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AMABILE'S CONSENSUAL ASSESSMENT TECHNIQUE: WHY HAS IT NOT BEEN USED MORE IN DESIGN CREATIVITY RESEARCH?

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Abstract: Amabile's Consensual Assessment Technique (CAT) has been described as the "gold standard" of creativity assessment; been extensively used within creativity research, and is seen as the most popular method of assessing creative outputs. Its discussion within scholarly research has continued to grow year by year. However, since 1996, a systematic review of the CAT has not been undertaken, and, within design journals, appears not to have occurred, in relation to design, or more broadly, the creative industries in general. Yet, the consensus of domain judges is a prevalent methodology for design education, and professional design awards. This paper presents the findings from a systematic literature review of the CAT covering works from 1982 to 2011. It details key journals and authors publishing or citing CAT related studies, and highlights the limited number of CAT studies within design journals, with suggestions for why this may be the case.

Keywords: *consensual assessment technique, creativity, design research*

1. Introduction

For the past thirty years Amabile's (1982) Consensual Assessment Technique (CAT) has been used as a reliable and valid measure of creativity. It has been described as the "gold standard" of creativity assessment (Baer & McKool, 2009); been extensively used within creativity research, and is seen as the most popular method of assessing creative outputs (Kaufman, Plucker & Baer, 2008). Its discussion within scholarly research has continued to grow year by year. However, since 1996, a systematic review of the CAT has not been undertaken, and, within design journals, appears not to have occurred, in relation to design, or more broadly, the creative industries in general. This paper presents the findings from a systematic literature review of the CAT covering works from 1982 to 2011.

1.1. Background to the CAT

By emphasising the subjective element in creativity assessment, Amabile's CAT is at the opposite end of the assessment spectrum to other approaches to creativity assessment, most notably the Torrance

Test for Creative Thinking (TTCT). Yet, it is helpful to give some background history regarding the development of the CAT, in relation to TTCT.

Although a significant body of work had been completed on creativity, the majority of studies, at that time, had focused on the psychology of individual creativity. Amabile (1982) argued that you could not truly understand creativity without taking the social context of creativity into account: relationships with others, particular environments, externally imposed working constraints, etc. When Amabile began her enquiry into the social dimension of creativity she was faced with a research design problem: many of the accepted research method were not appropriate for social studies on creativity, for example like the TTCT. There were a number of reasons for this. The TTCT, and other divergent thinking tests, are about quantifying those aspects that set people apart, they aim to define and quantify the micro and macro factors that distinguish one individual from another. In contrast, researching the social context of creativity requires the need to define and quantify group characteristics beneficial for comparing a control group against a test group. Thus, there was a need to minimise individual difference, in order to test hypotheses about how one group may react differently to another, given changes in their social environment. The lack of an acceptable research methodology meant a new method to assess creativity need to be evolved, and to prove its validity. This was the purpose of the CAT. For the sake of argument, if we accept the basic definition of creativity, that creativity produces work that is both new and useful, we could state that our initial criteria for assessing creativity is how new and how useful the final output is. From such a position we are left with several questions: what is the appropriate assessment criterion for new and useful? How should assessors evaluate new and useful, and how do they do this with transparency and objectivity. Amabile argued that objective criterion did not currently exist (and may never exist) on which to assess creativity in this way. Moreover, that the judgements required to assess creativity "…can ultimately only be subjective" (1982, pp. 1001), and with an appropriate group of judges, "…is something that people can recognize when they see it." (1982, pp.1001). From this came and operational definition of creativity, upon which the CAT is based: "…a product or response is creative to the extent that appropriate observers independently agree it is creative. Appropriate observers are those familiar with the domain in which the product was create or the response articulated" (1982, pp.1001). Using this as a working definition Amabile moves away from the notion of objectivity in assessment and towards subjectivity. The question then is to what degree can judges actually agree on each other's subjective opinions? By basing the criteria within the judges' subjective opinion, this also negates the need for explicit criteria. As long as the judges are in agreement, then that is enough; they may not know specifically why a product has a certain level of creativity but if they agree that is does, then this shall form the basis for evaluation. Given such a radical departure from creativity assessment norms at the time, the consensual assessment technique was developed to evaluate whether such levels of agreement actually exist and to what degree they were reliable and consistent. Over a five-year period, Amabile conduct several studies using the CAT. With a wide range of groups represented from primary, secondary, and undergraduate education, the total numbers of students engaged in the research were 423. These groups either took part in a study to assess artistic or verbal creativity. A range of assessors recruited from academia, working practice and education judged this work. The total number of judges over the five years was 125; each judge was free to use his or her own subjective definition of creativity with which to assess the work. From these studies, Amabile concluded that high levels of judge agreement existed regarding creativity rating, with the results showing significant reliability when using the CAT. Furthermore, judges were able to distinguish 'creativity' from other aspects of the work such as aesthetic appeal and technical execution. With these findings in place, the CAT was used as the basis for research into the social impact on creativity. It is beyond the scope of this paper to detail the findings from this research, but a number of studies

