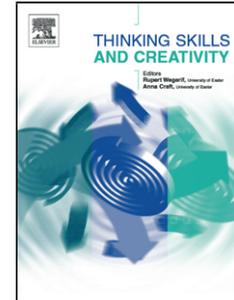


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The role of implicit theories, age, and gender in the creative performance of children and adults

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Highlights

- Children's implicit theories of intelligence correlated with their divergent thinking scores
- Adults' implicit theories of creativity correlated with their divergent thinking scores
- Endorsing an entity theory was associated with lower creative performance
- Age, but not gender, was positively related to creative performance
- The conclusion of this study may offer a potential route for creative intervention

Abstract

Given its importance in current society, understanding the individual differences that might encourage creative productivity should be an important focus for research. In this two-study paper, we suggest that an individual's beliefs about the malleability of abilities and traits plays an important role in their creative performance. This relationship was examined in both children (Study 1) and adults (Study 2). For Study 1, data was collected from 58 pupils (aged 4-7 years). Participants completed a divergent thinking task, and their implicit theories of intelligence were measured. Results showed that holding an entity theory of intelligence was associated with lower scores on the divergent thinking task. For Study 2, 131 adults participated, completing an online divergent thinking task as well as reporting their implicit theories of creativity. Leading on from the findings of Study 1, endorsing an entity theory of creativity was associated with lower scores on the divergent thinking task. In both studies, the role of

age and gender was examined. Results are discussed in relation to a potential avenue for interventions designed to encourage creativity.

Keywords

Creativity; divergent thinking; implicit theories of intelligence; implicit theories of creativity; intervention

1. Introduction

Modern interest in creativity has been growing since the late 1990s (Turner-Bisset, 2007). We live at a time when creative individuals are highly valued, with the ever-increasing need to cope with the fast-changing world. Creativity is acknowledged as being important for social and economic innovation, growth and development, as well as being found to influence individual wellbeing (e.g. Florida, Mellander & Stolarick, 2008; OECD, 2007; Scott, 2007; van der Pol, 2008; Wolfe & Bramwell, 2016; Zhao, 2012). Given the importance of such creative skills, understanding the individual differences that might encourage creativity should be an important focus for research. This goal is not new; in his Presidential address to the American Psychological Association in 1950, Guilford urged psychologists to spend more time focusing on the much 'overlooked' attribute. Despite this, empirical creativity research has been underdeveloped until relatively recently, not helped by disagreements over a unified definition of creativity (Sternberg & Lubart, 1996; Parkhurst, 1999). It is broad concept that can be described at different levels (e.g. eminent creativity with a 'big C' and everyday 'little c' creativity; Craft, 2001), and encompasses many task domains: scientific findings; movements in the arts; inventions; businesses; and social programmes. Generally however, there is scholarly consensus that creativity involves two major criteria; novelty and appropriateness (e.g. Amabile, Conti, Coon, Lazenby & Herron, 1996; Doron, 2017; Runco & Jaeger, 2012). The aim of the two studies in this paper is to explore the individual differences that might relate to creative thinking. Specifically, we will examine the role of implicit theories in the creative performance of children and adults.

If the consensus is that creativity is a necessity for future economic success, it would be logical to expect creativity to take priority in education. On the contrary, formal education has been criticised for producing "stereotypes" and "conformists" instead of "freely creative and original thinkers" (Rogers, 1970). Carl Rogers may have written this in 1970, but the influence of creativity in formal education has remained irregular and intermittent (e.g. Crompton, 2010; Feldman & Benjamin, 2006), with uncertainty about how the inclusion of creativity in the education system might be achieved. Alarming, Berghetto (2008) examined the beliefs of prospective teachers in the United States, finding that a disproportionate number thought that

the 1st grade of elementary school was the time to encourage more focus on memorisation rather than imaginative thinking. Creativity has been given the lowest rank in the academic hierarchy of subjects for several reasons. In the UK, vast shifts have occurred in the education and schooling system across the last 40 years. Increased emphasis on evidence, accountability, and performativity has led to diminished teacher autonomy (Turner-Bisset, 2007). Despite policy initiatives designed to encourage creativity (e.g. Department for Education and Skills document *Excellence and Enjoyment*, 2003), subjects such as literacy and mathematics still dominate the curriculum. It has been claimed that such heavy focus on these national curriculum areas has resulted in ‘creaticide’ (Berliner, 2011). Further, it has been suggested that, with increased emphasis on high-stakes testing, it becomes difficult to incorporate creative-based learning into teaching practices as doing so may lead to the disruption of other classroom processes (such as the progression of a class through the curriculum; Kaufman & Sternberg, 2010). In order to help schools to stimulate creativity more effectively, a better understanding of the mechanisms underlying creativity is necessary (Kaufman, 2015)

1.1 Divergent thinking and creativity

In his Structure of Intellect theory, Guilford (1950) made the distinction between two types of thinking: convergent production and divergent production. While convergent production is described as the process by which an individual finds a single solution to a problem, it is divergent production that has been linked to creativity, involving the generation of several solutions to a problem. Although not synonymous with creativity, divergent thinking has been described as “a significant basis of creative thinking and creative production” (Guilford & Hoepfner, 1971, p. 142), and can act as a useful indicator of creativity (Runco & Alcar, 2012). The concept of divergent thinking is characterised in different ways by different researchers, but most tend to focus on Guilford’s three basic components: fluency (quantity of ideas); flexibility (diversity of ideas); and originality (novelty or uniqueness of ideas). Despite criticism over the use of divergent thinking tests as a measure of creativity (e.g. Clark & Mirels, 1970; Hocevar, 1981; Zeng, Proctor & Salvendy, 2011), they have dominated the field of creativity for several decades and continue to underlie most creativity research (Runco & Alcar, 2012). Therefore, within the context of the studies presented here, creativity will be measured using divergent thinking tasks.

