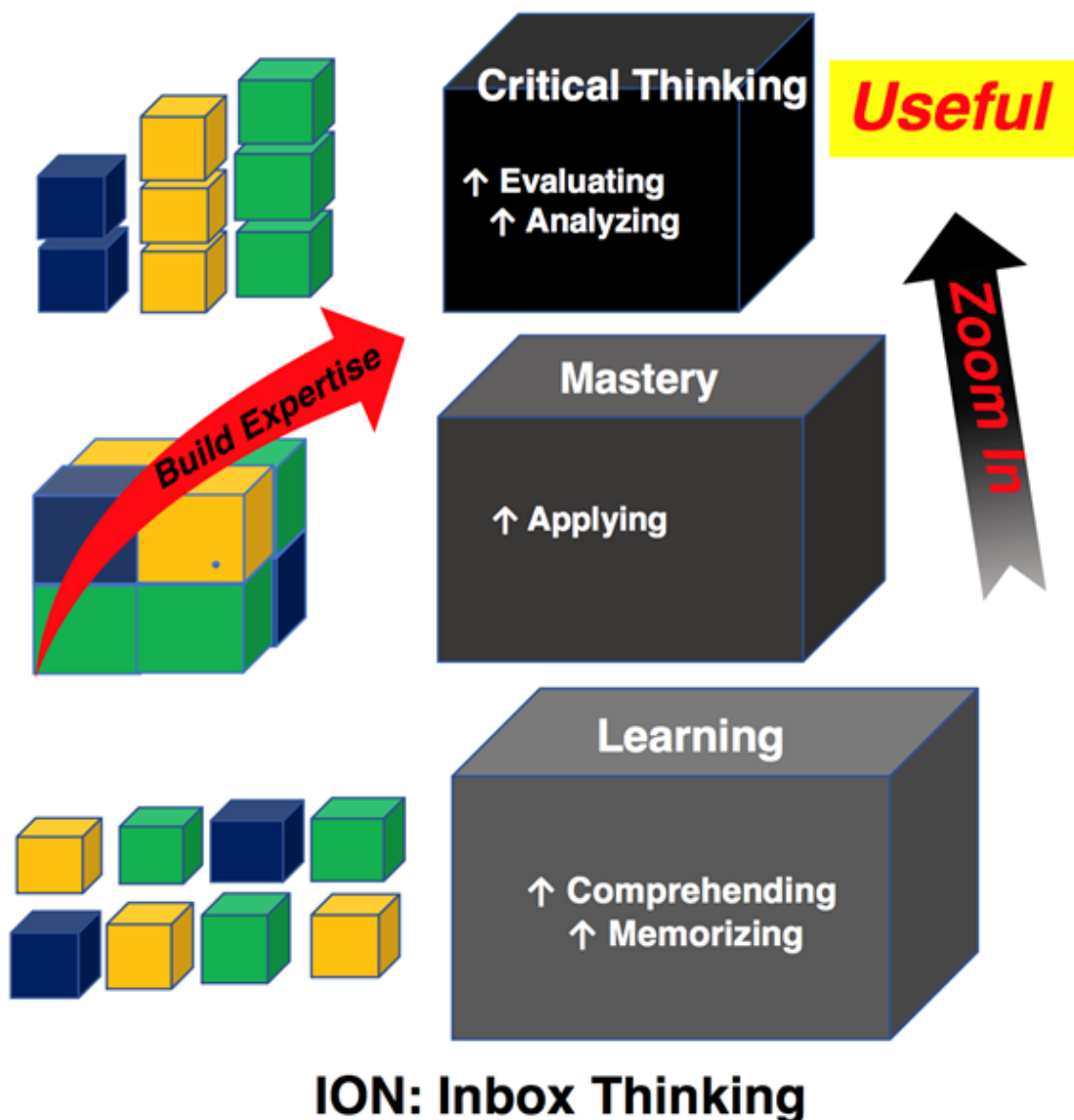


Figure 2. ION: Inbox Thinking

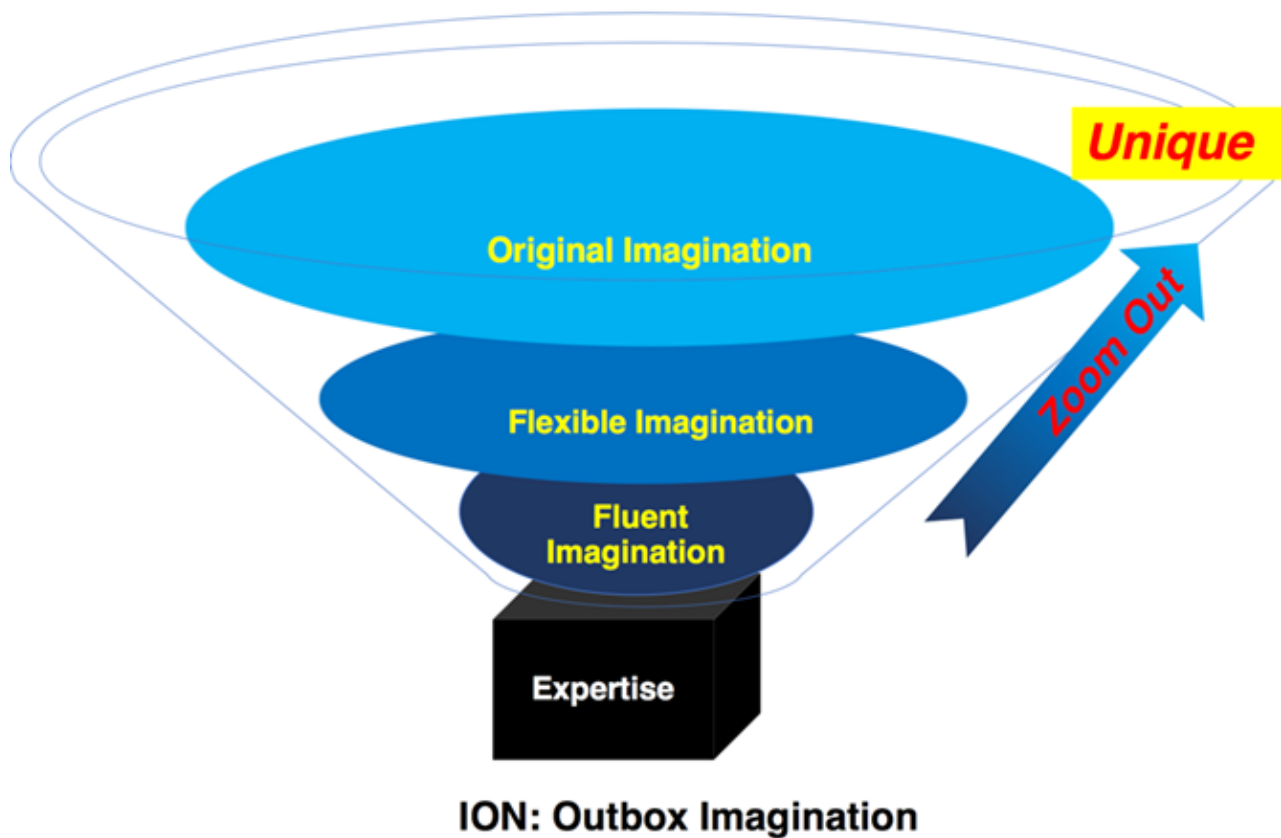


Figure 3. ION: Outbox Imagination

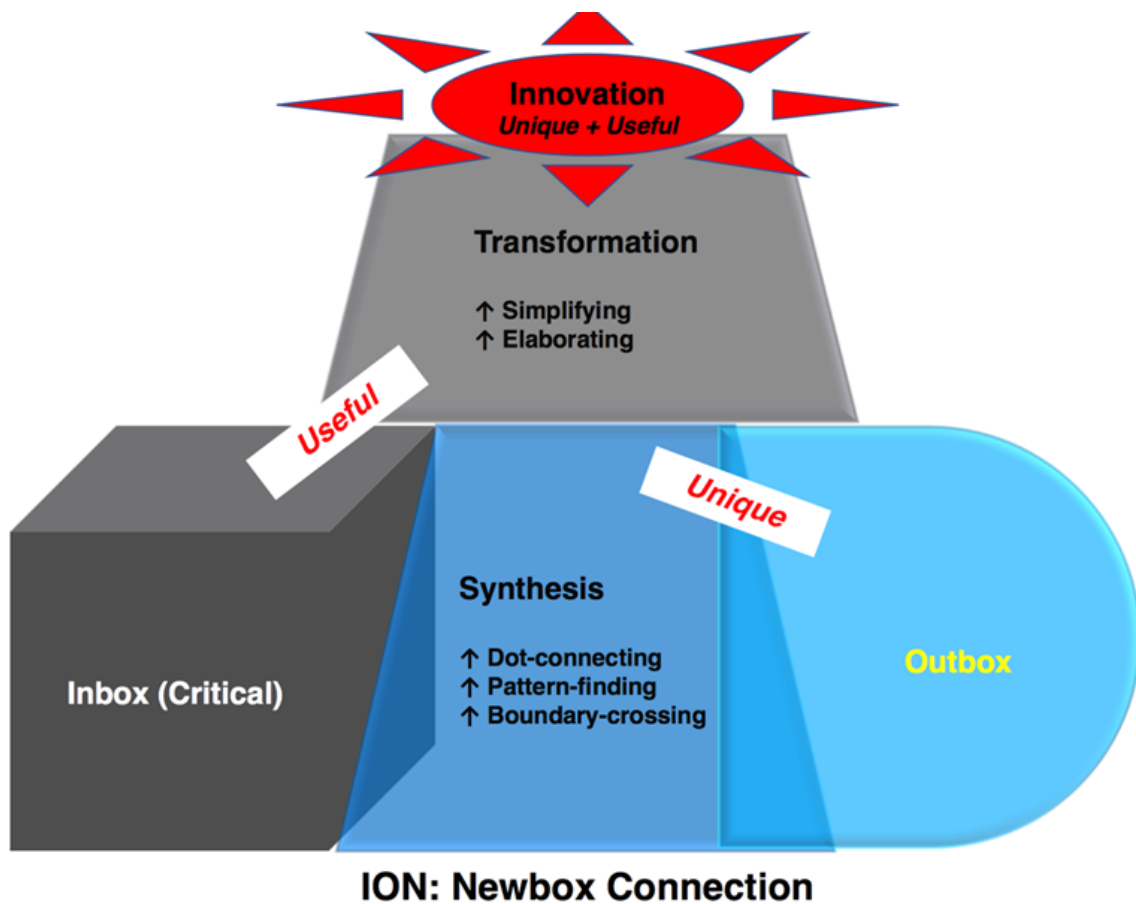


Figure 4. ION: Newbox Connection

Inbox thinking. Inbox thinking requires a persistent and systemic process to obtain the necessary knowledge and skills for expertise development. Expertise is the complete and in-depth understanding of a topic or subject. To develop expertise, individuals first use lower-level skills, such as memorization and comprehension, and then apply their learning to solve real world situations or problems (Figure 2). Expertise provides the foundation of outbox and newbox thinking, as the basis of the creative thinking skills of Figure 1 indicates (Kim, 2016; e.g., Vincent, Decker, & Mumford, 2002).