found negative relationships between external evaluation and surveillance on creativity (Amabile, Hennessey & Grossman, 1986; Hennessey, 1989; Amabile, Goldfarb & Brackfield, 1990). While such findings are disputed (we are now aware of several caveats regarding these early works), the value of the CAT as a research method has continued to evolve. In more recent years, creativity researchers (Baer, Kaufman & Gentile, 2004) have extended the CAT to less stringent experimental conditions than Amabile and others initially used. Such studies suggest satisfactory results could be achieved with less than 13 judges. Equally, Kaufman, Baer, Cole & Sexton (2008) have explored the use of non-expert raters for the CAT, and find that the requirement for expert judges still holds. However, despite this background within creativity research, the use of the CAT as a measure of creativity within design research appears relatively small. For example, within the published proceeding of invited papers for Design Creativity 2010, only one citation was given for the CAT (Collado-Ruiz & Ostad-Ahmad-Ghorabi, 2010b). The main aim of this study is to consider if this is an accurate reflection of the use of CAT in design research. In order to do so, a comprehensive database of CAT citations will be developed with which to:

- Identify key journals publishing CAT studies
- Identify key authors publishing CAT studies
- Identify the use of CAT within a range of design journals

2. Method

The CAT reference database was built using Reference Manager and Zotero to import citations from a number of databases, namely: PsycINFO, ISI Web of Knowledge and Google Scholar. Details and rationale are provided below. Key journals were defined as those with more than five citations for CAT within the last 30 years; key authors were defined as first authors with more than 10 citations for CAT within the last 30 years.

2.1. Why use Google Scholar rather than other databases?

Google Scholar has its advocate and critics. The reason for its inclusion in this study was as a direct result of the low number of citations to be found in more esteemed databases such as PsycINFO and Web of Knowledge for the consensual assessment technique. Given the aims of this study to undertake a systematic and comprehensive review, such omissions were major concerns. Without discounting the inaccuracies and limited data available via Google Scholar, its database offered the most comprehensive list of references related to the consensual assessment technique. Given this, the strategy used was to gather all of the related sources available via Google Scholar, and then check for duplications within PsycINFO and Web of Knowledge. The search criteria used were the term "consensual assessment technique", with the following restrictions: articles excluding patents, any time, at least summaries, English only documents. The result was 737 citations that matched these criteria.

2.2. Problems with downloading multiple citations from Google Scholar

Currently, Google Scholar only allows downloading one reference at a time, but with the application of a Zotero plugin for Mozilla Firefox multiple downloading is feasible. Unfortunately, this does have restriction and it was not possible to download all 737 citation from Google Scholar in one go. This highlighted a number of counting inaccuracies between Google Scholar, Zotero and Reference Manager; with the possibility that either Google Scholar was not correctly counting the references (as has been suggest by other researchers), or something was getting lost in the process of exporting. Given that the Zotero figure was higher than the initial 737 the decision was taken to accept the

Zotero figures as the more accurate: the total number of citation exported to Reference Manager was 745.

2.3. Cleaning the Reference Manager Data Base

The database was cleaned for duplications: leaving a total of 742 citations in the database. Despite setting the search criteria for papers written in English, a further 19 citations were identified that the titles suggested were written in a different language. These papers were deleted from the data base. Furthermore, 10 papers had data that was undecipherable in the form of symbols, and were also deleted from the database; leaving a total of 713 references in the database.

2.4. PsycINFO

In contrast to the several hundred citations for CAT within Google Scholar, PsycINFO returned 45 citations for the Consensual Assessment Technique. Within this list none of the design journals in this study were cited. After accounting for duplicates between the Google Scholar database and PsycINFO, of the 45 citations, only 39 could be found. This led to the inclusion of the following 6 references: Conti et al (1996); Baumgarten (1997); Mannarelli (2000); Liu & Shi (2007); Batey & Furnham (2009); Tan (2009); leaving a total of 719 citations in the database.

