The Influence of Bilingualism on Creative Thinking among College Students

Silvia Nevado Roca

X16114353

National College of Ireland - School of business

Dublin, Ireland

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Abstract

The purpose of this study was to investigate the effects of bilinguals or monolinguals on reliable measures of divergent and convergent thinking of creativity performances among 43 undergraduate students from the National College of Ireland (NCI). The Remote Association Test (RAT) a convergent thinking measure that also valued insight experiences, the Subjective Self Rating English proficiency questioner were used to look at the relationship between the degrees of bilingualism, and the Torrance Test of Creative Thinking for adults (ATTA), a standard divergent thinking test was used to measure creative potential. However, the poorer overall performance among bilinguals on the ability to complete successfully the RAT-test and the framing a creative problem in a verbal context results indicated bilinguals have poor accomplishment performance in our sample, this outcome is consistent with previous studies. Hence, the overall the results on creativity (ATTA) indicated no statistical differences between the group's condition and gender.

Keywords; bilingualism, insight, problem solving, working memory, creativity, Remote Associates Test, associative processing, convergent thinking, divergent thinking

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Introduction

This paper focuses on the difference between the levels of creativity between bilingual and monolingual college students. Creativity is a complex ability that is influenced by several features of social settings such as culture or language (Leikin, 2013). Bilingual individuals are normally involved in two cultures, using two languages, in contrast to monolinguals who are enclosed by one national environment and use one language on a regular basis. Several proposals examine the reasons why bilingualism allows developing abilities to spread into domains, such as creativity and cognitive performance. In this paper, we looked into the relationship between bilingualism as a cognitive process and mechanism, on executive functions that affect the creative process.

Definitions

What is creativity?

Creativity is frequently considered a mental process that builds the formation of new ideas or new links between current ideas or concepts (Simonton, 2010). As a shared criteria, creativity requires originality (often considered innovation, novelty) and utility, usefulness or with a value (Runco, & Jaeger, 2012). Weisberg, 2015 had some different criterion, he proposed creativity as a novel creation made with intentionality, for the reason that judgments of value are subjective and change from generation to generation.

What is bilingualism?

A definition of a heritage speaker in this case is an individual raised in a family where a non-English language is spoken (i.e., the current study examined bilinguals living in the linguistic environments of the L2), who speaks or just understands the heritage language, and who stands to some degree bilingual in English and the heritage language (Valdés, 2001). Other definitions of bilingual could distinguish between a simultaneous bilingual; those who learned both languages from birth, and a sequential bilingual; those who learned one language before the other, during childhood after the age of five or above, and there is

switching between both languages (Tabori, Mech, & Atagi, 2018). The second-language (L2) user will communicate like a native speaker, or otherwise the inability to sound identical to a native is caused by acquiring L2 by an older age (Cook, & Wei, 2016). Both languages are active and therefore thus implicate the bilingual to use cognitive resources to regulate the comparative levels of activation of the two languages (Gollan, Montoya, & Bonanni, 2005).

Research had pointed out that bilinguals may be less fluent in either of their languages than monolingual, those who speak the same language all the time (Michael & Gollan, 2005), overall with limited reading and writing skills (Carreira, & Kagan, 2011). Empirical data offers support for both bilingual advantages and disadvantages. However, the broad studies on bilingualism and creativity have been almost concentrated on children (Kharkhurin, 2010).

Theoretical background

Bilingualism and creativity

Peal and Lambert (1962) found that bilingual children foster more cognitive flexibility and creativity as a mechanism of shifting concepts amongst two languages and two different perspectives. Additionally, Cummins (1976) proposed that bilingualism increases abstract symbolic association and mental ability for each concept to be spoken, as a binary equivalent lexical representation to be accessible (i.e. translation equivalents). Therefore, creativity may affect a bilingual's ability to live with ambiguity (Stern, 1983). Going from one cognitive code to the other can be considered a top-down "biased competition" (Hommel, Colzato, Fischer, & Christoffels, 2011) as a multi-competence system in the same mind as an inter-relationship network (Cook et al., 2016).

Ricciardelli (1992) findings showed a robust positive link between bilingualism and creativity on 20 of the 24 studies reviewed, contrasted by monolingual counterparts. Nonetheless, Adesope, Lavin, Thompson, and Ungerleider (2010) conducted a meta-analysis among 63 studies to examine bilingualism and cognitive effects. Studies have revealed a

combination of results, some positive, others negative and null. Early research showed bilingual disadvantages of cognitive measures. Nevertheless, bilingualism showed positive cognitive benefits such as; first, higher metalinguistic awareness mainly in those who had higher proficientcy in both languages (Bialystok, 1988; Bialystok, Majumder & Martin, 2003; Campbell & Sais, 1995; Galambos & Hakuta, 1988; Ricciardelli, 1993). Second, bilingualism had a stronger representation and abstract mental abilities (Bamford & Mizokawa, 1992; Berguno & Bowler, 2004; Johnson, 1991; McLeay, 2003). Third enhanced learning strategies (Bochner, 1996) and fourth enriched problem-solving skills as their aptitude to attending to pertinent information and ignoring no proper data, resisting intrusions, which improved executive functions (Bialystok, 2005), this discrimination flourishes at theory-of-mind (Goetz, 1999). Also, bilinguals might have greater creative and divergent thinking skills (Ricciardelli, 1993) and larger cognitive flexibility (Hakuta, 1990; Kozulin, 1999).

A large number of studies suggested that bilingualism boosts attention in verbal and nonverbal performance better than monolingual (Bialystok, Craik, Klein, & Viswanathan, 2004; Bialystok, Craik, & Ryan, 2006; Emmorey, Luk, Pyers, & Bialystok, 2008). Reaching proficiency in a second-language (L2) involves a mastery of many phases of the language (phonology, vocabulary, and syntax), scholars recommend that language proficiency and experience should be considered when studying bilingualism (Conboy, & Mills, 2006) as most bilingual children hear more of one language than the other, and bilinguals commonly report that one language is their dominant language (Hoff et al., 2012). Research hints at the tendency for bilinguals' to have disadvantages on linguistic tasks, Kharkhurin (2008, 20010, 2011) conducted bilingualism adults studies taking into consideration variables on verbal fluency as the test of "vocabulary knowledge"(120 pictures of objects to be name) and the Abbreviated Torrance Test (ATA), assessing verbal and nonverbal creative abilities. ATA activity-1 centred on verbal fluency (many ideas as possible of a particular category),

findings showed lower on verbal abilities on bilingual. Otherwise, findings displaying bilingualism scored higher on the measure of fluid intelligence on the nonverbal tasks at figural-draw (ATA activity-2/3) with outstanding differences, the results showed a richness of pictures giving variety, vibrancy, energy, and strength of images, and colourfulness that produced senses of touch, smell, and sight which are an important indicator of creativity (Goff & Torrance, 2002). This disadvantage on linguistic deficits on vocabulary is supported by Oller and Eilers (2002) in that bilingual children show more mistakes in picture naming and need more time to label it (Gollan et al., 2005). This has also been the case with adults even in their dominant language, according to Roberts, Garcia, Desrochers, and Hernandez (2002).

Divergent thinking and Convergent thinking

Studies on creative thinking can use both divergent thinking and convergent thinking. Convergent thinking is an attention-demanding process, conscious, involving finding a logical, systematic accurate solution to a problem (e.g., multiple choice tests, quizzes). Whereas divergent thinking (DT) is an unconscious mind, where attention is defocused, it takes an extensive exploration for multiple solutions for a problem, which is spontaneous, free-flowing and non-linear disposed by different factors. In 1957, Guilford linked the properties of divergent thinking with four main features: such as fluency (the ability to produce many, large number of ideas), flexibility (the capacity to give variety of tactics), elaboration (considering many profound aspect on the details) and originality (producing unique ideas, thinking further than average) that will be reflected in the process under cognitive abilities (Kharkhurin, 2018; Nusbaum & Silvia, 2011). Divergent thinking is one of the most used common scientific methods that had been decisive in the ‘60s and early ‘70s to research among creativity (Simonton, 2000).

Studies on creativity look at the mental processes that must contribute to the creative process of open-ended problems that demand a genuine creativity response, compared to research that relies on problems that have fixed solutions. Examples of DT tasks, usually require a verbal response (Chein, & Weisberg, 2014; Gilhooly, Fioratou, Anthony, & Wynn, 2007) or figural prompts of fluency task (Kim, 2006). The aim is for individuals to produce uncommon usages for quotidian objects (e.g., bricks, knives, newspapers), or occurrences for common concepts (e.g., instances of things are round, strong, or loud), or significance of theoretical events (e.g., what would happen if people went blind, or no longer needed to sleep), or resemblances between concepts (e.g., ways where milk and meat are similar).

To produce creative thoughts and to be effective on a Divergent-Thinking-task, people have to inhibit interference (common use of the object), to recognize unusual creative views so executive cognition is a central part of this process (Gilhooly et al., 2007; Lee, & Therriault, 2013). Gilhooly and colleagues emphasise the importance of executive abilities related to memory. They examined long-term memory to try to recognise pre-uses, which predispose to automatic occurrences, to let spreading activation of the new ideas. Numerous theories have been suggested to explain this process such as associative processes that unfold in semantic memory. This uses top-down regulator over attention and cognition. The pioneer studies in this phenology started by Mednick (1962) with the Remote-Associates Test (RAT) which was supported by Beaty et al., 2012; Benedek, Franz, Heene, & Neubauer, 2012; Benedek et al., 2014; and Chein et al., 2014.