1.2 Individual differences in creativity

Due to its multifaceted nature, there is considerable debate regarding how creativity develops, with relatively few theories focusing on the longitudinal development of creativity throughout the lifespan (Starko, 2018). Reflecting disagreements about cognitive development more generally, some argue that creativity develops gradually over time, with increasing life

experience and education (e.g. Chae, 2003; Smith & Carlsson, 1983, 1985), while others present a more complicated picture (e.g. Kleibeuker, De Dreu & Crone, 2013). Some findings, in fact, suggest a decline in creativity with age throughout childhood. According to Land and Jarman (1993), 98% of 5-year-old children score in the highly creative range, compared to only 30% reaching the same level five years later, and only 2% in adulthood. This led the authors to the conclusion that “non-creative behaviour is learned”. Other researchers suggest that creative development occurs in a discontinuous manner across qualitatively different stages. Torrance (1968) was one of the first to report this idea within the field of creativity, suggesting a ‘fourth-grade slump’. Since then, many others have corroborated that, although *overall* creativity scores increase through the years of childhood and adolescence, some developmental stages are associated with strong declines, particularly relating to fluency measures (e.g. Claxton, Pannells & Rhoads, 2005; Daugherty, 1993; Krampen, 2012; Lau & Cheung, 2010; Runco, 1991; Smolucha & Smolucha, 1985; Urban, 1991). These slumps have been attributed to a range of different causes, including increased evaluative skills (Runco, 1991), a lack of willingness to face failure (Lau & Cheung, 2010), and increased pressure to conform to classroom expectations (Lau, Li & Chu, 2004; Torrance, 1968).

Research has also shown that gender and culture may influence creative performance (e.g. Cox, 2003; Dhingra & Sharma, 2012; Saeki, Fan & van Dusen, 2001; Singh, 1979; Troiano & Bracken, 1983; Zheng & Xiao, 1983). Males tend to have more critically acclaimed accomplishments in science, literature, arts, music, and technical development than females - particularly at the highest level (Hill, Corbett & St. Rose, 2010; Piirto, 1991). Helson (1990) argues that this is the result of small basic differences between boys and girls becoming exaggerated and intensified by cultural values, stereotypes, and socialisation processes. Indeed, such socialisation processes have been found to be present in classrooms. Fabricant, Svitak and Kenschaft (1990) reviewed research showing that teachers tend to allow boys more freedom in Maths classes to deviate from rules and discover alternative solutions to problems, while girls are required to follow rules more closely.

In other areas of performance, it has been found that individuals underachieve when they feel bounded by the expectations of others (Jacobs & Eccles, 1992; Jencks & Phillips, 1998). Kaufman (2006) asked students and community members to rate themselves in various domains of creativity, finding that self-assessments tended to be consistent with gender stereotypes. Females rated themselves higher than males on social-communication and visual-artistic domains, while males rated themselves higher on science-analytic and sports domains. However, findings have been inconsistent and often contradictory with regards to gender differences in performance on creativity tests (Cheung, Lau, Chan & Wu, 2004; Glover, 1976; Kaufman, Baer & Gentile, 2004; Lau & Cheung, 2010; Stricker, Rock & Bennett, 2001). Indeed,

Baer and Kaufman (2008) reviewed almost 80 studies on creativity, finding that only 13 of the studies included reported gender differences (both male and female advantages), while the remaining studies included report no gender differences or were mixed and contradictory.

The above suggestions that creativity may be a) a learned (or unlearned) behaviour, that is b) affected by expectations in school, and may even c) fall victim to cultural stereotypes, all point towards the role of social processes in understanding individuals' creative abilities. This idea is encapsulated by the sociocognitive approach which considers knowledge acquisition as a primarily cognitive process that can be influenced by individuals' interactions with their social world (Bandura, 1977, see also Karwowski & Kaufman, 2017). Attempts to encourage and enhance creativity have been made for many years (see Nickerson, 1999 for a review), but have so far failed to receive widespread acceptance or recognition. Plucker, Beghetto and Dow (2004) suggest that this is due in part to a myriad of myths and inaccurate conceptions about creativity held by researchers, practitioners and laypersons alike such as 'People are born creative or uncreative' (p. 85) and 'Creativity is intertwined with negative aspects of psychology and society' (p. 86). Pioneering research by Guilford (1958) highlighted that the "popular opinion that creative performance is the prerogative of the gifted few" may intensify the problem, in that "if the child classifies himself as belonging in the non-creative group he accepts his fate and makes little or no effort to be original or productive" (p. 17).

Since the distinction drawn by Sternberg (1985), individuals' implicit theories (as opposed to explicit theories) have been examined within the field of creativity. Most previous work within this area has focused on understanding people's perceptions of creativity, particularly in attempt to define the construct and identify estimates of creative characteristics (e.g. Andilou & Murphy, 2010; Chan & Chan, 1999; Fryer & Collings, 1991; Runco & Johnson, 2002; Seng, Keung & Cheng, 2008). Research on individual differences in creative self-beliefs has also increased in recent years (e.g. see Karwowski & Kaufman, 2017), focusing on related yet conceptually distinct constructs such as creative personal identity (Jaussi, Randel & Dionne, 2007), creative self-efficacy (e.g. Beghetto, 2006; Tierney & Farmer, 2002, 2011), and creative metacognition (Kaufman & Beghetto, 2013). Creativity literature shows that these self-beliefs play an important role in determining why, how and what we create (or do not create), and are investigated as predictors of creative activity, or as mediators of the relationship between ability and achievement (e.g. Beghetto & Karwowski, 2017; Karwowski & Lebeda, 2016; Karwowski & Kaufman, 2017). For instance, creative self-efficacy (the belief in one's ability to be creative) has been posited as a key determinant of creative outcomes (Ford, 1996). Indeed, a positive relationship between creative self-efficacy and creative performance has been demonstrated in children and adolescents (e.g. Beghetto, Kaufman & Baxter, 2011), university students (e.g. Reiter-Palmon, Robinson-Morrall, Kaufman & Santo, 2012), and employees (e.g.