Inbox thinking also includes critical thinking (deep-inbox thinking), which requires skills to analyze and evaluate ideas (Figure 2), and it occurs after ideas have been generated during outbox imagination. Evaluating or checking the particulars ensures the usefulness of an idea (checkbox of Figure 1), and expertise is essential for critical thinking (Kim, 2016).

Outbox imagination. Outbox imagination is also called divergent (or outside-the-box thinking), including fluent, flexible, and original imagination skills (Figure 3). Outbox imagination breaks the rules (Figure 1), challenges assumptions, and reframes ideas or information in spontaneous ways. Outbox imagination stems from a large, obtainable supply of expertise from inbox thinking. The TTCT-F measures fluent, flexible and original imagination skills, as Table 1 shows.

Fluent imagination is a skill used to spontaneously generate many ideas (Figure 3). The more ideas generated, the more unique and better ideas, and therefore, fluent imagination is the foundation of both flexible and original thinking. If individuals cannot generate many ideas, then they generate less substantial ideas. Fluent imagination is measured by the *Fluency* subscale (Table 1).

Flexible imagination is a skill used to generate various ideas from different angles by considering multiple options or perceiving a common object or situation in different ways (Figure 3). It is an even better predictor of innovation than fluent imagination. Flexible imagination is measured by the *Unusual visualization* subscale (Table 1).

