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Social media and creativity: The moderating role of executive functions

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I hereby declare that this Master's thesis is my original work
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I have duly acknowledged all the sources of information
which have been used in this thesis.

This Master's thesis has also not been submitted for any degree
in any university previously.

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Abstract

Despite the potential for social media to promote creative potential, little is known about this direct relation and the process by which engagement with social media affects the production of creative ideas. This study puts forth a novel application of the Dual-Pathway to Creativity Model (DPCM) to understand the social media-creativity link. The results showed that social media can be used for normative (checking and browsing), interactive ("liking"), and generative (posting photos) purposes. After controlling for pertinent covariates, only normative use was negatively related to the flexibility pathway. When each aspect of executive functions (updating, inhibition, and shifting) was examined as a separate moderator to clarify the conditions under which social media relates to creativity, only working memory significantly moderated the relationship between normative uses and persistence. These results contribute to an initial understanding of how the production of creative ideas is affected by engagement with social media and one's cognitive ability.

Keywords: social media use, SNS, creativity, dual pathway model, executive functions, flexibility, persistence, fluency, originality

Social Media and Creativity: The Moderating Role of Executive Functions

Social media applications and websites, or social network sites (SNS) are virtual communities that enable users to make individual profiles, interact with other individuals, create and share content, or socialize with people based on shared interests (Kuss & Griffiths, 2011). SNS are multifunctional and multifaceted, and consist of components such as instant messaging, microblogging, content sharing, gaming, to online dating (Kuss & Griffiths, 2017), which extends the reach of content, access to novel ideas, opportunity for social connection, and allows individuals to interact and communicate with others at unprecedented speed and ease. Social media also provides individuals with opportunities to engage in creative endeavors—the generation of original (i.e., novel) and effective (i.e., appropriate and useful) ideas (Runco & Jaeger, 2012). For example, sharing a photo or artwork on Instagram or uploading a video to YouTube can involve extrinsic motivation when "likes" and comments are garnered from other users, thereby affecting future creative production (Audia & Goncalo, 2007; Resnick, 2006). Despite the ubiquity and the potential for SNS to foster creative potential, researchers have just begun examining how SNS affect self-reported creativity (Chai & Fan, 2018; Sigala & Chalkiti, 2015) and providing narrative accounts of how creativity operates within specific platforms (Peppler, 2013; Peppler & Solomou, 2011). Given that the extant literature has focused on a relationship between traditional forms of media such as television (Valkenburg & van der Voort, 1994) and video games (Green & Kaufman, 2015) and creativity, there is a need to investigate the effect of new forms of media (i.e., social media) on rigorous

measures of creative idea generation (ideation). I also put forth executive functions, general control processes (Diamond, 2013), as moderators that can regulate the association between social media and creative ideation.

Creativity

Creative potential has historically been conceptualized as having both originality (i.e., novelty) and effectiveness (i.e., appropriateness, usefulness, or fit; Runco & Jaeger, 2012). Recent research has expanded this definition and contextualized creativity as part of a broader, collaborative, and socially determined process (Sternberg, 2003; Sawyer, 2007) and as a system composed of (a) individuals, (b) knowledge domains, and (c) a field of informed experts (Csikszentmihalyi, 1996, 2014). In Csikszentmihalyi's systems model, individuals build on existing practices and designs to produce new variations of the domain, which are incorporated as part of the domain if deemed valuable by informed experts. Within the context of social media, the "field of informed experts" has taken on new meaning since "expertise" is distributed among members of the community. SNS provide a platform for individuals to engage in creative ideation and gain expertise as both consumers and/or producers in the system. As such, researchers have turned to SNS as a model of a creative system, to describe how creativity operates in an online community (Peppler, 2013; Peppler & Solomou, 2011).

The way in which SNS affect the production of creative ideas can be understood with the Dual-Pathway to Creativity Model (DPCM; De Dreu, Baas, & Nijstad, 2008; Nijstad, De Dreu, Rietzschel, & Baas, 2010). The DPCM posits two