Jaussi et al., 2007). Relatedly, Goldsmith and Matherley (1988) found a positive correlation between self-reported measures of creativity and self-esteem. Equally, in her influential theory of creativity, Amabile (1983) emphasises the importance of intrinsic motivation in the creative process.

This focus on the role of self-identification, motivation, and confidence falls in line with the work of Dweck and colleagues (e.g. Dweck, 1986, 1999, 2011; Dweck, Chiu & Hong, 1995; Dweck & Leggett, 1988) who suggest that it is not necessarily the ability, or self-efficacious beliefs in ability, that predict performance, but an individual's belief, or implicit theories, about the underlying nature of ability. Exploration of this theoretical underpinning may hold the key to understanding why some people develop creativity and others do not, but has yet to be widely investigated within the creativity domain (Hass, Katz-Buonincontro & Reiter-Palmon, 2016). According to Dweck's theory, individuals fall on a continuum according to their beliefs regarding the *malleability* of personal traits and characteristics, and these beliefs orient them towards different goals, responses, and behaviour patterns. Some individuals believe that abilities and attributes are based on innate and unchangeable "entities" which remain relatively stable throughout the life time (said to hold an entity theory), whilst others believe that abilities and attributes are relatively malleable and can be developed through hard work, persistence, and effort (holding an incremental theory). Findings from research have consistently demonstrated that holding an entity theory of intelligence has a negative impact on academic achievement, while encouraging individuals to adopt more of an incremental framework can improve academic achievement (e.g. Aronson, Fried & Good, 2002; Blackwell, Trzesniewski & Dweck, 2007; Chen & Pajares, 2010; Claro, Paunesku & Dweck, 2016; Good, Aronson & Inzlicht, 2003; Romero, Master, Paunesku, Dweck & Gross, 2014; Zeng, Hou & Peng, 2016). This relationship between attainment and implicit theories of intelligence is thought to be driven by the resulting frameworks created by the two different beliefs, which in turn influence individuals' responses, values, and approaches to learning (Dweck, 1999). Specifically, incremental beliefs have been linked to adopting a mastery orientation with an emphasis on learning goals (Dweck & Leggett, 1988).

The study of incremental and entity beliefs have only emerged in the creativity literature relatively recently, and only in adult samples. Both Karwowski (2014) and Hass et al. (2016) investigated the relationship between such implicit beliefs and creative self-concept characteristics, finding that incremental beliefs about creativity were positively related to creative self-efficacy and creative personal identity. Of the limited number of studies that have investigated how implicit beliefs relate to creative performance, incremental beliefs have been positively correlated with the quality, originality and/or effectiveness in creative problem-solving tasks (Karwowski, 2014; O'Connor, Nemeth & Akutsu, 2013; Royston & Reiter-

Palmon, 2017) as well as with self-reported assessments of lifetime creative achievements (O'Connor et al., 2013).

If this theoretical underpinning can be applied to the domain of creativity, it may offer a reason as to why only certain individuals excel in creativity. One of the most pervasive myths surrounding creativity is that creativity is a fixed trait and that people do or do not have creative capacity (Doron, 2017; Plucker, et al., 2004; Treffinger et al., 1996). Indeed, Hass and Burke (2016) found that laypeople implicitly categorise famous creative exemplars as qualitatively different to themselves. The findings of intervention studies dispute this myth, with substantial evidence showing that creative thinking abilities can be developed and improved through training (see Scott, Leritz & Mumford, 2004 for a review). However, if entity theorists perceive attributes, including creative capacity, as fixed, they may categorise themselves as 'belonging' in the non-creative group and thus not invest any effort in order to improve. On the other hand, with the belief that abilities are dynamic and changeable, incremental theorists may not fall vulnerable to labelling themselves in the same way, instead focusing more on developing their creative abilities. At the time of writing, no studies have examined the relationship between incremental beliefs and creativity in children. We propose that Dweck's (e.g. Dweck, 1999; Dweck & Leggett, 1988) socio-cognitive model may build on previous work on implicit theories within the context of creativity and provide a potential mechanism for promoting creativity in schools. School-based interventions aimed at promoting incremental theories of intelligence have been found to be effective in improving attainment (e.g. Blackwell et al., 2007; Good et al., 2003; Mueller & Dweck, 1998); elucidating the impact of these different belief frameworks on creative performance may provide a potential avenue for creative intervention in education.

1.3 Current studies

We report here two studies designed to explore the relationship between implicit theories and creative performance. For each study, the divergent thinking approach was used as a measure of creativity. Study 1 explores the relationship between implicit theories of intelligence and divergent thinking scores in two groups of primary school children; those in Reception Year (Year R; 4-5 year-olds) and those in Year 2 (6-7 year-olds). Study 2 extends on these findings in a sample of adults by investigating individuals' implicit theories of creativity and their association with divergent thinking skills. In both studies, the role of age and gender is also examined.