2.5. Web of knowledge

Similarly to PsycINFO, Web of Knowledge returned 54 citations for the Consensual Assessment Technique. Accounting for duplicates between the updated Google Scholar database 51 were found. This led to the inclusion of the following 3 references: Corko &Vranic (2007); Hennessey & Amabile (2010); Kaufman (2010); leaving a total of 722 citations in the database.

2.6. Design research journals

Nineteen journals were chosen to represent design research for this review. They were as follows: Artifact; CoDesign; Design Issues; The Design Journal; Design Philosophy Papers; Design Studies; Form; International Journal of Arts and Technology; International Journal of Art & Design Education; International Journal of Design; International Journal of Design Sciences & Technology; International Journal of Technology and Design Education; Journal of Design History; Journal of Design Research; Journal of Engineering Design; Leonardo; Scientometrics; Social Studies of Science; Technoetic Arts.

3. Results/findings

3.1. CAT citations

Based upon the database described above, Figure 1. shows the growth of CAT citations relative to design related journals from 1980 to 2011.

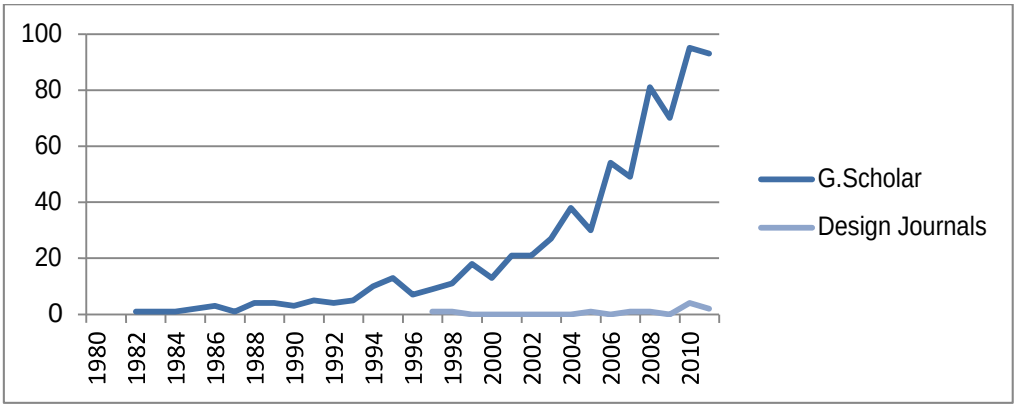

Figure 1. CAT citation in design journals relative to other journals

3.2 CAT citations with design journals

In searching for specific reference to the consensual assessment technique within design journals a total of 11 papers were identified. Of these 11 papers two operationalize the CAT within their studies, and state this specifically (Christiaans & Venselaar, 2005; Pektas, 2010). Three papers use judges to evaluate creative outputs, but these are not directly related to the CAT in terms of procedures (Verstijnen et al, 1998; Kokotovich, 2008; Collado-Ruiz & Ostad-Ahmad-Ghorabi, 2010a). The remaining papers up to 2011 make reference to Amabile's 1982 or a CAT work to support a point within their papers, but CAT was not part of the study (Cross, 1997; Jeffries, 2007; Cropley & Cropley, 2010; Jeffries, 2011; Howard, Culley & Dekoninck, 2011; Lau, 2011).

3.3 Key journals publishing CAT studies

From the 722 database three journals stand as key contributors to the debate on the Consensual Assessment Technique (number of citations in brackets). These are:

- Creativity Research Journal (55)
- The Journal of Creative Behavior (25)
- Psychology of Aesthetics, Creativity, and the Arts (18)

The caveat to this claim is that 207 of the reference in the database were without data on journal, books, chapter or thesis. However, 515 citations remained with these details, and it was decided that this number of citations formed a reasonable basis on which to proceed. Those with 5 or more reference to the CAT were as follows:

- Journal of Personality and Social Psychology (11)
- Roeper Review (11)
- Creativity and Innovation Management (11)
- Personality and Individual Differences (8)
- Thinking Skills and Creativity (7)
- Design Studies (7)
- Journal of Research in Personality (6)

3.3 Key authors publishing CAT studies

From the database of CAT citations six first authors account for 91 of the papers as follows (number of citations in brackets):

- Kaufman, J. C (22)
- Baer, J (17)
- Dollinger, S. J (15)
- Amabile, T. M. (13)
- Hennessey, B.A (13)
- Plucker, J. A (11)

4. Discussion

In an earlier section of this paper, for the sake of argument and word space, a definition of creativity being based on outputs that had the dual quality of originality and usefulness was suggested. Many readers will likely be familiar with this type of definition; equally aware of the controversy surrounding how researchers' define core characteristics like originality and the type of evidence required to assess creativity (Runco, 1999). Indeed, a number of works have begun to categories creativity in more precise terms, such as Big C creativity, Little C creativity, mini c creativity (Beghetto & Kaufman, 2007), and have different expectation associated with each of these terms regarding originality and usefulness, and the sort of study population they can be applied to: for example, kindergarten pupils, students in higher education, professional practitioners within a field.