Several studies on divergent thinking test have investigated gender differences in creative problem solving, findings showed incongruent outcomes, no such differences between gender (Cheung, Lau, Chan, & Wu, 2004), otherwise, females performed better on most of the indexes of divergent thinking test (Kuhn & Holling, 2009).

RAT as a convergent thinking test has been used to measure various cognitive abilities linked to creativity, counting insight, memory, and problem-solving (Aiello, Jarosz,

Cushen, & Wiley, 2012). With the RAT- test, individuals must consider a fourth word in relation to the first three words, the most common words that first come to mind are not related to the other cue words, therefore, recognising the correct associated word, needed to suppress the strongest associates, and search for 'remote associates' of the three cue words. Mednick noticed that individual differences on associative hierarchies are abrupt or flat. The more creative the individuals are, the more flat the hierarchies with several and freer connections, in other words, creative people showed higher associative fluency and more uncommon responses (Batey et al., 2006; Nusbaum & Silvia, 2011) than less creative people, responding slowly and gradually. For example, if the more creative individuals are asked to give word associations e.g., "table", they will give responses such as "leg" or "food" showing flat associative hierarchies, as contrasting of those who are given stereotypical associations, conventional and near link such as "chair", they have low creativity responses with abrupt associative hierarchies (Benedek, & Neubauer, 2013). Mednick detected that early responses are founded on a Memory strategy of retrieval from long term memory of pre-established uses as automatic (Bowden, Jung-Beeman, Fleck, & Kounios, 2005; Sawyer, 2011). Recent studies suggested that working memory capacity (WMC) of individuals who suppress information about subjects, use control attention to be distant from common concepts, to keep up reasoning-relevant ideas for succeeding in responding to finding new unusual thoughts, this is an indispensable aspect of fluid abilities, a skill to control one's attention in WM-span (Engle, 2002; Ricks, Turley-Ames & Wiley, 2007), it varies in two constructs, the ability of primary memory (PM) and the efficiency with which individuals encode information into secondary memory (SM) and hunt information in SM controlled by the central executive. This process has been correlated with DT in creativity on a subject's ability to detect the variations by bringing up new uncommon concepts inhibiting irrelevant thoughts, thus underlining the novelty of thought findings by Beaty, Silvia, Nusbaum, Jauk, and Benedek, 2014, which showed that both processes maintain DT ability as a dual-process model. It can

join in both, automatic and controlled cognitive processes (De Dreu et al., 2012; Evans, 2003; Kahneman, 2003) and it is both a flexibility pathway and the persistence pathway (Nijstad, De Dreu, Rietzschel, & Baas, 2010). This has lately been the main attention of research in experimental psychology and cognitive neuroscience (Miller, & Cohen, 2001). The gamble of generating a creative idea increases when more ideas are made. Creativity has also been linked with inhibition in experimental studies using the Stroop task (Zabelina, & Robinson, 2010; Chein et al., 2014) a challenging task, that can lead to a mismatch between a stimulus and response. Participants need to read the written colour names of the words independently of the colour of the ink (e.g., they would have to read "purple", when it is print in red font). Inhibitory control is active, then attention must be supported on relevant cues (colour or word), in which a misrepresentative cue in the stimulus needs a determination to be resolved, it is accompanied with a conflicting response. For bilingual the inhibitory control was more skilled more than monolinguals due to frequent code switching in monitor the correct language, effects on their efficient attentional mechanisms (Costa, Hernández, Costa-Faidella, & Sebastián-Gallés, 2009), so attention must be focused toward the relevant representational system. Bialystok et al., (2004) observed that people who are bilingual from childhood deal better when their attention was presented with cognitive control for problem-solving performances compared to monolingual. Key elements on Executive functions (EFs) are inhibition, working memory (WM), and cognitive flexibility (shifting to new circumstances as fast possible from different standpoints) which enable performance on decision making; gathering novelty, unexpected encounters; controlling impulsivity; and remaining stable on goal task (Diamond, 2013). Since 1926 Whallas has suggested that creative acts have four stages; first preparation, which consists of examining the problem; second incubation, which has time (unconscious) thinking about the problem; third illumination, ideas stem together to formulate a possible solution; and finally verification, an evaluation of the possible choice (Beaty, & Silvia, 2012; Silvia, 2008).

Cultural and educational context

Kharkhurin (2008) disputes that creative performance differences are from an individual's early age of the second language (L2) acquisition. He debates that it is not the involvement with two language systems, but the multicultural connotations that could have an effect on the cognitive operative system which may have resulted in cognitive flexibility and boosted creativity. Both historiometric and psychometric research, make available data supporting this concept as an important contributor to creative performance (Leung, Maddux, Galinsky, & Chiu, 2008; Simonton, & Ting, 2010). Kharkhurin (2018) emphasised the importance of studying the bilingual speaker's history with language to support empirical data. Examining acquisition of languages and levels of proficiency, the age of acquisition whether simultaneous or sequential, and the social-context. Early research as well as modern research, didn't check for participant's language proficiency, also the most significant aspect was that most of the bilingual participants were multilingual, which led researchers to misleading data through a lack of empirical systematic collected figures. Bilinguals rarely have the same fluency level with the two languages. As immigration flourished recently in many countries, they had to learn a second language (L2), as well as the cultural values of the country in which this L2 language is learned (Birman, Trickett, & Vinokurov, 2002). This cultural context may have had an effect and outlined the concept of creativity on bilinguals. Maddux, Adam, & Galinsky (2010) findings showed that the link between sociocultural environments such as living abroad and creativity has a positive effect with benefits. Multicultural learning forms a component of the adaptation process, and fosters an environment for greater creativity (Rudowicz, 2003). This suggests that multicultural experiences enable a recognition that the same problem can have multiple solutions, something that this study will seek to explore.

Research goals and hypotheses

This study aims to improve our understanding of the differences in creativity between bilingual and monolingual, to see if bilingualism affects the advance of creativity in undergraduate students as earlier work had been mainly focused on children. Based on the prior discussion, one prediction is that creativity benefits from an ability to generate and use remote associations, and as such, individuals differ in the association hierarchies (Nijstad et al., 2010). One suggestion is that bilinguals have capacity to choose between two languages, and may develop more flexibility with respect to thinking creatively for the origin of the cognitive flexibility associated with bilingualism. For that reason, participants who score higher in creativity should as well score higher as well in flexible cognitive control observed in the measures of creativity, involving original responses on the Torrance Test of Creative Thinking (ATA). The study inspected the validity of the of the 30-item RAT, whether native and non-native English language speakers would outline different in the outcomes, suggested by Lee, Huggins, and Therriault (2014).

Hypothesised that:

1) In the present study we expected monolinguals would display superiority of their vocabulary compared to their bilingual counterparts in the remote association task (RAT);
2) Bilinguals would display better scores in creativity index than monolinguals (ATTA);
3) Framing a creative problem in a verbal context would result in bilinguals' lower scores in creative performance as compared to their counterparts; and
4) To determine if there was any difference between males and females in levels of Creativity

Methods

Participants

The participants were 43 Undergraduate Students from the National College of Ireland (NCI), consisted of 14 males and 29 females, age (M = 22.02, SD = 2.33). Participants were clustered in two groups; 22 monolingual and 21 bilingual students. The majority of languages–both first (L1) and second (L2)–were English; Eleven participants indicated that they speak a third language, the majority of these are from India.

The study had a variation of languages such as Romanian, Portuguese (Brazilian), Russian, Irish, Marathi (Indo-Aryan), Punjabi (South Asia), India, Urdu (Indo-Aryan), Tamil (India), Hindi, Dari (Persian), Pasto (Arabic/Uzbek), Yoruba (Nigeria), Setswana (Southern Africa), Croatian, Korean, Tagalog (Philippine).

In addition, nine participants responded to be full bilingual when they had been asked on the degree of bilingualism. Supplementary to this, four bilingual participants have the first language (L1) as the stronger and with the other five contestants their second language (L2) is the stronger. Participants that had language of instruction advantage, this means, that thus participants that their elementary schooling was in a language other than that used at home (i.e., English), the level of language degree favoured L2 (English) as a stronger language.

Two participants were excluded from further data analysis, as one participant did not finish all performance test and the second participant had a history of brain damage. Also students that took a second language as a new-learners had been excluded from the category of bilingual.

Procedure

The study passes the ethical approval by the NCI ethics committee. All participants were recruited from college as a convenience and snowballing technique by advertisement on campus posters (see i.e., Appendix F page 57). Those participants were required to be 18 or

above. Applicants learnt that the study is about the psychology of creativity interest in the relationship of been monolingual or bilingual among creativity. How people think to explore innovative thoughts among several creativity tasks, for novelty and cognitive performance. Giving instructions the researcher intended to emphasize creative attitudes, by encouraging participants to engage with as much creativity energy as they could muster.