pathways to creative outcomes: *flexibility* and *persistence*. The flexibility pathway is characterized by taking different approaches and holistic processing of many broad and inclusive categories, while the persistence pathway involves a narrow processing style and the exploration of a few categories with prolonged and motivated effort (Baas, Roskes, Sligte, Nijstad, & De Dreu, 2013). These pathways can be illustrated using divergent thinking tasks (Guilford, 1967; Torrance, 1974), which have been shown to be reliable and valid psychometric assessments of creative thinking, and are predictive of real-world creative behaviours and achievements (Benedek, Borovnjak, Neubauer, & Kruse-Weber, 2014a; Plucker, 1999). Typical divergent thinking tasks ask for "unusual uses" of common household items or creative "instances" of common concepts. According to past studies (De Dreu, Nijstad, Baas, Wolsink, & Roskes, 2012; Nijstad et al., 2010), flexibility is demonstrated when participants respond with many conceptual categories (e.g., using a brick for building, as a weapon, or as a weight), while persistence is demonstrated with focused attention as indexed by within-category fluency—the number of unique responses (i.e., fluency) divided by the number of categories they came from (i.e., flexibility). Flexibility and persistence are thus postulated as alternate pathways to creativity and indeed have been shown to be uncorrelated in past studies (Nijstad et al., 2010). A final crucial indicator of creative potential is originality (i.e., infrequent unique responses), which is closely linked to all indicators (fluency, flexibility, persistence). It is typically after spending time generating unoriginal ideas within a category that a higher number

of unique ideas will be explored (i.e., higher fluency and originality; Baas et al., 2013; Nijstad et al., 2010).

While the DPCM suggests that different traits or states primarily influence either flexibility or persistence, it allows for states or traits to be negatively related to one pathway while positively related to the other. The flexibility pathway is generally facilitated by the approach system, subserved by dopaminergic pathways and the reward system, and characterized by openness to experience (Ashby, Isen, & Turken, 1999; Carver, Sutton, & Scheier, 2000). For example, individuals who score highly on openness to experience prefer novel, varied, and intense experiences (McCrae, 1987), which is linked to approach or explorative behaviour and positive affect (Fredrickson, 2001). Conversely, the persistence pathway is driven by avoidance-related states like the experience of emotions such as anxiety and fear and are closely linked to withdrawal motivation and relief when aversive goals are regulated (Carver et al., 2000). At first glance, avoidance motivation narrows attentional scope and should be negatively related to creative production. A series of studies conducted by Friedman and Förster supported this intuition, finding a negative direct association between avoidance and creative insight and generation (i.e., fluency; Friedman & Förster; 2000, 2001), However, another explanation is that avoidance motivation increases vigilance and recruits more persistent and systematic thinking, through an alternative "persistence" pathway, thus enhancing creativity (Baas et al., 2013; De Dreu et al., 2008). Researchers have proposed a set of critical moderators (e.g., time-on-task, working memory capacity) to explain the persistence pathway (Baas et al., 2013; De Dreu et al., 2008, 2012;

Nijstad et al., 2010). For example, taxing working memory capacity hindered creativity in individuals with avoidance-oriented motivation, even when creativity was required for goal progress (Roskes, De Dreu, & Nijstad, 2012), suggesting that these individuals engaged in effortful processing, which required additional cognitive resources, and interfered with the persistence pathway to creativity.

Social Media and Creativity

To examine the role of SNS use in the DPCM, it is vital to first explicate the multifaceted nature of SNS (Kuss & Griffiths, 2017; Sigerson & Cheng, 2018). Although objective measures are regarded as the "gold standard" of accurately measuring usage, relying solely on objective measures is problematic because of misinterpretations of behaviour and intentions of SNS use. Thus, researchers have operationalized social media use in terms of objective indicators such as duration used per day (or usage), or frequency of uses in a particular time period, as well as subjective measures or psychological aspects of SNS use assessed by attitudinal questions related to emotional connection and integration of social media into daily life (Ellison, Steinfield, & Lampe, 2007; Rosen, Whaling, Carrier, Cheever, & Rokkum, 2013; Sigerson & Cheng, 2018).

Given this, an existing delineation of social media use in the context of Facebook (Gerson, Plagnol, & Corr, 2017)—Passive and Active Facebook Use Measure (PAUM)—provides a good foundation to explore the flexibility and persistence pathways within the DPCM. The authors characterized Facebook use into three categories: passive, active social, and active non-social. Active social interactions in social media involves posting status updates and posting photos,

active non-social activities consist of creating or RSVPing to events, while passive use comprises of browsing through profiles and newsfeeds. Burke, Marlow, and Lento (2010) found that passive consumption of content on Facebook and not engaging with other users was related to more loneliness. Active social use was associated with fewer depressive symptoms (Escobar-Viera et al., 2018), receptiveness to new ideas and expressions of self-identity (Pagani, Hofacker, & Goldsmith, 2011), and positive correlates of subjective well-being (Ellison et al., 2007). This evidence suggests that active social engagement within SNS aligns with the approach-related traits or states that influence the flexibility pathway of the DPCM, however the picture is more nuanced for passive social media use. For example, if one browses social media as a means to stay up to date with their friends' lives, this would correspond to an approach motivation, whereas passively scrolls through social media for no particular reason or to pass time would not exactly correspond to either motivational state or pathway. However, this scale does not generalize to all SNS use (e.g., not all platforms can be used to create or RSVP to events) and due to the lack of universal methods to assess types of SNS use (Trifiro & Gerson, 2019). Thus, the Social Media Usage subscale of the Media and Technology Usage and Attitudes Scale (MTUAS) will be adapted to assess general social media uses (Rosen et al., 2013; Appendix A). The scale assessed how often individuals conduct activities such as "post photos", "browse profiles and photos", "click 'Like' to a posting, photo, etc.". It is plausible that the items load on similar factors of active social (commenting on friends' posts), active (posting photos) and passive (browsing) factors. This study will provide an initial exploration of the