Original imagination is a skill used to generate new or unusual ideas, the most critical element of creative thinking (Figure 3). It is an even better predictor of innovation than flexible imagination. Original imagination is measured by the *Originality* subscale (Table 1).

Newbox connection. At the top of the pyramid, supported by both inbox and outbox thinking, is newbox thinking or newbox connection (Figure 1). It connects, combines and synthesizes previously unrelated ideas; usefully refines and transforms the synthesized ideas into a new creation (Figure 4); and finally, promotes the creation to be recognized as an innovation by society. The TTCT-F measures newbox connection skills of synthesis, transformation and promotion (Table 1).

Synthesis. Synthesis is combining the essences of ideas and information into a new coherent whole (Figure 4). Innovation often starts by synthesizing elements of existing ideas because innovation is an extension of existing knowledge/skills. The TTCT-F measures boundary-crossing, pattern-finding, and dot-connecting skills, which connect different aspects of unrelated ideas (Table 1).

Boundary-crossing is thinking unconventionally, going beyond a subject or a field, and seeing a connection between different or irrelevant subjects or fields. It is measured by the *Extending or breaking boundaries* subscale of *Creative strengths* (Table 1).

Pattern-finding is disregarding irrelevant or superficial information and bringing essential elements or attributes forward. It uses symbols to represent complex ideas, images or data without losing the essence or distorting facts. Dot-connecting is seeing ideas or information as a whole instead of many unrelated pieces. Pattern-finding and dot-connecting make new connections between irrelevant ideas through: 1) metaphorical-thinking that helps form analogies and bridge conceptual gaps to view ideas from new perspectives, measured by the *Synthesis of lines or circles* subscale and the *Synthesis of incomplete figures* subscale of *Creative strengths*; 2) nonverbal-thinking or -communication, such as visualizing or thinking in pictures, measured by the *Internal visualization* subscale of *Creative strengths*; 3) five-sense-thinking (thinking with the five senses: e.g., using or combining sight, sound, touch, smell or taste), measured by the *Colorfulness of imagery* subscale of *Creative strengths*; and body-thinking (thinking with the body: e.g., communicating ideas in physical, lively and emotionally vivid ways), which is measured by the *Movement or action* subscale of *Creative strengths* (Table 1).

Transformation. Creativity is more than just coming up with an idea; synthesized ideas must be transformed into a useful creation, requiring individuals to diligently and persistently elaborate, refine and simplify to produce a final creation (Figure 4). The TTCT-F measures elaboration, refinement and simplicity skills (Table 1).

Elaboration is necessary to refine details, explain, expand, enrich and complete the lengthy transformation stage. It is measured by the *Elaboration* subscale (Table 1).

After elaborating the synthesized ideas with details, refinement is necessary to improve or magnify the uniqueness of the creation by experimenting with unexpected variations. Based on others' perspectives or criticism, further refinement makes a good creation better. Refinement is measured by the *Richness of imagery* subscale of *Creative strengths* (Table 1).

When transforming ideas into their maximum usefulness, there must be a balance of elaboration/refinement and simplicity. Simplicity is removing unessential elements to

make the essence useful by thoroughly understanding the complexities. It is measured by the *Abstractness of titles* subscale (Table 1).

Promotion. A creation must be promoted in the right place at the right time so that it can be recognized as an innovation by others and society (Figure 4). The TTCT-F measures storytelling, articulation and naming skills (Table 1).

Crafting and sharing compelling and interesting stories is necessary for promotion. The audience remembers simplistic and persuasive storytelling better than factual lists, because it appeals to the audiences' emotions and enables them to create mental images. Articulating features and benefits of a creation is also necessary for promotion so that the audience can understand, accept and desire the creation. Both storytelling and articulation skills are measured by the *Storytelling articulateness* subscale (Table 1).

Developing a creation's name or title that grabs others' attention is also a necessary skill for promotion, because it helps the audience remember and convey it to others. Naming is measured by the *Expressiveness of titles* subscale (Table 1).