A preliminary pilot trial was conducted scheduled in one session (one participant from each group) to find how long will required to complete it. This initial study provided results suggesting that the best intervention was to test participants individually, the cause focused on the impediment of the bilingual participant knew the meaning of few words on the RAT task. For this reason all participants had been arranged individually in a classroom in college, each participant was tested in a 30-min session, were asked to read and sign the informed consent form. Each participant had acquired a personal ID number for the information to be completely anonymous. Then they completed a Biographic-questionnaire, a Remote-Associates Test (RAT) and the Abbreviated Torrance Test (ATA) all run by paper-and-pencil, presented by colour pencils box, rubber, and pencil sharpener to use if they will like. All assessments were offered in English, as a language of testing, it was coherent by the fact that all participants were University students. The policy of the NCI university is that as International students whose first language is not English are prerequisite to have a suitable score in an approved examination in English language (such as IELTS) before they can register on an academic course.

Participants had been asked to preserve confidentiality of the study to reduce biases, to ensure further participation is not influenced by prior knowledge, which can impact the expectations on his/her performance.

Design

The study is an experimental design which included two control groups in which there are two independent variables; students who are monolingual or bilingual, and these conditions determined the two groups. Then each participant was assessed on a remote association test (RAT), time score, aha! Experiences and the Abbreviated Torrance Test (ATTA) as the main dependable variables. The statistical program SPSS (IBM-Statistics-24) was utilized in order to analyse the collected data.

Measures

Participants will fill out a **biographic questionnaire**, the questionnaire covers some general questions correlated to the participant's language history, for the reason that individuals differ significantly in the relationship between languages in many factors. Participants valued their abilities in reading, writing, speaking, and listening in English as well as their other languages, useful data to evaluate proficiency levels. It is based on questions that have been asked by Kharkhurin, (2008) in previous studies with construct validity and content validity. For more details see a new version online; a multilingual and multicultural experiences questioner (MMEQ); http://surveys.harhur.com/index.php?r=survey/index

Convergent thinking tests: **Remote Associates Test** (Mednick, 1962; Mednick, 1968; Mednick & Mednick, 1967) are intended to require the respondent to perform creatively with valued insight experiences. It consists of a trio of cue words that are not obviously linked to each other, but rather, are interrelated to a shared connected fourth word. Participants must go over semantic association, synonymy, or establishment of a compound word (e.g., bird/tie/pen; →black; black bird, black tie, black pen). Participants given three practice item sets to become familiar with the task. Instructions were presented. Participants were given 15 seconds per set of three cue words to find the correct answer. Each trial had been presented

individually. The score on RAT-task is a binary item 1 for a correct response or a score of 0 for an incorrect response, so that score of 30 is the maxim of points for correct responses. Items were presented in order of easy to difficult. The study used a shorter version of the RAT selected from Lee, Huggins and Therriault, 2014, findings showed that items are measuring a single (unidimensional) construct. According to Lee et al., (2014), the satisfaction of RAT has good internal consistency, with a Cronbach alpha coefficient reported of .82. In the current study, the Cronbach alpha coefficient was .78.

The present study use Bowden, and Jung-Beeman (2003) scale to measure **Insight Experiences**, the awareness of the experiences among problem-solution, the scale is 5-point scale as 1=*you did not know but after discerning you figured out that it was the answer, 3= means that you didn't immediately know the word was the answer, but you didn't have to think about it much either. To 5= the solution popped out*. Participants were told that the problems on RAT-task have a level of difficulty and that they would not, consequently, might not capable of solving all of them.

The **Abbreviated Torrance Test for Adults** (ATTA) a standard divergent thinking test. Cast-off to measure creative potential developed on adults, ATTA was based on the basis of the Torrance Tests of Creative Thinking (Torrance, 1966) to reduce testing time. The standard ATTA has three paper-and-pencil activities (one verbal and two figural), 3 minutes' limit per activity. Preceded by a manual that included instructions that describe general guidelines and encourages participants to use their imagination and thinking abilities, to solve problems or communicate ideas, participants are likely to identify problems, make presumptions, and generate ideas by writing and by drawing pictures. We use the manual of ATTA (Goff & Torrance, 2002) to score the activities. The first Activity is a verbal response for significances of hypothetical situations. Participants were queried to presume that they could walk on air or fly without being in an airplane or a similar vehicle, and then to identify

the troubles they might encounter. In the nonverbal, figural completion task (Activity 2, see Appendix F section), participants were given two unfinished figures and were asked to draw as many pictures as possible with these figures, and provide a title for each picture. In the second nonverbal figure task (Activity 3), participants were presented with a group of nine triangles arranged in a 3×3 matrix and were asked to draw as many pictures or objects as they could use the triangles and title them.

Norm-referenced measures assess fluency, flexibility, originality, elaboration and flexibility. Criterion-referenced measures assess emotion/expression, provocative questions, richness and colourfulness of imagery, future orientation, humour or conceptual incongruity, resistance to premature closure, unusual visualization or different perspective, movement and/or sound, abstractness of title, articulateness in telling story, combination of two or more figures, internal visual perspective, and fantasy. Each of these indicators was given a rating of 0 if the indicator does not occur, 1 if the indicator appears once, or 2 if the indicator appears more than once. Scores were given for each added design after all figure or triangles are used, and abstract design without meaning, and duplicate design are not counted. The total verbal creativity index was computed as a sum of five verbal criterion-referenced creativity indicators; and added to the total nonverbal creativity index which was computed as a sum of 10 nonverbal criterion-referenced creativity indicators.

The statistical program SPSS was utilized in order to organize and compile the collected data. All the indicators are then tallied and converted into a final score that indicates a person's index and level of creativity (see Appendix Scoring Interpretation Worksheet for more information, page 56). Then the Creativity Index is graded from 1 to 7 (1 = Minimal; 2 = Low; 3 = Below Average; 4 = Average; 5 = Above Average; 6 = High; 7 = Substantial). The validity of the Torrance Tests of Verbal and Figural, is robust (Cramond, Matthews-Morgan, Bandalos, & Zuo, 2005; Kim, 2006). According to Goff and Torrance (2002)

reported a reliability of 0.90 for the Creativity Index (CI), using a KR-21 reliability coefficient, in the current study, the Cronbach alpha coefficient for CI was .69. Presented in Appendix

Previous research by Kharkhurin (2010) compared monolinguals and bilinguals on the verbal and nonverbal indicators of the Abbreviated Torrance Test for Adults. Five verbal and ten non-verbal criterion-referenced creativity indicators were recognized using the standard assessment procedure (Goff & Torrance, 2002). The verbal criterion-referenced creativity indicators were obtained from Activity 1 (richness and colourfulness of imagery, expressions of feelings and emotions, future orientation, humour/conceptual incongruity, and provocative questions), and the non-verbal ones were obtained from Activities 2 and 3 (openness/resistance to premature closure, unusual visualization, movement and/or sound, richness and colourfulness of imagery, abstractness of title, environment for objects/articulateness in telling a story, combination/synthesis of two or more figures, internal visual perspective, expressions of feelings and emotions, and fantasy).

All measures are presented in Appendix section if more information is needed.

Results

Descriptive Statistics

Descriptive statistics were primarily computed for all items. The sample was 22 monolingual and 21 bilingual undergraduate students (N = 43, 14 = males, 29 = females), age (22.02 mean, 2.33 standard deviation). In the language condition 8 males and 6 females were monolingual, and in the bilingual condition there were 14 males and 15 females. Frequencies for the current sample on self-report background questionnaires are explained on Table 1, 42.9% reported being full bilingual. 19% quite a bilingual by (L1) predominate and 23.8% contestants reported their stronger language was the (L2).

Group differences and the RAT

On average, the monolingual participants solved 14% (SD = .88) of the problems within each of the time limits (15 s) and their counterparts solved 9.19% (SD = 8). The Measured variables (Accuracy, Time and Aha! experience) preliminary analysis of the variances indicate data is normal distribution (seeTable-3) on average, the monolinguals spent 5 minutes and 37 second to concluded the RAT test, less time than their counterparts were an average of 6 minutes and 34 seconds. The frequency and percentage of all participants solving each problem was compared to previous work by Lee, Huggins, & Therriault, (2014) presented in Table-5.

Participants reported insight attended solution of the solved problems, ratings associated with a strong feeling of insight, such as the solution popping up as a fast response were higher for monolinguals with lower standard deviation (M= 31.7%, SD=15.67%) than bilingual (M= 24.21%, SD= 23.23%). An indicate feeling somewhere in between from easy to moderate were for monolinguals higher (M= 12.29%, SD =6.37%) and lower for bilinguals (M= 8%, SD= 4.90%) also higher with a moderate feeling of insight for monolinguals (M= 12.75%, SD= 8.19%) than bilinguals (M= 8.37%, SD= 7.65%). In between for monolinguals were lower (M= 4.50%, SD=3.21%) than bilinguals (M= 5%, SD= 3.46%). Subsequently,

problems with hard mental process on partial insight for monolinguals were lower for mean and then higher in standard deviation (M= 2%, SD=1.41%) than their bilingual counterparts (M= 2.13%, SD= 1.13%). On average data of insights/feelings by monolinguals were 52.41% and bilinguals 34.67% of the total solved problems. For more evidence see Table 4.