MTUAS to assess general social media uses across different social media platforms. Interactive, generative, and normative uses are also proposed as common factors across SNS, and align with active social, active, and passive uses respectively.

In terms of approach- and avoidance-related uses of social media, although no measure is known to directly assess these states, it is conceivable that social media can be used for either motivation or goal. In general, approach motivation could inspire someone to use social media in order to achieve something positive while avoidance-uses of social media can be for avoiding negative stimuli. In the 2 x 2 achievement framework, the approach-avoidance distinction has been further separated to mastery and performance standards (Elliot, 1997; Elliot & Murayama, 2008). Mastery-based standards are absolute or intrapersonal and focus on learning, while performance-based standards are normative and focus on performing to the best of one's ability. Combining the mastery-performance and approach-avoidance delineations leads to four achievement goals: (a) mastery-approach (attaining task-based or intrapersonal competence), (b) mastery-avoidance (avoiding task-based or intrapersonal incompetence), (c) performance-approach (attaining normative competence), and (d) performance-avoidance (avoiding normative incompetence). Adapting the items from Elliot and Murayama's (2008) achievement goals questionnaire, mastery-approach uses of social media could be assessed with the item "my goal is to learn as much as possible from social media" while mastery-avoidance with "my goal is to avoid learning less than it is possible to learn from social media". Performance-approach uses involve "striving to do well compared to others on social media" while performance-avoidance consist of "striving to

avoid performing worse than others on social media". In general, the approach uses would correspond to the flexibility route to creativity while avoidance uses to the persistence route. Since the 2 x 2 framework is an initial attempt to situate SNS uses within the approach and avoidance framework, no specific hypotheses will be made about the effect of the mastery/performance dimensions on creativity.

Executive Functions

In order to understand boundary conditions related to both the persistence and flexibility pathways of creativity, executive functions (EFs) will be examined as moderators of the SNS-creativity relationship. EFs refer to adaptive and goal-directed control processes involved across many domains of life from physical and mental health to school and job success (Diamond, 2013). There are three correlated but separable components of EFs (Miyake et al., 2000; Miyake & Friedman, 2012): (a) *updating* (an ability to manipulate information in working memory), (b) *inhibition* (an ability to suppress irrelevant stimuli), and (c) *shifting* (or task switching; an ability to switch between mental sets).

Past studies have established that working memory serves as a moderator of the cognitive persistence pathway to creative production (De Dreu et al., 2012). Updating involves monitoring new information while revising the contents of working memory with information relevant to the task at hand (Jonides & Smith, 1997). Common updating tasks usually require participants to continuously update relevant verbal or visuospatial stimuli in their working memory while processing irrelevant interspersed tasks. This suggests that updating likely affects creativity through the persistence pathway since it enables focused and systematic combining

of elements and possibilities, and taxing working memory would be detrimental to individuals who engage in avoidance-related states or SNS uses because they require more effort and cognitive resources compared to approach-related uses (Baas et al., 2013).

Inhibition (also *inhibitory control*) is the process of suppressing dominant but irrelevant impulses or response tendencies (Friedman & Miyake, 2004). The process is multidimensional, encompassing several functions such as prepotent response inhibition, resistance to distractor interference, and resistance to proactive interference. The most well-known inhibition task assessed prepotent response inhibition—the Stroop task (Stroop, 1935), which requires a controlled response to identify the ink color of a word and suppress the automatic tendency to name the word itself. Individuals are slower to respond to incongruent stimuli (e.g., the word "red" printed in green ink instead of red ink) and this effect captures prepotent response inhibition. Contrary to traditional views of inhibition (e.g., creative people being characterized by a lack of cognitive and behavioural inhibition; Martindale, 1999), empirical investigations using inhibition tasks points to the opposite direction—prepotent response inhibition—assessed by performance on the Stroop task (Benedek, Jauk, Sommer, Arendasy, & Neubauer, 2014b; Edl, Benedek, Papousek, Weiss, & Fink, 2014; Golden, 1975) and inhibition without interference (Dorfman, Martindale, Gassimova, & Vartanian, 2008; Kwiatkowski, Vartanian, & Martindale, 1999) are beneficial to creativity processes. Researchers proposed that creative problem solving involves adaptive inhibition strategies under different conditions (Vartanian, 2009), one of which involves inhibition of prepotent

responses, allowing the individual to persist and generate highly creative ideas. Engagement with social media presents numerous opportunities to suppress automatic urges and focus on pertinent information, which is consistent with the persistence pathway to creativity. It is also conceivable that inhibition ability could moderate the impact of social media on the flexibility pathway such that individuals who are poor at inhibition are better able to use social media to flexibly process many broad mental categories (whereas those who are adept at inhibition are less likely to use social media to aid in flexible thinking).