Relationships between the TTCT-F and the TTCT-V

Torrance (2000) indicated that the TTCT-F and the TTCT-V provide different contributions that together make up the whole of one's creative potential, because they measure creativity differently. Cramond, Matthews-Morgan, Bandalos and Zuo (2005) concluded that the two versions of the TTCT measure different creative abilities, citing Torrance (1990)'s report that indicated little correlation ($r = .06$) between scores on the two tests. However, the study (Torrance, 1990) was never published and is currently unavailable. Kim (2011b) also argued that Torrance intended that the two versions are a part of the complete measure of creative potential, because they measure different cognitive skills and attitudes.

Ongoing discussions in the field of creativity measurement are whether the TTCT-F or the TTCT-V measures general creative potential and whether creative potential should be measured in a specific domain. Baer (2009, 2011) argued that the lack of relationship between the scores on the two versions of the TTCT disproves the TTCT's ability to provide a domain-general measure of creativity. Baer (2009) claimed that the two versions are like two completely different IQ tests because they are unrelated, even though they are intended to measure the same thing. Baer (2009, 2011) argued that the correlation of .06 between scores on the two versions indicates that they measure two different constructs: a) Either the TTCT-F or the TTCT-V measures a general factor, and the other measures something unrelated to creativity, or b) Neither of the two versions of the TTCT measures creativity. Thus, Baer (2011) concluded that Cramond and Kim should argue

for domain-specificity of the two versions, but this is contrary to Torrance's (2000), Cra-
mond et al.'s (2005) and Kim's (2011b) arguments, that the two versions together were
intended to assess individuals' general creative potential.

Although the TTCT-F and the TTCT-V are the most widely used and researched crea-
tivity tests, only two studies (e.g., Clapham, 2004; Ulger, 2015) have specifically exam-
ined the relationships between the two versions. Both reported a significant relationship
between the two versions (e.g., $r = .36$, $p < .01$ in Clapham, 2004; $r = .25$, $p = .01$ in Ul-
ger, 2015). Only Ulger (2015) has examined the relationships between the *subscales*
of the two versions. However, Ulger used only *Fluency* and *Originality* subscales with
a smaller sample size ($N = 108$). Thus, this study examined the relationships between the
two versions using each of the subscales with a larger sample size ($N = 994$).

In addition, the TTCT manuals provide both age-based and grade-based norms, so it
can be assumed that standard scores on the TTCTs are fair across age or grade levels.
Torrance (1977; Torrance & Aliotti, 1969) and others concluded that scores on the TTCTs
are fair in terms of gender; however, this has not been confirmed by recent research.
A definite confirmation of the gender neutrality of the TTCTs is important because they
are often used to identify gifted students, and could be biased if male or female students
have higher scores than their counterparts.

The research questions were: 1) How are the total scores and the subscale scores on
the TTCT-F and the TTCT-V related?; and 2) Between the two versions, which one is fair-
er across gender?

METHOD

Participants

For the present study, scores from the TTCT-F and the TTCT-V were used from 994 par-
ticipants ranging in age from preschool children to adults. The sample included 597
males and 364 females (i.e., 33 participants did not indicate their gender). Table 2 shows
the number of male and female participants for each age group category. The data were
obtained from the Scholastic Testing Services, and sampling information, including de-
mographics, was not reported because of the company's anonymity policy.

Table 2
Sample Sizes, Means and Standard Deviations of the Scores on the TTCT Figural
and the TTCT Verbal According to Age Groups (N = 961)

<i>n</i>			Verbal Index <i>M</i> (<i>SD</i>)		Figural CI <i>M</i> (<i>SD</i>)	
Age\Sex	Male	Female	Male	Female	Male	Female
Ages 4-7	121	132	103.78 (18.43)	106.20 (16.86)	112.57 (16.13)	117.19 (14.88)
Ages 8-9	153	160	96.15 (20.46)	102.96 (18.78)	106.81 (16.53)	112.45 (15.25)
Ages 10-17	52	44	95.21 (18.68)	104.98 (17.24)	111.29 (16.11)	112.34 (13.66)
Adults	271	28	71.79 (23.80)	110.14 (16.22)	112.60 (14.31)	124.50 (14.35)
Total	597	364	86.55 (25.52)	104.93 (17.78)	111.00 (15.59)	115.08 (15.22)

Note. Verbal Index = The mean of the Verbal subscales, CI = Creativity Index = The mean of the Figural subscales plus Strength (13 Checklists of Creative Strengths).