Group differences and the (ATTA)

Descriptions on continuous variables for the Abbreviated Torrance Test (ATTA) are explained in Table 7, show the mean and standard deviation of the Creative Index which is a total score of the ATTA, the study looked at the subscales on Norm-referenced and the total criterion-referenced creativity indicator score by Language Group. The monolingual group scored lower on both conditions Norm-Referenced M= 55, SD = 4.87, Indicator score M= 14.41, SD= 5.73, than the bilingual group Norm-Referenced M= 56.29, SD = 5.82, Indicator score M= 16.67, SD= 8.05.

Table 1 *Frequencies for the current sample on Background Questionnaires*

Variable		Frequency	Valid Percentage
Gender			
Male	Monolingual	8	36.4
	Bilingual	6	63.6
Female	Monolingual	14	28.6
	Bilingual	15	71.4
Age	18	1	2.3
	19	2	4.7
	20	8	18.6
	21	10	23.3
	22	6	14.0
	23	9	20.9
	24	2	4.7
	25	2	4.7
	26	1	2.3
	28	1	2.3
	30	1	2.3
First Language			
Monolingual	English	22	100
Bilingual	English	6	28.6
	Arabic	1	4.8
	Brazilian (Portuguese)	2	9.5

	Croatian	1	4.8
	Romanian	2	9.5
	Russian	1	4.8
	Dari (Persian)	1	4.8
	Korean	1	4.8
	India (Hindi)	2	9.5
	India (Marathi: Indo-Aryan)	2	9.5
	India (Punjabi; Indo-Aryan)	1	4.8
	India (Tamil)	1	4.8
Second Language	English	13	61.9
	Hindi (India)	1	4.8
	Irish	2	9.5
	Romanian	1	4.8
	Russian	1	4.8
	Setswana (Southern Africa)	1	4.8
	Spanish	1	4.8
	Yoruba (Nigeria)	1	4.8
Third Language	English	2	9.5
	French	1	4.8
	Hindi	2	9.5
	Omiya	1	4.8
	Pasto/Arabic/Uzbek	1	4.8
	Punjabi (South Asia) India	1	4.8
	Russian	1	4.8
	Tagalog (Philippine)	1	4.8
	Urdu (Indo-Aryan)	1	4.8
Degree Bilingualism	poor in my second Language	2	9.5
	Quite I am bilingual, dominant L1	4	19.0
	I am fully bilingual	9	42.9
	Quite I am bilingual, dominant L2	5	23.8
	I am functional L1	1	4.8
Proficiency (bilingualism)			
Speaking	functional	2	9.5
	good	3	14.3
	very good	6	28.6
	native-like	9	42.9
Listening	good	4	19.0
	very good	7	33.3
	native-like	10	47.6
Reading	functional	1	4.8
	good	4	19.0
	very good	5	23.8
	native-like	11	52.4

Writing	Fair	2	9.5
	functional	5	23.8
	good	2	9.5
	very good	3	14.3

Table 2

Correlations *between measures of aha! Experience control by time and correct score on variables.*

	Variables	**1**	**2**
Monolingual			
1.	Aha! experiences	_	
2.	Time expended	-.885**	_
	Variables	**1**	**2**
Bilingual			
1.	Aha! experiences	_	
2.	Time expended	-.976**	_

Note. **. Correlation is significant at the 0.01 level (2-tailed).

Table 3 *Descriptive on continuous variables by Language Group (n= 43) 22 monolingual and 21 bilingual, in RAT test*

		Mean (95% Confidence intervals)	Std. Error Mean	Median	SD	Range
RAT Scores	Monolingual	14 (12.17-15.83)	.88	14.50	4.12	18
	Bilingual	9.19 (6.99-11.40)	1.06	8	4.84	17
Time	Monolingual	322.32 (301.85-342.79)	9.84	327.5	46.17	213
	Bilingual	380.43 (356.82-404.04)	11.32	390	51.87	192
Aha! Experiences	Monolingual	52.41 (24.12-43.63)	4.22	52.50	19.81	92
	Bilingual	34.67 (24.12-45.21)	5.05	30	23.16	81

Table 4
Descriptive on continuous variables for the INSIGHT experiences by categories (22 monolingual and 21 bilingual).

Feeling of insight		**Mean** (95% Confidence intervals)	**Std. Error Mean**	**Median**	**SD**	**Range**
Popped out	Monolingual	31.7 (24.42 - 39.08)	3.50	27.50	15.67	65
	Bilingual	24.21 (13.01 - 35.40)	5.33	15	23.23	75
Easy to moderated	Monolingual	12.29 (8.61 - 15.96)	1.70	12	6.37	20
	Bilingual	8 (4.23 - 11.77)	1.63	8	4.90	16
Moderated	Monolingual	12.75 (8.91 - 16.59)	1.83	9	8.19	30
	Bilingual	8.37 (4.68 - 12.06)	1.76	6	7.65	33
Hard to moderated	Monolingual	4.50 (2.46 - 6.54)	.93	4	3.21	10
	Bilingual	5 (-.51 – 10.51)	1.73	4	3.46	8
Harder process	Monolingual	2 (1.05 – 2.95)	.43	1	1.41	4
	Bilingual	2.13 (1.18 – 3.07)	.40	2	1.13	3

Table 5
Frequency of Correct Responses and Item Response-RAT.

Item 1-2-3		**Solution**	**Correct Responses** (within 15 seconds)		
RAT Items (easiest to hardest)			**RAT Frequency**	**Percentage** Present study	Lee, Huggins, & Therriault, (2014).
1.	Cane - daddy – plum	Sugar	20	46.5	76
2.	Cracker - fly – flight	Fire	18	41.9	74
3.	Duck - fold – dollar	Bill	18	41.9	72
4.	Cream - skate – water	Ice	25	58.1	71
5.	Fountain - baking – pop	Soda	14	32.6	64
6.	Preserve - range - tropical	Forest	20	46.5	60
7.	Political – surprise – line	Party	12	27.9	59
8.	Dew - comb – bee	Honey	34	79.1	56
9.	Loser - throat – spot	Sore	30	69.8	54
10.	Show – life – row	Boat	7	16.3	49
11.	Cottage – Swiss – cake	Cheese	28	65.1	43
12.	Food – forward – break	Fast	14	32.6	39

13.	Dream - break – light	Day	17	39.5	76
14.	Aid - rubber – wagon	Band	16	37.2	72
15.	Safety - cushion – point	Pin	8	18.6	65
16.	Flake - mobile – cone	Snow	16	37.2	63
17.	Fur - rack – tail	Coat	22	51.6	63
18.	Fish - mine – rush	Gold	11	25.6	56
19.	Night – wrist – stop	Watch	28	65.1	47
20.	Hound – pressure – shot	Blood	3	7.0	31
21.	Opera - hand – dish	Soap	17	39.5	68
22.	Worm - shelf – end	Book	16	37.2	66
23.	Print - berry – bird	Blue	16	37.2	60
24.	Sense - courtesy – place	Common	10	23.3	54
25.	River - note – account	Bank	29	67.4	53
26.	Carpet – alert – ink	Red	19	44.2	32
27.	Basket - eight - snow	Ball	15	34.9	35
28.	Main – sweeper – light	Street	15	34.9	34
29.	Nuclear – feud – album	Family	2	4.7	31
30.	Piece - mind – dating	Game	1	2.3	11

Table 6

Correlations *between measures of correct RAT scores and total Creativity Index (CI)*

Variables	**1**	**2**
Monolingual		
1. RAT scores	_	
2. CI	-.24	_
Variables	**1**	**2**
Bilingual		
1. RAT scores	_	
2. CI	.11	_

Note. **. Correlation is significant at the 0.01 level (2-tailed).

Table 7.
Descriptive on continuous variables for the Creative Index of the ATTA by Language Group (22 monolingual and 21 bilingual).

Creative Index		**Mean** (95% Confidence intervals)	**Std. Error Mean**	**Median**	**SD**	**Range**
Norm-Referenced	Monolingual	55.95 (53.79-58.12)	1.04	56	4.87	19
	Bilingual	56.29 (53.64-58.93)	1.27	57	5.82	26
Indicator Score	Monolingual	14.41 (11.87-16.95)	1.22	14.50	5.73	24
	Bilingual	16.67 (13.00-20.33)	1.76	14	8.05	26

Inferential Statistics

Independent sample t-tests were used to examine potential group differences on creativity. Preliminary analysis of the variances indicate data is normal distribution.