2. Study 1

Following the divergent thinking approach, children's creativity was measured using an adaptation of Guilford's (1967) Alternative Uses Task. Implicit theories of intelligence were measured using self-reports. Given the evidence reviewed, we expected that children who report holding a stronger entity theory of intelligence would have lower scores in divergent thinking. Given that children's creative

skills have been reported to continue developing between the age of 4 and 7 years, we expected that the divergent thinking scores of children in Year 2 would be higher than those in Reception Year. We also investigated gender differences in the divergent thinking scores as previous explorations have been contradictory and inconsistent.

2.1 Method

2.1.1 Participants

Participants were 58 children recruited from a state-funded infant school in the UK (26 females, 32 males). There were 30 children in Year R ($M_{Age} = 4.20$, $SD_{Age} = .41$) and 28 in Year 2 ($M_{Age} = 6.36$, $SD_{Age} = .49$). The school admits pupils from a catchment area with a mixture of different socio-economic groups, and includes mixed ability children. It is important to note that testing took place in November/December; children in the UK begin formal school in the term during which they turn 5-years-old (Year R), so all those in the Year R group had been in school since the beginning of September.

2.1.2 Measures

2.1.2.1 Divergent thinking task

Divergent thinking was measured using Guilford's Alternative Uses Task (1967), and consisted of three open-ended questions about possible uses for common household objects. In the current study, participants were asked to list as many uses as they could for a paper clip, a newspaper, and a cup. Responses were coded to assess pupils' divergent thinking using three categories: fluency; flexibility; and originality. (See section 2.3 for more information on coding). Within the current sample, the measure had very high internal consistency across the categories, with an overall Cronbach's alpha of .96 (fluency $\alpha = .88$; originality $\alpha = .88$, and flexibility $\alpha = .84$).

2.1.2.2 Implicit theories of intelligence

Implicit theories of intelligence were measured using three items from Dweck's (1999) Implicit Theories of Intelligence Scale for Children. Only three out of the original six scale items were used in the current study as Dweck (1999) recommends using the entity-only scale with younger children. Responses for the items were measured based on a 6-point Likert scale (1- strongly disagree to 6- strongly agree). Implicit theories of intelligence scores were computed by combining the score from each of the three questions, with higher scores indicating more of an entity theory of intelligence. This measure has been found to have high internal reliability, with Cronbach's alpha values ranging from .94 to .98, and a test-retest reliability of

.80 over a two-week period (Dweck, et al., 1995). Within the current study, the Cronbach's alpha value was .84.

2.1.3 Procedure

Participants were tested individually in a quiet corner of their usual classroom. The session took the form of a brief, enjoyable 'game' and 'quiz', which lasted for about 15 minutes per child. Children completed the divergent thinking questions first, and were given up to 3 minutes to answer each question. To encourage performance, the instruction to '*be creative*' was given to all participants. The effects of such explicit instructions favour the production of divergent thinking (Harrington, 2006). Children gave their responses verbally and the experimenter recorded all answers given.

Following the divergent thinking task, participants completed the Implicit Theories of Intelligence Scale items. Children were read the questions and told to indicate their level of agreement to each question by pointing to the corresponding number on a printed scale. If children did not understand the question, the experimenter would relate intelligence to 'being clever' and repeat the question.

2.3 Results

2.3.1 Data Preparation

With reference to the divergent thinking task, responses were scored according to the following three categories: fluency (the total number of answers given); flexibility (the number of different concepts or categories whereby higher scores indicate a greater variety of different ideas); and originality. Originality was calculated by the formula: $1 - (\text{proportion of participants giving that response})$, so the higher the originality index, the more creative it is (Runco & Acar, 2010). All responses were double-coded and where there were discrepancies between coders, the authors discussed and agreed. Since the divergent thinking categories were all found to significantly correlate with each other (lowest $r(56) = .88, p < .001$), the three scores were totalled to create one overall divergent thinking score which was used in all proceeding analysis. With regards to the implicit theories of intelligence scores, a score was derived by totalling responses from the Likert scale from the three questions. Higher scores indicate more of an entity theory. Gender and Year Group were both dummy coded. The mean scores and standard deviation of these variables used are displayed in Table 1.

Table 1. Mean and SD of divergent thinking and implicit theories of intelligence scores

		Divergent thinking	Implicit theories of intelligence
		M (SD)	M (SD)
Whole sample		33.89 (16.16)	3.60 (1.34)
Gender	Female	31.16 (17.21)	4.03 (1.24)
	Male	36.10 (15.17)	3.25 (1.34)
Year group	Year R	27.12 (14.15)	3.78 (1.23)
	Year 2	41.14 (15.19)	3.40 (1.45)

2.3.2 Relationships between creativity, implicit theories of intelligence, age, and gender

To assess the relationship between implicit theories of intelligence and divergent thinking we conducted a Pearson's Product-Moment Correlation. Results indicated a moderate significant negative correlation between divergent thinking and implicit theories of intelligence scores ($r(56) = -.41, p = .001$). As shown in Figure 1, lower entity scores were associated with higher divergent thinking scores.