Each of the subscale scores was approximately normally distributed and the skew and kurtosis value were not greater than |1.0|. Some creative attitudes and outbox and newbox thinking are assessed by the Checklist of 13 *Creative Strengths* of the TTCT-F. However, these scores were not analyzed separately because Creative Strengths scores were available only as composite scores, which have been included under the creative attitude category. Considering the large sample size and multiple significance tests used in the study, I used conservative α levels ($=.001$) after Bonferroni corrections in all analyses of the study.

RESULTS

The correlation coefficients between the TTCT-F and TTCT-V subscales for the total group are presented in Table 3 and those for male and female participants separately are presented in Table 5. As Table 3 shows, Verbal Index (Mean of the Verbal *Fluency*, *Flexibility*, & *Originality* scores) was significantly associated ($r = .39$, $p < .001$) with Figural Creativity Index ([Mean of the Figural *Fluency*, *Originality*, *Elaboration*, *Abstractness of Titles*, & *Resistance to Premature Closure*] + [*Creative Strengths*]). Verbal Index was significantly associated ($p < .001$) with Figural outbox imagination (*Figural Fluency*, $r = .27$; and *Figural Originality*, $r = .32$), newbox connection (*Elaboration*, $r = .39$; and *Abstractness of Titles*, $r = .28$), and creative attitude (*Resistance to Premature Closure*, $r = .19$;

and *Creative Strengths*, $r = .13$). Verbal Index was more strongly associated with Figural *Elaboration* ($r = .39$) than other Figural subscales. Verbal *Fluency* was more strongly associated with Figural *Elaboration* ($r = .38$) than Figural *Fluency* ($r = .29$). Verbal *Flexibility* was more strongly associated with Figural *Elaboration* ($r = .40$) than other Figural subscales. Verbal *Originality* was more strongly associated with Figural *Elaboration* ($r = .35$) than Figural *Originality* ($r = .30$).

Table 3
Correlation Coefficients between the Scores on the TTCT Figural and the TTCT Verbal Subscales for the Total Group (N =994)

		Verbal			
	Figural	Index	Fluency	Flexibility	Originality
Outbox Imagination	CI	.39*	.39*	.38*	.36*
	Fluency	.27*	.29*	.24*	.24*
	Originality	.32*	.32*	.30*	.30*
Newbox Connection	Elaboration	.39*	.38*	.40*	.35*
	Titles	.28*	.27*	.29*	.27*
Creative Attitude	Closure	.19*	.20*	.18*	.18*
	Strengths	.13*	.12*	.13*	.13*

Note. Verbal Index = The mean of Verbal Fluency, Flexibility and Originality; CI = Creativity Index = (The mean of Figural Fluency, Originality, Elaboration, Abstractness of Titles, and Resistance to Premature Closure) + Strength; Titles = Abstractness of Titles; Closure = Resistance to Premature Closure; Strengths = Creative Strengths = 13 Checklists of Creative Strengths.

* $p < .001$.

Table 4
Means and Standard Deviations for the Scores on the TTCT Figural and the TTCT Verbal Subscales

TTCT	Subscale		Male		Female	
			Mean	SD	Mean	SD
Verbal		Fluency	85.78	26.94	104.40*	19.53
		Originality	94.58	25.34	110.26*	17.82
		Flexibility	80.37	26.22	101.18*	18.82
Figural	Outbox imagination	Fluency	99.16	19.69	101.93	18.98
		Originality	99.51	19.14	101.43	18.05
	Newbox connection	Elaboration	94.38	18.63	103.26*	19.15
		Titles	101.69	20.74	106.71*	21.90
	Creative attitude	Closure	100.26	17.69	101.27	18.17
		Strengths	12.00	3.67	12.14	3.61

Note. Titles = Abstractness of Titles, Closure = Resistance to Premature Closure, Strengths = 13 Checklists of Creative Strengths. * $p < .001$.