The Relationships between Group differences and the RAT test

Accuracy differences

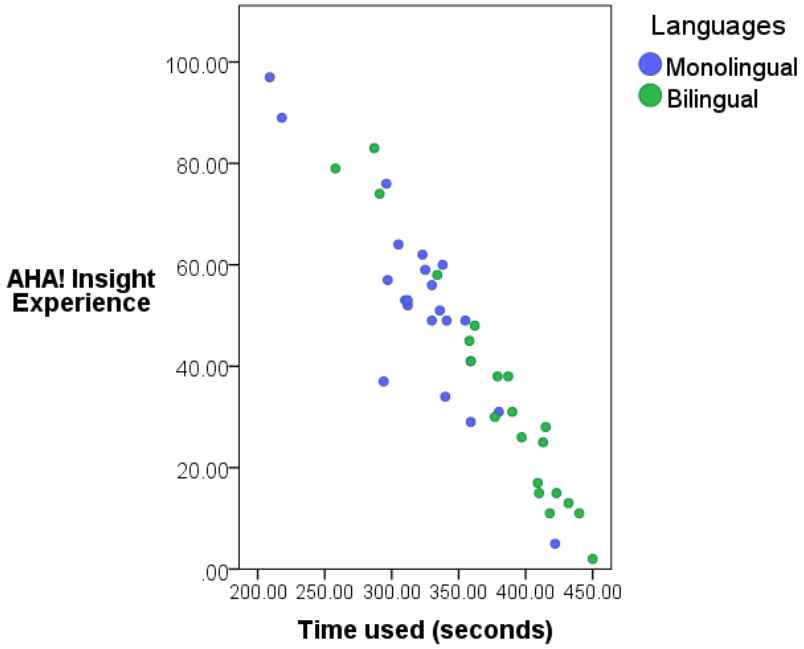
An independent-samples t-test was conducted to compare accurate scores on RAT in monolingual and bilingual conditions. There was a significant difference in the scores for monolinguals (M =14, SD = 4.12) and bilinguals (M = 9.19, SD = 4.84) conditions; t(41) = 3.51, p = .001. The magnitude of the differences in the means (mean difference = 4.80952, 95% CI: 2.04536 -7.57369) had very large effect sizes (Cohen's d = 1.07) a 107%. These results suggest that monolinguals had with differences a higher number of correct answers than their bilingual counterparts.

Reports of insight in solution responses

The relationship between perceived aha experiences assessed on a correct response on RAT task and time expending was investigated using the Pearson product-moment correlation coefficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasity. There was a strong negative correlation between the two variables, monolinguals r = -.89, n = 22, p <.001, at the side of bilinguals r =-.98, n = 21, p <.001 scoring great in aha experiences associated with less time spent, sharing a 79.21% by monolinguals and a 96.04% by bilinguals. z=-2.66 p= 0.008, there is a statistically difference in the strength of the correlation between variables.

The scatterplot (see Figure 1) showed a negative correlation in the linear relationship. We can conclude that there are differences in the strength of the correlation between insights feelings associated with time for both groups. Less time corresponded with a greater insight as per correct response accessed faster when popped up (see Table-3)

Figure 1-*Scatterplots of the relationship of Insight experiences and the time used*



The Relationships between group differences and the creativity test (ATTA)

A Pearson correlation analysis was carried out to examine RAT and Creativity Index of ATTA two see if they are significantly associated with each other. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscedasity. There was a negative correlation between the two variables for monolinguals r = -.24, n = 22, p <.28, while for bilinguals it was a positive correlation considerably lower r = .11, n = 21, p = .64 in RAT scores associated with CI, sharing a 5.8% by monolinguals and a 1.2% by bilinguals. Z= -1.08 p= .28. Data showed there is no statistically difference in the strength of the correlation between variables.

An Independent-t-test was conducted to evaluate the impact of the intervention on student's scores on creativity of the Abbreviated Torrance Test for Adults (ATTA) for monolinguals and bilinguals on the Norm-Referenced Measures. There was no statistically significant difference in scores for monolingual (M = 55.95, SD = 4.87) and bilingual (M = 56.29, SD = 5.82; t(41) =-.203, p = .84, two-tailed). The magnitude of the differences in the

means (mean difference =-.33, 95% CI: -3.63 to 2.97) was a small (eta square =0.06), only 6% of the variance is explained by having one language or having two.

An Independent-t-test was conducted to evaluate the impact of the intervention on student's scores on creativity of the Abbreviated Torrance Test for Adults (ATTA) for monolinguals and bilinguals on the Total Indicator Scores**.** There was no statistically significant difference in scores for monolingual (M = 14.41, SD =5.73) and bilingual (M = 16.67, SD = 8.05; t(41) =-.203, p = .84, two-tailed). The magnitude of the differences in the means (mean difference =-.33, 95% CI: -3.63 to 2.97) was a large effect (eta square = 0.32), a 32% of the variance is explaining by have one language or having two.

Verbal and non-verbal indicators in creativity

The present study used ATTA assessment procedure to look at different aspects among verbal and non-verbal indicators as previous studies by Kharkhurin (2010). The verbal criterion were added from Activity-1 and the nonverbal ones from Activities-2 and 3. Preliminary analyses were performed to evaluate assumptions, the examination presented no normal distribution among bilingual group on verbal variable p=.005, for this reason a nonparametric tests were assessed. A Mann-Whitney U Test revealed a significant difference in verbal criterion of monolingual (Md= 4, n=22) and bilingual (Md= 2, n=21) U = 145, z = -2.14, p= .03, r = 0.12. Below is a graph that represents participants mean criterion referenced on verbal and nonverbal responses by language group (see Figure 2).

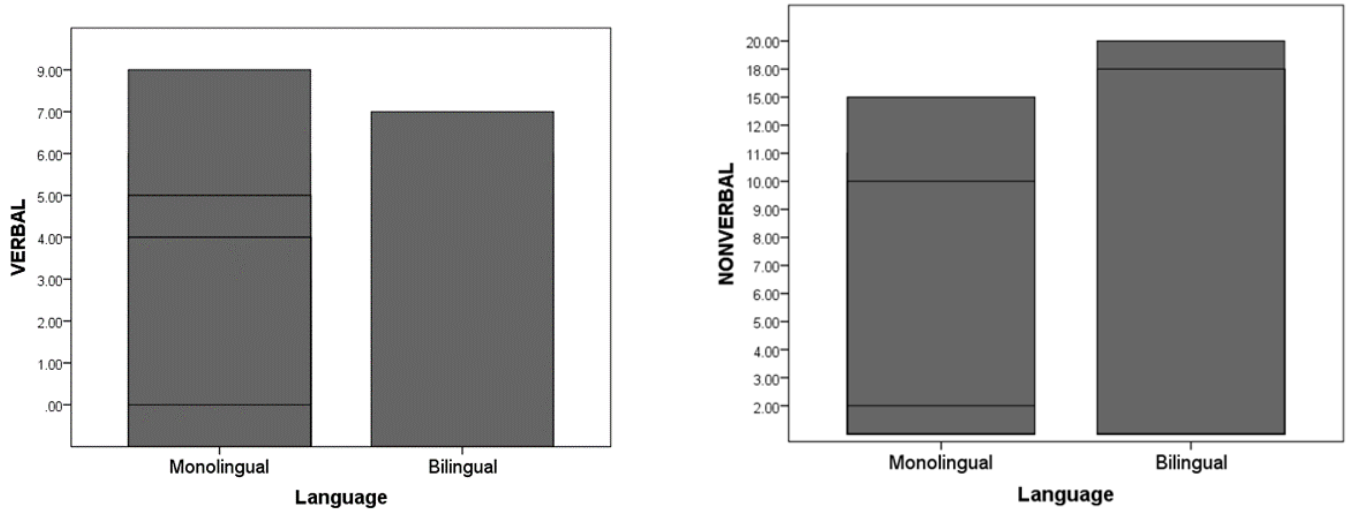
An Independent-t-test was conducted to evaluate Non-verbal indicators. There was no statistically significant difference in scores for monolingual (M= 7.68, SD= 3.58) and bilingual (M= 9.90, SD= 5.57; t(41)= -1.57, p = .13, two-tailed). The magnitude of the differences in the means (mean difference = -2.22% CI: -5.09 to .65) was a large effect (eta square = 0.47), a 47% of the variance Non-verbal is explained by language condition.

Gender and Creativity Measures

Preliminary analysis conducted to evaluate the proportion of cases of a dependent variable (DV) are equal across levels of a categorical independent variable (IV) such as language condition (monolingual and bilingual) and gender. A Chi-square test for independence (with Yates' continuity correlation) indicated no significant association between condition (monolingual or bilingual) and gender status, X2(1, N = 43) = .05, p = .83, phi = .08. There were no differences in the proportion of males and females in the two quantity groups. A two-way between group analysis of variance was conducted to explore; for: (i) Differences in language condition (monolingual or bilingual) and gender on levels of Creativity Index (CI) respectively, and (ii) to examine if the effect of language condition on levels of CI depends on being a male or female. Participants were divided into two groups according to their language. The interaction effect between language condition (monolingual or bilingual) and gender was not statistically significant, F (2, 39) = 1.01, p = .32. There was no statistically significant main effect for gender (F (2, 39) = .08, p = .78) however the effect size for this difference was very small (partial eta squared = .002).

Figure 2

Participants mean criterion referenced on verbal and nonverbal responses (figural)by language group



Verbal **Non-Verbal responses** (figural)

Discussion

The aim of this study was to investigate the effects of being bilingual or monolingual using reliable measures of divergent and convergent thinking of creative performance. The results gave some support for the hypothesis that framing a creative problem in a verbal context would result in lower creative performance by bilinguals. However, no evidence was found to support bilinguals 'advantages on the nonverbal creativity tasks.