The focus, however, on creative output is not the only means to define creativity; other categories of research explore the creative process, the creative person, or the creative environment (Isaksen & Murdock, 1993). An argument can be made (for some creativity researchers this argument is generally accepted) that to validate findings in these three other areas, inference needs to be shown with the creative output (Kaufman & Baer, 2002). By doing so this places the primacy of creative output at the heart of creativity assessment. As mentioned above, such a decision is controversial. It may also partly explain the low use of the CAT in design research.

The CAT is a measure of creativity that is firmly placed within notions of creativity as an output. With a degree of contrast (as a broad generalization) much focus within design research has been given to "understanding designing as a process" (p.1, Nagai & Gero, 2012). Such broad distinctions are not to be taken as a sign of polarity: while offering theoretical value, the 4 P's of creativity research (product, process, person, press) clearly interact and influence each other in practical terms.

Indeed, the number of methods with which to measure creativity are considerable and varied (Batey & Furnham, 2006): from protocol studies, self-report measures, divergent thinking tests, to creativity assessment by domain experts, and each method has its strengths and limitations. For example, Protocol analysis enables researchers to explore the type of cognitive processes and decisions participants make during an activity, for example when sketching ideas for a design. Such study is crucial to our understanding of the creative process. Equally, self-report measures offer a valuable and established approach to creativity research (Lau, 2011; Batey, Furnham, & Safiullina, 2010). Some researchers have argued that given an emphasis within design education for expert judges to form consensual assessments on creative outputs, data gathered by self-reports offer an alternative perspective on creative potential (Jeffries, 2007; Kaufman & Baer, 2002). Self-report data enables researchers to examine an individual's self-image in relation to their creativity, and such factors are

important for theoretical and pedagogic reasons. There are, however, acknowledged challenges to the use of self-report instruments such as, not being easily verifiable, and open to "halo" effect bias on the part of the participant (Brown, 1989; Lubart & Guignard, 2004).

Notwithstanding the value of alternative method to researching creativity, perhaps an emphasis on the process of design creativity has overshadowed methodologies that relate more to the creative output? The rationale for asking this question is based on the small number of CAT studies in design journals relative to creativity journals and number of CAT citations within the wider community of scholars.

The counter argument is that those studies within design journals that cite the CAT often directly address this issue of product relative to process; notably Cross (1997) and Christiaans & Venselaar (2005), but in both cases this could well be traced back to Christiaans earlier research in 1992. Thus, one could argue that the value of creative output methodologies, and by extension the CAT, has had is supporters within design research for some time.

Of those studies that cited CAT in design journals, from the 11 papers identified, only two directly made use of the CAT. In both cases the reliability of the CAT was, for the most part, above the standard 0.7 levels required for inter-rater reliability (ranging from 0.66 to 0.81; 0.81 to 0.86). Whilst these are favourable, the number of expert judges varied from 10 graduate industrial design students to 3 design academics. Selection of judges in terms of level of domain expertise, and how many judges should be used in a study is a point of debate. Issues around the use of novices relative to expert judges have for and against arguments; equally the number of judges has varied in CAT studies throughout the years.

The issue of validity, however, is more problematic, particularly in the light of debates surrounding the domain specificity/generality of creativity, and the role task selection plays in creativity assessment (Byrne, 2011). For example, the task set; the amount of time given to complete the task; a subject's level of intelligence; the domain identity of the judges; the researchers' method of distinguishing high from low levels of creativity using CAT scores; a judges rating of highest and lowest works relative to their own tacit standards of creativity within the domain; all these considerations could have an impact on CAT validity in relation to design creativity. Unfortunately, it is beyond the scope of this current paper to address each of these issues adequately; they are highlighted here to foster the discussion regarding the CAT and its value to design research.