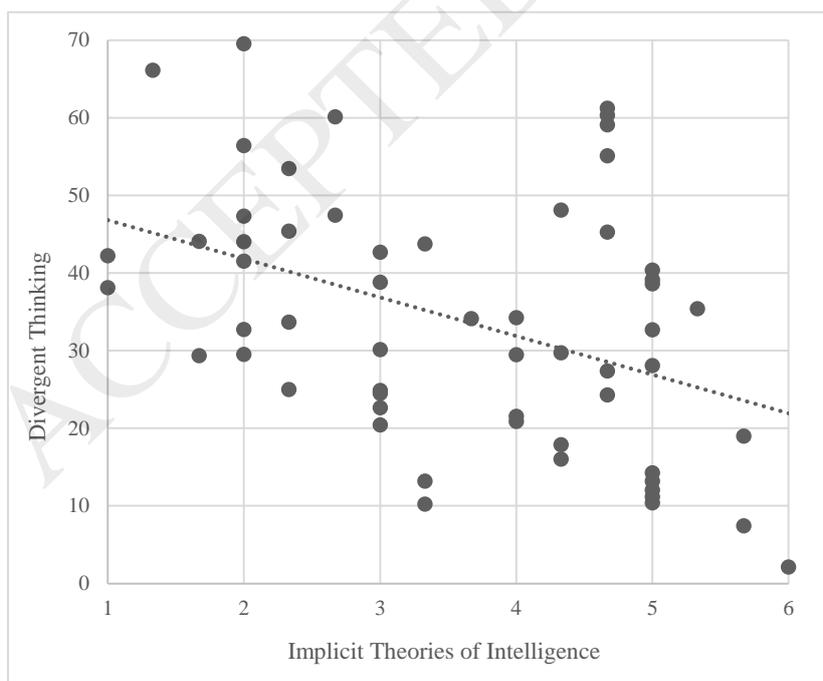


Figure 1. Scatterplot of individuals' implicit theories of intelligence against their overall divergent thinking scores

In order to explore the validity of implicit theories of intelligence as a predictor of divergent thinking scores, we conducted a regression analysis. We also included age and gender in the model in order to examine the relative impact of these factors. The overall model was significant ($\text{Adj } R^2 = .28$, $F(3,54) = 8.40$, $p < .001$), and as can be seen in Table 2, both implicit theories of intelligence and year group were found to significantly predict divergent thinking scores. Specifically, lower implicit theories of intelligence scores (lower entity theory endorsement) and the older age group were associated with higher divergent thinking scores.

Table 2. Regression model investigating implicit theories of intelligence, year group, and gender as predictors of the divergent thinking scores

	<i>B</i>	<i>SE B</i>	<i>B</i>
Constant	43.25	6.67	
Implicit theories of intelligence	-4.31	1.42	-.36*
Year group	12.38	3.65	.39*
Gender	.27	3.79	.01

* $p < .01$, ** $p < .001$

2.3.3 Summary of findings

The findings presented here regarding the relationship between divergent thinking and implicit theories of intelligence is in line with our predictions, in that endorsing an entity theory was associated with lower scores in divergent thinking in a sample of infant school children. Specifically, children who believe that intelligence is a fixed, unchangeable entity score lower on the divergent thinking task. We also explored the predictive validity of school year and gender in predicting children's divergent productivity. We found that school year group, but not gender, was positively related to divergent thinking, in that the older group (6-7 year olds) performed better than the younger group (4-5 year olds).

These findings add to a complex issue; previous research examining the developmental trajectory of children's creative thinking abilities is mixed and rife with disagreement. Here, we find

evidence of improved divergent thinking skills across the first few years of school. Despite the lack of gender differences reported here in divergent thinking skills, there continue to be large differences in the creative achievements of men and women (Simonton, 1994; Piirto, 1991, 2004). Abra and Valentine-French (1991) suggest that the discrepancy between measures of creativity and real-world creative accomplishments may be the result of the over-representation of children and college students in creativity research, who may have creative potential, but who have not yet exhibited the kind of creative achievement in which gender differences are apparent. Therefore, Study 2 will examine the relationship between implicit theories and divergent thinking in a sample of adults.

3. Study 2

Extending on the work of Study 1, Study 2 examines the role of individual differences in the creativity of adults, specifically examining the relationship between creative performance and implicit theories of creativity. As in Study 1, creativity was measured using a divergent thinking task; in this case, an online version of the Wallach and Kogan (1965) Creativity Test. Creativity is considered an important component of intelligence in most major theories of intelligence (e.g. Guilford, 1967; Sternberg, 1996) and the two factors are often significantly correlated. Therefore, with reference to previous research on the impact on intelligence beliefs on performance, and the findings of Study 1, we expected to find similar results when examining the relationship between implicit theories of creativity and creative performance, with holding an entity theory being associated with lower scores in divergent thinking. We also explored whether divergent thinking scores change with age and across gender in adulthood.

3.1. Method

3.1.1 Participants

A sample of 131 (89 females, 42 males) adults took part in the study. Participants were recruited through online advertising, as well as the use of a University participant pool system in which undergraduate students receive course credit for participation. Our sample had a mean age of 25.59 years, although two participants did not report their age ($SD_{Age} = 9.61$; $Min_{Age} = 17$; $Max_{Age} = 53$).

3.1.2 Measures

3.1.2.1. Divergent thinking task

The Wallach and Kogan Creativity Test (WKCT; 1965) was adapted so that it could be administered to participants online. The test usually consists of two visual tasks (Pattern Meanings and Line Meanings) and three verbal procedures (Instances, Alternate Uses, and Similarities) designed to assess creativity. For the current study, due to the limitations of using an online survey, only the

Instances test was used. The Instances test requires the participant to list as many examples as possible of objects/ideas. The question used in the current study can be seen below:

'In the box below please list as many things as possible that have wings'

As with Study 1, responses were coded to assess participants' divergent thinking using the same three categories: Originality; Fluency; and Flexibility. See Section 3.3 for information on coding. Previous research with 2,476 students from Hong Kong has found the WKCT, used online, to be highly internally consistent ($\alpha = .82$ to $.92$, Cheung & Lau, 2010). The Cronbach's alpha value for the example used with the current sample across the three categories revealed moderately high internal consistency ($\alpha = .80$).