The first aim of the study was to test the hypothesis that bilinguals show less verbal abilities than monolinguals. The results showed that monolinguals had a superior mastery of their vocabulary by an average of 14%, compared to their bilingual counterparts at 9.19%. The convergent thinking RAT task was administered to determine participants' word knowledge and thereby comparing the language skills of bilinguals and monolinguals. The study used the English version of the RAT by Lee et, al., (2014). The bilingual sample had been inspected on proficiency levels in English and heritage participants had proficiency level. The poorer overall performance among bilinguals on the ability to complete the RAT-test successfully corroborates previous studies that suggested that bilinguals restricted on reading and writing skills were due to their linguistic status (Gollan et al., 2005). Generally, bilinguals perform better in tasks which involve different solutions instead of a single correct response to a question (Beardsmore, 2008).

Simultaneously, those bilinguals who may have less experience in English should be at a disadvantage on the verbal activities as some of the participants didn't know the meaning of some words as thus acquired L2 later in their life as concerns of arriving at an English country with lower fluency in English. Another important factor, context of acquisition, it is when participants have not been raised in the same cultural background as English/American ones. Here in the study participants that came from other non-English speaking countries showed difficulty in responding accurately, thus they didn't have the correct association words in their knowledge to reach a correct association to link with the trial.

Several studies observed that problem-solving ability on Remote Associates Test (RAT) could be associated with WMC. Finding the correct solution to these problems requires questioning ones to experience knowledge in a quick and effective manner. In the present study the researcher had encouraged participants not to be worried to say aloud the first words that might come across to resolve the problem, those who communicated their first impressions had more chances to solve the problem, Aiello, Jarosz, Cushen, and Wiley (2012) suggested that this process of using "your guts" merely only works for monolingual solvers and their bilingual counterparts may need to appeal to their executive functions to succeed in performing a task, in these cases attentional control may be critical for reaching a solution. Chein et al., (2014) provided no evidence that supports this notion for verbal overshadowing of RAT performance across the groups. Participants search through their semantic knowledge, mostly using one constraint at a time, often, the most common words that first come to mind are not related to the other cue words, and that direct open-minded association will bring a belief that a solution will be materialized between search items. Therefore, recognizing the correct associate word, individuals need to suppress the strongest associates and search for 'remote associates' of the three cue words. Reallocation can take a sudden solution that sometimes comes with an insight-Aha experience (Chein et al., 2014). Therefore, an effective inhibitory function may be important when a solver needs to deal with fixation, to be distant from common concepts, in which word-field information provides the direction of an incorrect solution, which creates a problematic situation that involves one to think differently. Studies considered that mental impasse is a necessary condition for insight feelings occasioned with a long time thinking on a solution after having few incorrect retrievals, and later, seem with a sudden awareness on the correct response (Knoblich, Ohlsson, & Raney, 2001; Wen, Butler, & Koutstaal, 2013).

The convergent thinking RAT task and Aha-Experiences

Previous research on insight experience showed a disagreement concerning the particular processes underlying insight. From this research, a marker has been taken for insight into their response during the 15-sec time limit, when participants find a correct solution. Data showed a statistical difference in the strength of the correlation between time spent and aha insight experience; 79.21% by monolinguals and a 96.04% by bilinguals. The current findings showed that participants reported aha! Experience when they used less time on retrieval response, they gained the response quickly corresponded with greater insight. Our outcomes replicated findings as found in previous studies in the literature (Chein et al., 2014; Jung-Beeman et al., 2004; Kounios et al., 2006; Sandkühler, & Bhattacharya, 2008). Mednick suggested early responses are founded on a Memory strategy of retrieval from long term memory as automatic (Bowden, Jung-Beeman, Fleck, & Kounios, 2005; Sawyer, 2011). An average of insight feelings by monolinguals were 52.41 % and bilingual 34.67% correlated by a negative relationship, less time and more insight feelings. However, the results need to be considered with caution, we didn't directly measure impasse and restructuring to generalize our results.

Examples on fixation-trial on the present study had presented Rat-13 (Dream /break /light), Rat-15 (Safety/cushion/point). Next, the current study come to an agreement with Lee et, al., (2014) on the level of difficulty of item RAT-30 (Piece - mind – dating; game) had only 2.3% of correct responses, and RAT-29 (nuclear/feud/album; family) by only 4.3 % of the correct response. These two items could be considered as a substitute in future studies. Followed by levels of difficulty Rat-20, Rat-10 and RAT-15, these four items were challenging for all participants, independently of what group conditions were imposed.

Group differences and the Creativity Test

Hence, overall, the condition to be monolingual or bilingual had no main effect on the divergent thinking tasks of creativity as measured by the- ATTA scores on Creativity Index. The results didn't show any dissimilarities to confirm any meaningful outcome difference between groups, may have been produced by the lab-context condition of 3 minutes period to generate with success novel ideas is not enough time to come up with colourfulness or original ideas, it is short interval if we associated to real life creativity processes. Considering creativity as a multidimensional concept Cropley (2000) recommended that judgements must be based on several tests, rather than relying on a single score. Nonetheless, this result couldn't replicate the positive results reported by Kharkhurin (2008, 20010, 2011) on group differences of divergent thinking. However, when the study assessing verbal and non-verbal indicators revealed a significant difference in verbal criterion among language group, the finding supported the hypothesis that bilinguals' linguistic performance is poorer than the monolinguals' one.

Limitations and future research

There are several limitations to this study. First, the study did not have a big sample size of diverse groups which compared bilinguals' creativity depending on their degree of bilingualism. Secondly, in the present study on RAT performances, we only considered a correct or incorrect answer, rather than bringing together intermediate responses during the search process. The answer words were not analysed. Latent Semantic Analysis (LSA) is based on a statistical latent model for factor analysis of calculation data, which can distinguish between highly similar and dissimilar matches to a target word (Hofmann, 2017), how people combine constraints to search through and retrieve semantic information from memory. Further research might be of interest to focus on the search process rather than the final answer, to understand how individuals come up with such answers, and how close

thoughts are to utter a correct response. As previous research supported the idea that bilinguals perform better in tasks which involve different solutions instead of a single correct response to a question (Beardsmore, 2008), LSA can offer advantages of digital databases to perceive how individuals activate mental networks. Another limitation of this study relates when comparing results with the Lee study, there is a need to be aware that the studies varied in language (American undergraduate students vs. Dutch university students) and from this research (multicultural background vs English in Ireland). Some of the words which identify as American style and might have negatively influenced negatively our participants to seek response such as RAT-2 (Cracker/fly/flight), RAT-3 (Duck/fold/dollar) these words could be considered for revision in future research.

Third, the ATTA is a complex measure and is complicated by the dependence of all scales on the same stimuli. Kim (2006; Kim, Cramond, & Bandalos, 2006-a) suggested that the structure of the Torrance Tests of Creative Thinking (versions of children) scores stay reliable with a two-factor theory, which is linked to Innovative and Adaptive styles grounded on Kirton's theory (1976, 1978, 1989). Future research might like to examine the latent structure of ATTA for adults to seeing different personality's to approach in creativity levels such innovations as more prone to taking a risk doing things differently, seeking at improvement, or otherwise, as an adaptive preference to doing things well, create original ideas, which are suitable to the current norms. More studies are required, that would help to clarify some of the issues left unsolved in this study.

Conclusion

To determine if there was any difference between group conditions we look at levels of Creativity and language condition (monolingual and bilingual). The data showed no solid evidence to prove advantages in creativity levels. Understanding mental processes by

creativity take a multidisciplinary dynamic, influenced and interacted on by their respond to environmental stimuli, subject by culture, with guidance thinking and cultural behaviours as dependent learning styles. Disregard of the complexity of bilingualism and creativity as a result of the research, we can summarize that bilinguals might be less fluent in either of their languages, not equally competent in both languages.

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Appendix A

INFORMED CONSENT FORM

ID NUMBER _____

There are some information to be attentive before you start the study:

Purpose

You are being invited to participate in a research study; Bilingual and monolingual college students among creativity. This study is being set by Silvia Nevado as part of Final Year Project on research Bachelor of Arts (Hons) Psychology at National College of Ireland (NCI).

Eligibility Requirements

- You must be 18 years old or above and you are elected to participate in this study
- If you agree to take part in this study, you will respond a biographic questionnaire, remote-associates test and three tasks among creativity, will take you approximately 20 minutes to complete the full study.

Benefits

We hope that your participation in the study may help to provide more positive and meaningful understanding. We hope to publish or summarize the overall results of data, unable to link your answers from the study.

Please preserve confidentiality of the information presented to you and do not expose research procedures to anybody, to reduce biases, and to ensure that further participation is not influenced by prior knowledge, which can impact the expectations on future performance.

Risks

- We believe there are **no notorious risks** associated with this research study
- We will minimize any risks by not collecting any information from you that would connect directly with your responses. Participant info will be coded using an ID number, to insure confidentiality that limits access to personal information.

Voluntary

- Please note that your questionnaire answers are anonymous. Your participation is completely voluntary.

- You are free to withdraw at any time. You may decide to skip questions or discontinue participation at any time without penalty.

Your Rights as a Participant

- Your participation in this study is completely voluntary and you can withdraw at any time.
- You are free to skip any question that you choose. If you feel upset after completing the study, or find that some questions or aspects of the study triggered distress, talking with a qualified clinician may help. If you feel you would like assistance please contact;
    - **NiteLine** Student Support Lines open 9pm – 2:30am 1800 793 793
    - Or you could contact; National College of Ireland (NCI) Counselling Service Mary Keating by call or text on 086 8783086 or email counselling@ncirl.ie or contact studentsupport@ncirl.ie for more information.