Table 5
Correlation Coefficients between the Scores on the TTCT Figural
and the TTCT Verbal Subscales for Male (n = 597) and Female (n =364)

Figural TTCT		Verbal TTCT					
		Fluency		Flexibility		Originality	
		Male	Female	Male	Female	Male	Female
	CI	.32*	.44*	.26*	.49*	.33*	.35*
Outbox imagination	Fluency	.30*	.24*	.25*	.20*	.27*	.17*
	Originality	.33*	.28*	.28*	.29*	.32*	.22*
Newbox connection	Elaboration	.25*	.45*	.23*	.49*	.25*	.39*
	Titles	.21*	.26*	.17*	.37*	.24*	.21*
Creative attitude	Closure	.19*	.22*	.15*	.22*	.18*	.16*
	Strengths	.02	.29*	-.01	.39*	.06	.26*

Note. CI = Creativity Index = (The mean of Figural Fluency, Originality, Elaboration, Titles and Closure) + Strength; Titles = Abstractness of Titles; Closure = Resistance to Premature Closure; Strengths = Creative Strengths = 13 Checklists of Creative Strengths.

* $p < .001$.

As Table 3 shows, Verbal *Fluency* was significantly associated ($p < .001$) with Figural outbox imagination (Figural *Fluency*, $r = .29$; and Figural *Originality*, $r = .32$), newbox connection (*Elaboration*, $r = .38$; and *Abstractness of Titles*, $r = .27$), and creative attitude (*Resistance to Premature Closure*, $r = .20$; and *Creative Strengths*, $r = .12$). Interestingly, Verbal *Fluency* was more strongly associated with Figural *Elaboration* ($r = .38$) than Figural *Fluency* ($r = .29$). However, when examining the correlation coefficients for males and females separately, as Table 5 shows, Verbal *Fluency* was more strongly associated with Figural *Elaboration* ($r = .45$) for females, but with Figural *Originality* ($r = .33$) for males, than with other Figural subscales.

Verbal *Flexibility* was significantly associated ($p < .001$) with Figural outbox imagination (Figural *Fluency*, $r = .24$; and Figural *Originality*, $r = .30$), newbox connection (*Elaboration*, $r = .40$; and *Abstractness of Titles*, $r = .29$), and creative attitude (*Resistance to Premature Closure*, $r = .18$; and *Creative Strengths*, $r = .13$). Verbal *Flexibility* was more strongly associated with Figural *Elaboration* ($r = .40$) than other Figural subscales. However, when examining the correlation coefficients for males and females separately, as Table 5 shows, Verbal *Flexibility* was more strongly associated with Figural *Elaboration* ($r = .49$) for females, but with Figural *Originality* ($r = .28$) for males, than with other Figural subscales.

Verbal *Originality* was significantly associated ($p < .001$) with Figural outbox imagination (Figural *Fluency*, $r = .24$; and Figural *Originality*, $r = .30$), newbox connection (*Elaboration*, $r = .35$; and *Abstractness of Titles*, $r = .27$) and creative attitude (*Resistance to Premature Closure*, $r = .18$; and *Creative Strengths*, $r = .13$). Interestingly, Verbal *Originality* was more strongly associated with Figural *Elaboration* ($r = .38$) than Figural *Originality* ($r = .30$). However, when examining the correlation coefficients for males and females separately, as Table 5 shows, Verbal *Originality* was more strongly associated with Figural *Elaboration* ($r = .39$) for females, but with Figural *Originality* ($r = .32$) for males, than with other Figural subscales.

Table 5 shows the means and standard deviations of the Figural Creativity Index and Verbal Index as well as for each age group category and gender. To examine the gender effect on the TTCT, I conducted a multivariate analysis of variance (MANOVA) on the TTCT subscale scores and found a significant gender effect (Wilks' $\lambda = .82$, $F [9, 951] = 22.97$, $p < .001$). As follow-up tests to the MANOVA, I conducted ANOVAs on the TTCT-F and the TTCT-V subscales to determine their contribution to the significant gender effect. For the TTCT-F, I found significant gender differences (females > males) in newbox connection (for *Elaboration*, $F [1, 959] = 50.33$, $p < .001$; and for *Abstractness of Titles*, $F [1, 959] = 12.70$, $p < .001$). However, gender differences were neither significant in outbox imagination (for *Fluency*, $F [1, 959] = 4.61$, $p = .032$; nor for *Originality*, $F [1, 959] = 2.37$, $p = .124$); nor in creative attitude (for *Resistance to Premature Closure*, $F [1, 959] = 0.72$, $p = .398$; nor for *Creative Strengths*, $F [1, 959] = 0.33$, $p = .564$). For the TTCT-V, however, I found significant gender differences (females > males) in all of the Verbal subscales: *Fluency* ($F [1, 959] = 131.63$, $p < .001$), *Originality* ($F [1, 959] = 107.20$, $p < .001$) and *Flexibility* ($F [1, 959] = 174.49$, $p < .001$).