3.1.2.2 Implicit theories of creativity

Dweck's (1999) Implicit Theories of Intelligence Scale was adapted to focus on beliefs about creativity. As in Study 1, and following the recommendations given by Dweck, only the entity items were used (in this case, four items). The adaptation was made by replacing the word 'intelligence' for 'creativity' e.g. "You have a certain amount of intelligence, and you really can't do much to change it" was changed to "You have a certain amount of creativity, and you really can't do much to change it". As with the original scale, participants rate their agreement on a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). High scores indicate a stronger entity theory. Within the current sample, the Cronbach's alpha for the adapted creativity measure ($\alpha = .91$) was similar to levels reported for the original scale (e.g. Dweck et al., 1995).

3.1.3. Procedure

Participants were provided with a URL which directed them to the online survey. After providing informed consent, participants reported their age and gender. Participants then completed the Implicit Theories of Creativity questions, followed by the Instances section of the Wallach and Kogan Creativity Test (1965). Complying with the specifications for administrations, no time limits were set. Due to the nature of an online questionnaire, the atmosphere when taking the test would have been informal. This follows the procedure Wallach and Kogan carried out with their own sample.

3.3. Results

3.3.1 Data Preparation

As in Study 1, participants' responses were coded according to their fluency (the total number of answers given), flexibility (the number of different concepts/categories), and originality. To score originality, each response was compared to all other responses from the sample. Responses given by

only 1 per cent of the sample were classed as unique (2 points), responses given by 5 per cent of the participants were classed as unusual (1 point), and anything above this percentage was not given a score. All unique/unusual scores (for each participant) were totalled to create an originality score whereby higher scores indicate more originality. All responses were double-coded and where there were discrepancies between coders, the authors discussed and agreed. All divergent thinking categories significantly correlated with each other (lowest $r(129) = .664$, $p < .001$) so scores were combined to create one overall divergent thinking score. See Table 3 for Descriptive statistics.

Table 3. Mean and SD of Divergent thinking and implicit theories of creativity scores

	Divergent thinking	Implicit theories of creativity
	M (SD)	M (SD)
Whole sample	16.24 (12.73)	3.59 (1.27)
Gender	Female	15.16 (9.21)
	Male	18.55 (18.00)

3.3.2 Relationships between creativity, implicit theories of creativity, age, and gender

To assess the relationship between implicit theories of creativity and divergent thinking we conducted a Pearson's Product-Moment Correlation. Results indicated a small but significant negative correlation between divergent thinking and implicit theories of creativity scores ($r(129) = -.24$, $p = .006$), as shown in Figure 2. These findings suggest that the stronger the entity theory that participants held, the lower their divergent thinking score.

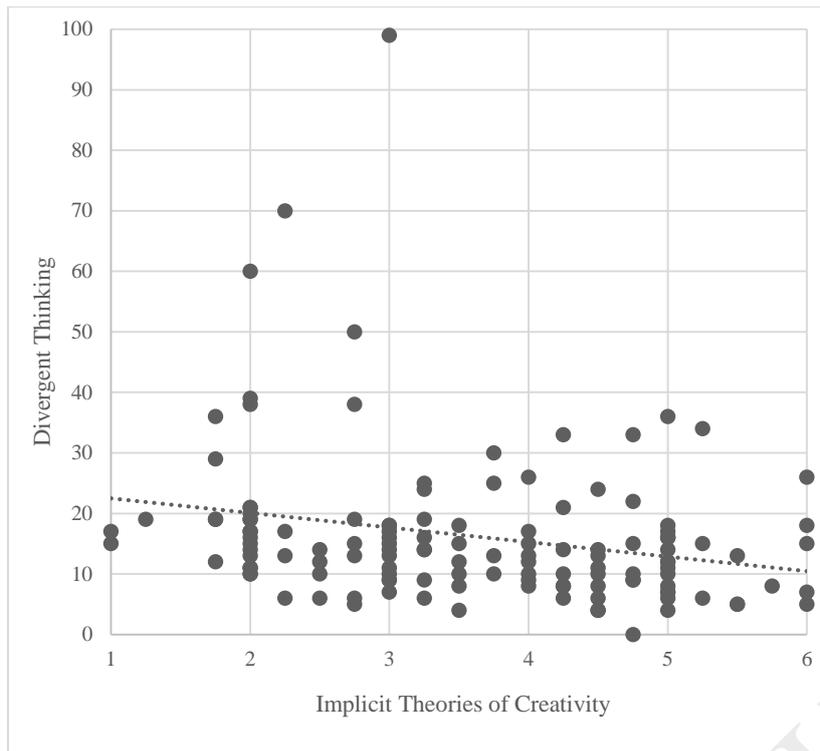


Figure 2. Scatterplot of individuals' implicit theories of creativity against their overall divergent thinking scores

Regression analysis was performed to predict divergent thinking scores based on implicit theories of creativity. We also included age and gender in this model to assess the relative contribution of each. The overall regression model was significant ($\text{Adj } R^2 = .09$, $F(3,125) = 5.40$, $p = .002$), and as shown in Table 4, implicit theories of creativity and age (but not gender) were significant predictors of divergent thinking scores.