Lau's 2011 paper for the Journal of Design Research is of particular interest at this point. Clearly, this is a paper that undertakes a detailed review of methods to assess creativity and relate them to design. It covers a wide range of works that fall within self-report measures, divergent thinking tests, creative problem solving, and specifically discusses the creative output, or end product, as a measure of creativity within design. The connection to CAT is established indirectly through citing Hennessey's work (1994), however, given the detailed focus within the paper on TTCT, Creative Problem Solving, and other methods, it is interesting to consider why there is no direct discussion of the CAT. Indeed, the issue of subjective judgement and assessment criteria are fundamentally reframed by use of CAT methodology, as mentioned earlier in this paper. In this respect, does the philosophical stance of the CAT devalue the method from the perspective of design research? Yet, the consensus of domain judges (often using their subjective opinion and expertise) is a prevalent methodology for assessment in design education, and professional design awards (of which creativity is either an implicit or explicit expectation).

4.1 Limitations and areas for future research

The results extracted from this study are limited in a number of ways. Firstly, the type of design journals searched, while comprehensive, may have overlooked some publications. Secondly, for

practical reasons the focus on first authors was a useful way to gather key authors related to CAT, but this does not reflect the role of second author or et al, and further work here may change the emphasis on key figures within this area of research. Thirdly, and finally, there is a need for a keyword search of abstracts. Both the PsycINFO and Web of Knowledge are able to provide abstracts, but this was not available via Google Scholar. In practical terms, gathering the abstract from 722 papers is a long term aim, but using the key journal data identified here, these journals show 159 papers with CAT citations. A keyword search of these abstract would be feasible, and clarify if, and how, the CAT was used in these studies.

5. Conclusion

Amabile's Consensual Assessment Technique (CAT) has been described as the "gold standard" of creativity assessment, and has been extensively used within creativity research during the past 30 years. Yet, the key finding of this paper highlight a limited number of CAT studies within design journals. The reasons for this are unclear. Whether this is because the CAT is tied to a definition of creativity built upon creative output and the subject opinions of judges, or a number of specific concerns regarding its validity as a measure of design creativity are discussed.

References

Amabile, T. M. (1982). Social psychology of creativity: A consensual assessment technique. Journal of personality and social psychology, 43, 997-1013.

Amabile, T. M., Goldfarb, P., & Brackfleld, S. C. (1990). Social influences on creativity: Evaluation, coaction, and surveillance. Creativity Research Journal, 3, 6-21.

Amabile, T. M., Hennessey, B. A., & Grossman, B. S. (1986). Social influences on creativity: The effects of contracted-for reward. Journal of personality and social psychology, 50, 14-23.

Baer, J., Kaufman, J. C., & Gentile, C. A. (2004). Extension of the Consensual Assessment Technique to Nonparallel Creative Products. Creativity Research Journal, 16, 113-117.

Batey, M. & Furnham, A. (2006). Creativity, intelligence, and personality: A critical review of the scattered literature. Genetic, Social, and General Psychology Monographs, 132, 355-429.

Batey, M. & Furnham, A. (2009). The relationship between creativity, schizotypy and intelligence. *Individual Differences Research*, 7, 272-284.

Batey, M., Furnham, A., & Safiullina, X. (2010). Intelligence, general knowledge and personality as predictors of creativity. *Learning and Individual Differences*, 20, 532-535.

Baumgarten, M. D. (1997). *The effects of constraint on creative performance*. ProQuest Information & Learning, US.

Beghetto, R. A. & Kaufman, J. C. (2007). Toward a broader conception of creativity: A case for" mini-c" creativity. *Psychology of Aesthetics, Creativity, and the Arts*, 1, 73.

Brown, R. T. (1989). Creativity: What are we to measure? In J.A.Glover & R. R. R. C. R. Ronning (Eds.), *Handbook of Creativity* (pp. 3-32). New York: Plenum Press.

Byrne, C. (2011). *Task selection and the consensual assessment technique: Using collage tasks in creativity research* (MA Thesis). Retrieved from http://www.uclan.ac.uk/schools/adp/just_published.php

Christiaans, H. (1992). *Creativity in Design: The role of knowledge in designing*. Lemma BV, Utrecht, Holland.

Christiaans, H. & Venselaar, K. (2005). Creativity in design engineering and the role of knowledge: Modelling the expert. *International Journal of Technology and Design Education*, 15, 217-236.

Collado-Ruiz, D. & Ostad-Ahmad-Ghorabi, H. (2010a). Influence of environmental information on creativity. *Design Studies*, 31, 479-498.

Collado-Ruiz, D. & Ostad-Ahmad-Ghorabi, H. (2010b). *Influence of Environmental Information on Expert-perceived Creativity of Ideas.* Design Creativity 2010, 71.