DISCUSSION

The significant relationship ($r = .39$) between the overall scores on the TTCT-F (Figural) and the TTCT-V (Verbal) might indicate that the two versions measure one creativity factor, which is consistent with previous findings (e.g., Clapham, 2004; Ulger, 2015). However, it is inconsistent with Torrance's (1990) and Cramond et al.'s (2005) claims that the two versions measure two different sides of one general creativity factor, because Torrance (1990) might have used a smaller number of participants than Clapham (2004) and Ulger (2015) did. Verbal outbox imagination (fluent, flexible and original imagination) scores' significant associations with Figural outbox imagination (fluent and original imagination), with newbox connection (elaboration and simplicity skills) and with creative attitude (open-mindedness and Creative Strengths) scores indicate that the two versions

might measure similar concepts. However, Verbal scores are mainly associated with Figural elaboration skills for females, but with Figural original imagination for males. This might suggest that the TTCT-V measures only some elements of the creativity that is measured by the TTCT-F. Moreover, the findings of significant gender differences (females > males) in only newbox connection for TTCT-F, but in all fluent, flexible and original imagination for TTCT-V, indicate that the TTCT-F is a more reliable and valid measure of creativity than the TTCT-V.

For females, both Verbal fluent imagination and original imagination are associated with Figural elaboration skills more strongly than with Figural fluent imagination and original imagination. For males, however, both Verbal fluent imagination and original imagination are mainly associated with Figural original imagination. These findings, combined with the earlier findings of females' better elaboration (on the TTCT-F) and males' better outbox (all fluent, flexible and original) imagination (on the TTCT-V), indicate that females are best at elaboration skills (to focus, think in-depth and express complex thoughts) whereas males are best at original imagination, which respectively best predict their creative thinking skills. This is consistent with previous studies' findings, that due to their attention to detail and their persistence, females are best at inbox thinking and elaboration skills, whereas males are best at outbox imagination (e.g., Cheng, Kim, & Hull, 2010; Kim, Cramond, & Bandalos, 2006; Kim, Lee, Chae, Andersen, & Lawrence, 2011; Lee & Kim, 2011; Razumnikova, Volf, & Tarasova, 2009). This might be because traditionally females are expected to conform to rules more than males (Bender, Nibbelink, Towner-Thyrum, & Vredenburg, 2013; Charyton, Elliott, Rahman, Woodard, & DeDios, 2011; Cogérino, Bois, & Amorose, 2006; Razumnikova, 2002; Stoltzfus, Nibbelink, Vredenburg, & Thyrum, 2011).

CONCLUSIONS

The results of the present study indicate that the TTCT-F and the TTCT-V are significantly related; yet the TTCT-F is a more comprehensive, reliable and valid measure of creative potential than the TTCT-V. The TTCT-F provides test-takers with *profiles of their* creative thinking skills and creative attitudes compared to their peers. The profiles highlight test-takers' areas of strengths and weaknesses so that they can further develop their creative potential. This information is also useful as a cross-pollination tool, because notable innovators in history have cross-pollinated with others with different strengths. Cross-pollination is sharing, adaptation and building upon the diverse expertise of others, which stretches across fields through networking, collaboration and/or win-win competition. (Kim, 2016).

Traditional IQ tests are a common form of assessment used to identify exceptional students for alternative programmes like advanced placement. However, Kim's meta-

analysis (2005) showed a negligible relationship between IQ and creativity, which indicates that even without high IQs, individuals may be highly creative. The TTCT-F is culturally fairer (Cramond, 1993; Torrance, 1971, 1977; Torrance & Torrance, 1972) and predicts creative achievement better (Kim, 2008b) than IQ tests and other creativity tests (including divergent thinking tests). A creative mind is today's greatest treasure, which needs to be identified and nurtured. This will help reverse the creativity crisis that stems from the creativity decline in the United States since the 1990s (Kim, 2011c). The TTCT-F should be used to identify and develop all children's creativity.

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