Table 4. Regression model investigating implicit theories of creativity, age, and gender as predictors of the Divergent Thinking scores

	<i>B</i>	<i>SE B</i>	<i>B</i>
Constant	16.11	4.37	
IToC	-2.26	.84	-.23*
Age	.27	.11	.21*
Gender	3.52	2.27	.13

* $p < .01$, ** $p < .001$

3.3.3 Summary of findings

The findings of Study 2 are in line with our expectations for the primary aim of this investigation. Specifically, people who scored lower on the divergent thinking tasks (associated with less creative capacity) tended to hold a stronger entity theory of creativity. These findings add support to the results of Study 1, whereby implicit theories regarding the malleability of human qualities and abilities appear to reflect task performance. Specifically, individuals who believe that creative ability is fixed and unchangeable, score lower on the divergent thinking task. As in Study 1, we found that age, but not gender, was positively related to divergent thinking scores within the sample of adults. These findings, and their implications, are discussed below.

4. *General Discussion*

The primary aim of this research was to explore the relationship between individuals' implicit theories and their creative performance. In Study 1, we found that within a sample of infant school children, holding a stronger entity theory of intelligence was related to lower scores on a divergent thinking task. In Study 2, we adapted Dweck's (1999) original items to examine the implicit theories of creativity in adults. Mirroring the findings of Study 1, we found that holding a stronger entity theory of creativity was related to worse performance on a divergent thinking task in adults. Previous investigations of individuals' implicit theories regarding the malleability of creativity have been limited until recently, especially in children. The current findings support the majority of the studies that have examined this relationship previously in adults (largely university students), although explorations have yielded some mixed results and the question of whether creative implicit beliefs relate to creative performance still remains. While Karwowski (2014), O'Connor et al. (2013) and Royston and Reiter Palmon (2017) all found that holding an entity theory of creativity was associated with weaker performance on problem-solving tasks, in an unpublished study, Makel (2008) failed to replicate the same findings. To our knowledge, this is the first investigation of this relationship between implicit theories and creativity in children. Bridging the gap between these implicit theories and creativity holds the potential to yield large educational benefits with only relatively small changes in policy.

Sixty years ago, Guilford (1958) raised the concern that creativity was commonly believed to be special talent available to only a select few, and that identifying with the non-talented group can result in lowered motivation and productivity. The findings reported from both studies go some way to support this claim, as well as being in line with the work of Dweck and colleagues who suggest that the implicit theories that an individual holds about the malleability of basic qualities and abilities can have a big impact on their goals, values, and achievements (e.g. Blackwell et al., 2007; Claro et al., 2016; Dweck, 2006; Romero et al., 2014).

For incremental theorists, their motivational framework is mastery-oriented, with a focus on learning goals. As such, individuals who endorse an incremental theory are more resilient following failure, as well as being willing to take opportunities for challenge, learn from mistakes, and invest effort in order to improve their ability and performance. In contrast, entity theorists are oriented towards helplessness responses, placing more emphasis on performance goals. As a result, they become concerned with gaining favourable judgements (from self and others) and avoiding negative ones, in turn avoiding challenge which may result in vulnerability following failure. In relation to creativity, entity theorists may be more likely to view their creative abilities as fixed, identifying with the ‘non-creative’ group and as posited by Guilford (1958), making less effort over time to be original or productive.

As well as promoting optimal learning, mastery goals have been tied to intrinsic (rather than extrinsic) task motivation. This theoretical position provides a clear link to Amabile’s (1983) theory of creativity, which states that intrinsic motivation is fundamental to the creative process. If an individual is mastery-oriented, perceiving creativity as an ability which can be developed, may encourage their interest and self-determination; both hallmarks of intrinsic motivation (Amabile, 1989). If an individual holds an entity theory with a greater focus on performance goals, they may rely more on extrinsic motivation, which has been found to undermine intrinsic motivation (Lepper, Greene & Nisbett, 1973).

Formal education has been criticised for not doing enough to promote children’s development of creativity, with uncertainty over how the inclusion of creativity in the curriculum might be achieved (Feldman & Benjamin, 2006; Robinson, 2011). In the last decade, there has been a call for schools to change and reconsider the ways in which creativity is taught to encourage ‘less waste of human creative talent’ (Baer & Kaufman, 2008 p. 76). The importance of doing so has been emphasised by Kaufman (2015) who found that individuals’ creative self-concept (creative self-efficacy and creative personal identity) stabilises from late adolescence, highlighting the need for earlier intervention. The findings presented here suggest a potential avenue for successful intervention. Studies have shown that an incremental theory can be induced, with educational interventions rooted in Dweck’s theoretical model having a significant effect on pupils’ academic achievement in English and Maths (Aronson et al., 2002; Blackwell et al., 2007; Good et al., 2003; Mueller & Dweck, 1998). Although the studies in this paper are largely exploratory, the relationship between creative performance and implicit theories of intelligence suggest that an intervention rooted in Dweck’s theoretical underpinning may have a positive effect on children’s creativity. Future research should examine the impact of encouraging individuals to adopt more of an incremental framework on their creative performance and focus on this relationship as a mechanism for effective intervention.

As a secondary aim, we also explored the relative contribution of gender and age in predicting creative performance. For both children and adults, we found that age, but not gender, positively predicted divergent thinking scores. Previous research regarding the relationship between age and creativity is conflicting, and few theories have examined the longitudinal development of creativity across time (Starko, 2018). It has been suggested that starting formal education coincides with a slump in creativity (e.g. Gardner, 1982; Smith & Carlsson, 1983, 1985), however, the results of Study 1 provide evidence of improved divergent thinking scores across the first few years of schooling. Equally, there remains a lack of consensus of the trajectory of divergent thinking skills in adulthood, but previous research points towards a productivity age curve, whereby creativity peaks in early adulthood and declines thereafter (Simonton, 1988; McRae, Arenberg & Costa, 1987). In a more recent study, Kleibeuker et al. (2013) found distinct developmental trajectories across late adolescence and early adulthood for creative performance dependent on the creativity measure used. Specifically for divergent thinking measures, they found that originality continued to increase into adulthood, while fluency and flexibility reached adult level early in adolescence. In the sample included in Study 2, divergent thinking scores continue to increase with age, beyond early adulthood ($Max_{Age} = 53$). However it is important to note that this is a relatively small sample so the generalisability of the results could be limited.