Conti, R., Coon, H., & Amabile, T. M. (1996). Evidence to support the componential model of creativity: Secondary analyses of three studies. *Creativity Research Journal*, 9, 385-389.

Corko, I. & Vranic, A. (2007). The influence of information about existing products in the specific domain on the creativity of new products. *Drustvena Istrazivanja*, 16, 613-625.

Cropley, D. & Cropley, A. (2010). Recognizing and fostering creativity in technological design education. *International Journal of Technology and Design Education*, 20, 345-358.

Cross, N. (1997). Descriptive models of creative design: application to an example. *Design Studies*, 18, 427-440.

Hennessey, B. A., Amabile, T. M., & Martinage, M. (1989). Immunizing children against the negative effects of reward. *Contemporary Educational Psychology*, 14, 212-227.

Hennessey, B. A. & Amabile, T. M. (2010). Creativity. *Annual Review of Psychology*, 61, 569-598.

Hennessey, B.A. (1994) 'The consensual assessment technique: an examination of the relationships between ratings of product and process creativity', *Creativity Research Journal*, Vol. 7, pp.l93-208.

Howard, T. J., Culley, S., & Dekoninck, E. A. (2011). Reuse of ideas and concepts for creative stimuli in engineering design. *Journal of Engineering Design*, 22, 565-581.

Isaksen, S. G., Murdock, M. C., Isaksen, S. G., Murdock, M. C., Firestien, R. L., & Treffinger, D. J. (1993). The emergence of a discipline: Issues and approaches to the study of creativity. *Understanding and recognizing creativity: The emergence of a discipline*, 13-47.

Jeffries, K. K. (2007). Diagnosing the creativity of designers: individual feedback within mass higher education. *Design Studies*, 28, 485-497.

Jeffries, K. K. (2011). Skills for creativity in games design. *Design Studies*, 32, 60-85.

Kaufman, J. C. & Baer, J. (2002). Could Steven Spielberg manage the Yankees?: Creative thinking in different domains. *Korean Journal of Thinking and Problem Solving*, 12, 5-14.

Kaufman, J. C., Baer, J., Cole, J. C., & Sexton, J. D. (2008). A comparison of expert and nonexpert raters using the consensual assessment technique. *Creativity Research Journal*, 20, 171-178.

Kaufman, J. C. (2010). Further evidence of BVSR in the areas of aesthetic judgment and personality Comment on "Creative thought as blind-variation and selective-retention: Combinatorial models of exceptional creativity" by Prof. Simonton. *Physics of Life Reviews*, 7, 180-181.

Kaufman, J. C., Plucker, J. A., & Baer, J. (2008). *Essentials of creativity assessment*. Hoboken, NJ US: John Wiley & Sons Inc.

Kokotovich, V. (2008). Problem analysis and thinking tools: an empirical study of non-hierarchical mind mapping. *Design Studies*, 29, 49-69.

Lau, K. W. (2011). The difficulties of assessing design students' creativity: a critical review on various approaches for design education. *Journal of Design Research*, 9, 203-219.

Liu, T. R. & Shi, J. N. (2007). Relationship among working memory, intelligence and creativity of the 9-11 years old children. *Chinese Journal of Clinical Psychology*, 15, 164-167.

Lubart, T. & Guignard, J. H. (2004). The generality-specificity of creativity: A multivariate approach. *Creativity: From potential to realization*, 43-56.

Mannarelli, T. C. (2000). *Biting the hand that feeds them: Disdain and motivation of creative individuals in the music industry*. ProQuest Information & Learning, US.

Nagai, Y. & Gero, J. (2012, March 7). *Special issue on Design Creativity* [PDF via Website]. Retrieved from http://www.jaist.ac.jp/ks/labs/nagai/DesignCreativityW/

Pektas, S. T. (2010). Effects of cognitive styles on 2D drafting and design performance in digital media. *International Journal of Technology and Design Education*, 20, 63-76.

Runco, M. A. (1999). Creativity need not be social. *Social creativity*, 1, 237-264.

Tan, A. G. (2009). Fostering creative writing: Challenges faced by Chinese learners. In S.B.Kaufman, J. C. Kaufman (Eds.), *The psychology of creative writing* (pp. 332-350). New York, NY US: Cambridge University Press.

Verstijnen, I. M., Van Leeuwen, C., Goldschmidt, G., Hamel, R., & Hennessey, J. M. (1998). Sketching and creative discovery. *Design Studies*, 19, 519-546.