This project was reviewed and approved by the Ethical Review board of NCI,
If you have any questions about this project or if you have a research-related problem, you may contact the Principal Investigator Silvia Nevado at ncicreativethinking@gmail.com, or the Project Supervisor Fearghal O'Brien at (353) 01 449 8736. It is important that you feel that all your questions have been answered.

CONSENT

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.
Signature of research participant

---------- ----------

Signature of participant Date

Appendix B

BIOGRAPHICAL QUESTIONNAIRE

Participant ID: ----------*

The following Questionnaire obtains your demographics and information about your cultural and linguistic experiences. Please answer the questions to the best of your knowledge

1. Age: ----------

   Only numbers may be entered in this field

2. Gender: ☐ Female Male ☐

3. What language would you consider to be your **first language** (L1)?

   ---

4. How did you learn this language up to this point?

   Check any that apply

   - Mainly through interacting with family members at home ☐
   - Mainly through interacting with other people ☐
   - Mainly through formal classroom instructions ☐
   - Other:

   ---

5. Rate your ability in this language (L1) on the following aspects:

	very poor	poor	fair	functional	good	very good	native-like
Speaking proficiency							
Listening proficiency							
Reading proficiency							
Writing proficiency							

6. Provide the age at which you were first exposed to this language in terms of speaking, reading, and writing. Only numbers may be entered in this field.

   Speaking: ----------

   Reading: ----------

   Writing: ----------

7. Provide the number of years you have spent on learning this language.

   (Only numbers may be entered in this field).

8. If you have taken a standardized test of proficiency for this language (e.g., TOEFL, SAT), indicate the name of the test and the score you received.
   - Test Name:----------
   - Score: ----------

9. Do you speak a second language?

   Yes ☐ No ☐

   a) What language would you consider to be your **second language** (L2)?

   ----

   b) This is a language that you have acquired second. How did you learn this language up to this point? Check any that apply

   c)
   - Mainly through interacting with family members at home ☐
   - Mainly through interacting with other people ☐
   - Mainly through formal classroom instructions ☐
   - Other:

     ----

   c) Rate your ability in this language (L2) on the following aspects:

	very poor	**poor**	**fair**	**functional**	**good**	**very good**	**native-like**
Speaking proficiency							
Listening proficiency							
Reading proficiency							
Writing proficiency							

d) Specify the age at which you started learning this language in the following situations:

If you started learning this language at birth, put 0.

- At Home: ----------
- In school: ----------
- After arriving in the country where this language is spoken: ----------

e) Provide the age at which you were first exposed to this language in terms of speaking, reading, and writing. Only numbers may be entered in this field:

Speaking: ----------
Reading: ----------
Writing: ----------

f) If you have taken a standardized test of proficiency for this language (e.g., TOEFL, SAT), indicate the name of the test and the score you received.

- Test Name:----------
- Score: ----------

10. Check the ratio numbers that reflects your degree of bilingualism among your fist language (L1) and the second language (L2).

Ignore any other language(s) you may speak.

1 2 3 4 5 6 7 8 9 10

I speak only L1 I am fully bilingual I speak only L2

If you'd speak only **L1** you would check the lower number. If you'd speak only **L2** you would check the higher number.

If you speak **both languages equally**, you check the one in the middle = **5.** The more you go to the left, the stronger is your L1 in comparison with your L2. The more you go to the right, the stronger is your L2 in comparison with your L1.

11. Do you speak a third language?

Yes ☐ No ☐

What language would you consider to be your Third language (L3)? ----------

Appendix C

THE REMOTE-ASSOCIATES PROBLEM (RAT)

ID NUMBER _____

In this task, you will see a set of three words. Each will be related in some way to a single answer word. You job is to determine what that word is. For example

---

1. Example: Rocking – Wheel - High Answer: Chair
2. Example: Sleeping – bean - trash Answer: Bag

Other Times, some of the words will be more conceptually-related to the word you are trying to guess, and might be related to different meanings of a word. For instance

3. Example: Ribbon – Arrow - Curtsy Answer: Bow

(these refer to three different meanings of BOW)

You will have 15 seconds per problem to identify the correct answer. If you guess incorrectly, you can have the rest of this time to come up with an answer

Rate aha! Experience on a 5-point scale

1 = You did not know, but after discerning about the suggestion of the words, combining the single word with each of the three words, you guessed out that it was the response.

3 = you did not immediately know the word was the answer, but you did not have to think about it much either.

5 = the solution popped out. You suddenly recognised that it was the answer.

Item 1-2-3	**solution**	**Aha! Experiences score**
1. Cane - daddy – plum	---	---
2. Cracker - fly – flight	---	---

Rate aha! Experience on a 5-point scale

1 = You did not know, but after discerning about the suggestion of the words, combining the single word with each of the three words, you guessed out that it was the response.
3 = you did not immediately know the word was the answer, but you did not have to think about it much either.
5 = the solution popped out. You suddenly recognised that it was the answer.

Item 1-2-3	**solution**	**Aha! Experiences score**
3. Duck - fold – dollar	----------	----------
4. Cream - skate – water	----------	----------
5. Fountain - baking – pop	----------	----------
6. Preserve - range - tropical	----------	----------
7. Political – surprise – line	----------	----------
8. Dew - comb – bee	----------	----------
9. Loser - throat – spot	----------	----------
10. Show – life – row	----------	----------
11. Cottage – Swiss – cake	----------	----------
12. Food – forward – break	----------	----------
13. Aid - rubber – wagon	----------	----------
14. Safety - cushion – point	----------	----------
15. Flake - mobile – cone	----------	----------
16. Dream - break – light	----------	----------
17. Fur - rack – tail	----------	----------
18. Fish - mine – rush	----------	----------
19. Night – wrist – stop	`----------	----------
20. Hound – pressure – shot	----------	----------
21. Opera - hand – dish	----------	----------
22. Worm - shelf – end	----------	----------
23. Print - berry – bird	----------	----------

Rate aha! Experience on a 5-point scale

1 = You did not know, but after discerning about the suggestion of the words, combining the single word with each of the three words, you guessed out that it was the response.
3 = you did not immediately know the word was the answer, but you did not have to think about it much either.
5 = the solution popped out. You suddenly recognised that it was the answer.

Item 1-2-3	**solution**	**Aha! Experiences score**
24. Sense - courtesy – place	----------	----------
25. River - note – account	----------	----------
26. Carpet – alert – ink	----------	----------
27. Basket - eight - snow	----------	----------
28. Main – sweeper – light	----------	----------
29. Nuclear – feud – album	----------	----------
30. Piece - mind – dating	----------	----------

Appendix D

ABBREVIATED TORRANCE TEST FOR ADULTS (ATTA),

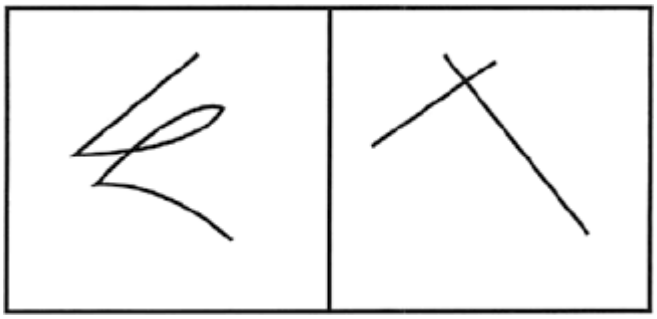
(Goff & Torrance, 2002)

Activity-1

JUST SUPOSSE you could walk on air or fly without being in an airplane or similar vehicle. What problems might this create? List as many you can.