In addition, the role of gender in creativity is a complex and controversial topic. Here, we find no relationship between gender and divergent thinking scores in children or adults. This reflects the work of Kogan (1974), who, more than forty years ago, conducted a review of gender differences in creativity, finding ‘with a sigh of relief that one solidly affirms the relative equality of the sexes in so significant a domain’ (p. 1). More recently, Baer and Kaufman (2008) provided an updated review, similarly finding considerable evidence of relative equality. In this extensive review, Baer and Kaufman included research comparing genders on different measures; creativity tests, subjective assessments, and creative accomplishments. In none of these areas did the research clearly support gender differences in creativity. Yet, despite this, the differences in real-world creative accomplishments between males and females are large and significant (Simonton, 1994; Piirto, 1991, 2004), so further work is required in order to narrow this achievement gap.

It is important to note certain limitations when considering the conclusions of the two studies presented in this paper. Firstly, the use of the divergent thinking approach as a measure of creativity may influence the validity of our findings. Further, for Study 2, only one example of the Instances test was used, which may raise issues regarding the reliability and validity of the measure. However, the Cronbach’s alpha for the coding categories within the measure (flexibility, fluidity, and originality) was moderately high ($\alpha = .80$) suggesting appropriate

levels of internal consistency. Additionally, we followed the protocol of a number of other studies which only used one example as their measure of creativity (e.g. O'Connor et al., 2013). The use of divergent thinking tests has been criticised as a measure of creative achievement for providing an imperfect proxy (e.g. Clark & Mirels, 1970; Hocevar, 1981; Zeng et al., 2011). Despite this, and although divergent thinking and creativity are not synonymous, in a recent review, Runco and Accar (2012) concluded that divergent thinking tests remain a reliable and valid indicator of originality and creative problem-solving, and are still widely used in creativity research.

Also potentially problematic is the measure of implicit beliefs used in both studies. Previous investigations of incremental and entity beliefs with adults within the domain of creativity have been divided in the measure used. Similar to the method used in the current study, both O'Connor et al. (2013) and Makel (2008) adapted Dweck's original questions by replacing the word 'intelligence' with 'creativity'. However, Karwowski (2014) suggests that this scale is too simplistic to capture the multifaceted character of creativity and subsequently developed a scale designed to measure both entity and incremental creative beliefs (10-items). Karwowski's scale has since been used by Hass et al. (2016) and Royston & Reiter-Palmon (2017). The decision not to use Karwowski's scale in the current studies was based on their low internal consistency (Royston & Reiter-Palmon reported $\alpha = .50$ for the incremental scale), their limited use with children, and us wanting to use a comparable scale in both studies. Karwowski's items are more elaborately worded (Hass et al.) and were deemed not to be appropriately accessible for the age of the children participating in Study 1 (Karwowski, 2015, states that it is difficult to talk about creative self-beliefs in children under the age of 10 years). Dweck (1999) recommends that when measuring implicit theories of intelligence in young children, it is preferable to use the entity-only scale to avoid fatigue and confusion over the mixture of entity and incremental items. Furthermore, although Dweck's scale is normally used with children older than those in the current sample, the items are much simpler than those in Karwowski's scale and as each child was tested on an individual basis, the experimenter was able to assess the level of understanding and explained the meaning of the word 'intelligence' if necessary (see Section 2.1.3). As demonstrated in Table 1, there was a spread of scores, and the Cronbach's alpha value for the current sample ($\alpha = .84$) was high, similar to the values reported by Dweck and colleagues (see Dweck, et al., 1995).

Finally, the studies presented here are both correlational in nature. Thus, we are unable to establish the direction of the causal relationship between implicit theories and divergent production. As suggested by Hass et al. (2016), it could be that people with more positive

creative experiences develop more creative self-efficacy and adopt learning strategies conducive to developing incremental beliefs and a mastery approach to creativity. However, previous research has demonstrated that experimental manipulations and interventions designed to encourage incremental beliefs regarding intelligence lead to increased educational success (e.g. Aronson et al., 2002; Blackwell et al., 2007; Good et al., 2003; Mueller & Dweck, 1998). Furthermore, using an experimental manipulation, O'Connor et al. (2013) found that incremental primes (reading simple statements framed in an incremental way), led to increased performance on a creative problem-solving task. It therefore seems probable that it is implicit theories impacting divergent thinking.

Overall, the studies presented here draw attention to a potential antecedent to the individual differences in creative performance based on Dweck's socio-cognitive model. For both children and adults, there appears to be a relationship between their beliefs regarding the malleability of abilities and their divergent thinking scores. In a time when creativity, problem-solving, and critical thinking are increasingly coveted in society, understanding the individual differences that might encourage such skills should be an important focus for research. It is still too early to understand how implicit theories of creativity operate in educational settings, but it remains an important area for empirical investigation and theoretical development (Hass et al., 2016). Further exploration of the relationship between implicit theories and creativity could benefit teachers, industry leaders and researchers alike in attempting to develop ways to encourage creativity through school-based interventions.

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