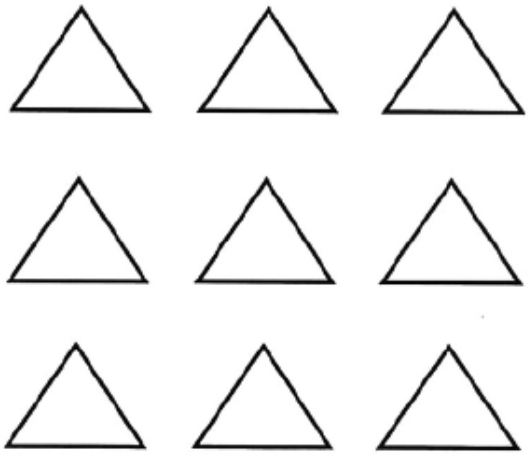
Activity-2

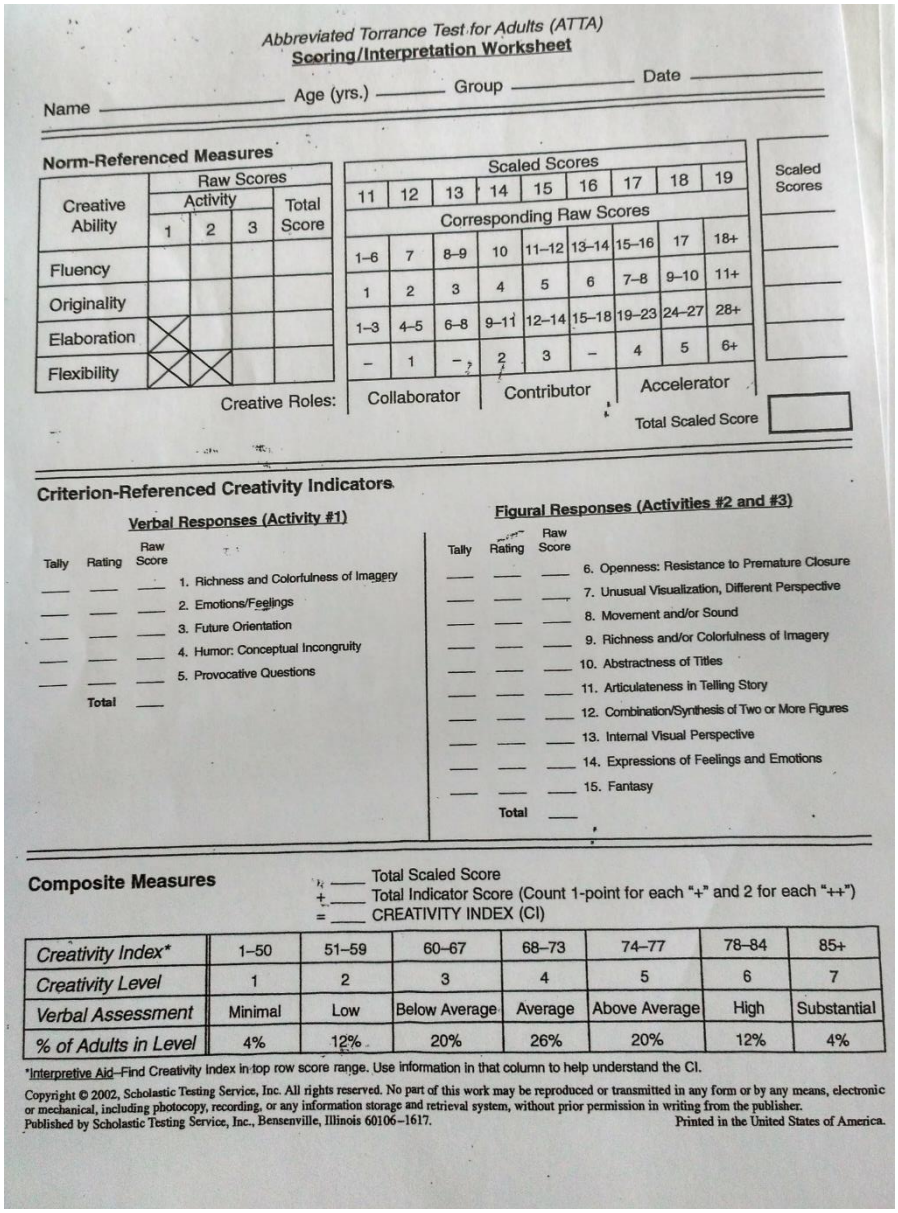
Use the incomplete figures below to make some pictures. Try to make your pictures unusual. Your pictures should communicate as interesting and as complete a story as possible. Be sure to give each picture a title.



Activity-3

See how many objects or pictures you can make from the triangles bellow, just as you did with the incomplete figures. Remember to create titles for you pictures.





Abbreviated Torrance Test for Adults (ATTA)
Scoring/Interpretation Worksheet

Name _____ Age (yrs.) _____ Group _____ Date _____

Norm-Referenced Measures

Creative Ability	Raw Scores: Activity 1	2	3	Total Score
Fluency				
Originality				
Elaboration	X			
Flexibility	X	X		

Scaled Scores	11	12	13	14	15	16	17	18	19
Corresponding Raw Scores	1–6	7	8–9	10	11–12	13–14	15–16	17	18+
	1	2	3	4	5	6	7–8	9–10	11+
	1–3	4–5	6–8	9–11	12–14	15–18	19–23	24–27	28+
	–	1	–	2	3	–	4	5	6+

Creative Roles: Collaborator | Contributor | Accelerator

Scaled Scores: _____ _____ _____ _____

Total Scaled Score: _____

Criterion-Referenced Creativity Indicators

Verbal Responses (Activity #1)

Tally	Rating	Raw Score	
___	___	___	1. Richness and Colorfulness of Imagery
___	___	___	2. Emotions/Feelings
___	___	___	3. Future Orientation
___	___	___	4. Humor: Conceptual Incongruity
___	___	___	5. Provocative Questions
	Total	___	

Figural Responses (Activities #2 and #3)

Tally	Rating	Raw Score	
___	___	___	6. Openness: Resistance to Premature Closure
___	___	___	7. Unusual Visualization, Different Perspective
___	___	___	8. Movement and/or Sound
___	___	___	9. Richness and/or Colorfulness of Imagery
___	___	___	10. Abstractness of Titles
___	___	___	11. Articulateness in Telling Story
___	___	___	12. Combination/Synthesis of Two or More Figures
___	___	___	13. Internal Visual Perspective
___	___	___	14. Expressions of Feelings and Emotions
___	___	___	15. Fantasy
	Total	___	

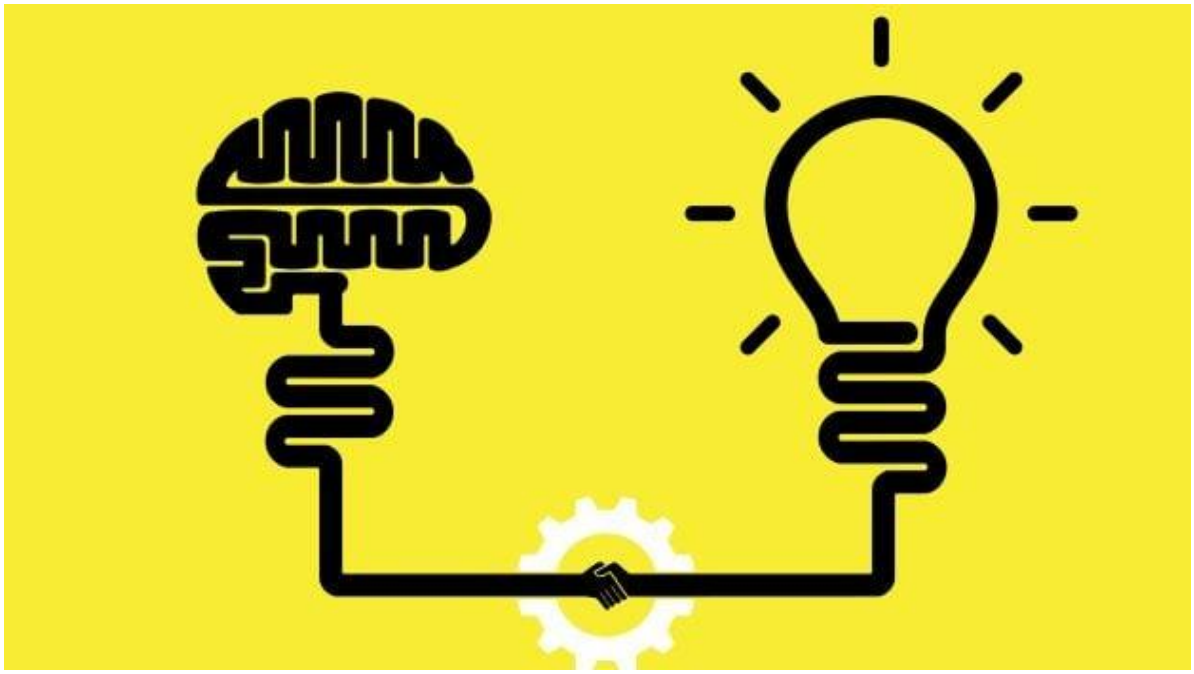
Composite Measures

___ Total Scaled Score
+ ___ Total Indicator Score (Count 1-point for each "+" and 2 for each "++")
= ___ CREATIVITY INDEX (CI)

*Creativity Index**	1–50	51–59	60–67	68–73	74–77	78–84	85+
Creativity Level	1	2	3	4	5	6	7
Verbal Assessment	Minimal	Low	Below Average	Average	Above Average	High	Substantial
% of Adults in Level	4%	12%	20%	26%	20%	12%	4%

*Interpretive Aid–Find Creativity Index in top row score range. Use information in that column to help understand the CI.

Appendix E



CREATIVITY

We are looking for volunteers
to be part on a study on Creativity.
If you are interested, please email
Silvia
at
ncicreativethinking@gmail.com

Thank you!

This study has been received ethics permission through a NCI Research Ethics Committee.

ncicreativethinking@gmail.com ncicreativethinking@gmail.com ncicreativethinking@gmail.com ncicreativethinking@gmail.com ncicreativethinking@gmail.com ncicreativethinking@gmail.com ncicreativethinking@gmail.com ncicreativethinking@gmail.com ncicreativethinking@gmail.com ncicreativethinking@gmail.com ncicreativethinking@gmail.com ncicreativethinking@gmail.com ncicreativethinking@gmail.com ncicreativethinking@gmail.com ncicreativethinking@gmail.com ncicreativethinking@gmail.com

CREATIVITY

We are looking for volunteers
to be part on a study on Creativity.
If you are interested, please email
Silvia
at
ncicreativethinking@gmail.com

Thank you!

This study has been received ethics permission through a NCI Research Ethics Committee.