In shifting tasks, conditions and rules change and requires individuals to disengage from a previously relevant mental set in order to engage in a new and relevant goal or task (Monsell, 2003). Given that real-world social media use often involves switching between different multifunctional platforms (Pew Research Center, 2018), it is plausible that shifting ability modulates the flexibility pathway. While shifting has been conceptually linked to cognitive flexibility (Diamond, 2013), empirical evidence has not shown direct associations with creativity (Benedek et al., 2014b; Lee & Therriault, 2013). It is possible that shifting ability moderates the SNS-creativity pathway, such that individuals who are adept at shifting are able to disengage from irrelevant categories and produce original ideas across a variety of new categories via the flexibility pathway but perform poorly in the persistence pathway.

The Current Study

Social media provides opportunities for the individual to engage in different activities and states, which then would affect the flexibility and/or persistence

pathway of creativity. Due to the dearth of studies examining the relationship between social media use and creative potential, the main goal of this study was to provide initial evidence for this link using the multiple indicators of both key variables using the DPCM as a theoretical framework (De Dreu, Baas, & Nijstad, 2008; Nijstad, De Dreu, Rietzschel, & Baas, 2010). Approach-related and active uses of social media are expected to positively predict the flexibility pathway indexed by number of categories generated in divergent thinking tasks. Avoidance-related and passive normative uses of social media are expected to positively relate to the persistence pathway indexed by within-category fluency. However, because the scales used in the present study do not map on exactly to approach and avoidance motivations, all types of social media were examined in relation to both flexibility and persistence pathways.

A second goal was to clarify the boundary conditions of the dual pathway of creativity (Friedman & Förster; 2000, 2001; Roskes et al., 2012). Given that persistence is associated with more systematic and analytical performance that requires cognitive control of the contents of one's working memory (Koch, Holland, & Van Knippenberg, 2008) and inhibition of irrelevant information, it is likely that with the increased use of social media and the more experience navigating a barrage of information, using working memory and inhibitory control to systematically retrieve, recombine, and inhibit old information into new elements, contributes to better within-category fluency in the persistence pathway. The inverse would then be true for the effect of inhibition on the flexibility pathway, which requires holistic processing. Although shifting has shown inconsistent relationships with social

media and creativity, its conceptual overlap with flexibility warrants further investigation as a moderator. Individuals who are better able to shift between mental sets are likely able to generate more distinct conceptual categories (i.e., flexibility), but this might weaken persistence.

Method

Participants

One hundred and seventy-five undergraduate students from Singapore Management University were compensated either extra course credit or cash for their participation in the study. Five participants failed to complete the study, resulting in a final sample size of one hundred and seventy.

Measures

Social media use. Participants' social media use was assessed using a variety of self-reported measures (Rosen et al., 2013) such as time spent on SNS, activities conducted on SNS, and motivations for using SNS. Participants were first asked to estimate the total time spent (on an average day) using social media platforms. Subsequently, they answered an adapted version of the 9-item Social Media Usage subscale of the Media and Technology Usage and Attitudes Scale (MTUAS) where the word "Facebook" was replaced with "social media" (Rosen et al., 2013; Appendix A). The scale assessed objective and general social media use such as how often individuals "post photos", "browse profiles and photos", "click 'Like' to a posting, photo, etc." on a 10-point Likert scale from "never" to

"all the time", and was predicted to load on normative, interactive, and generative factors.

Finally, the Achievement Goal Questionnaire-Revised (AGQ-R; Elliot & Murayama, 2008; Appendix B) was adapted to assess participants' general orientation towards approach and avoidance goals in the social media context. Examples of each goal are: "I am striving to do well compared to other social media users" (performance-approach), "my aim is to avoid doing worse than other social media users" (performance-avoidance), "my aim is to completely master the material presented in social media" (mastery-approach), and "my goal is to avoid learning less than it is possible to learn in social media" (mastery-avoidance). Participants indicated their responses to each item on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree).

Creativity task. Different components of creative thinking were assessed with a divergent thinking task—the unusual uses test (Guilford 1967, Torrance, 1974). The task was timed for 4 minutes and asked participants to develop as many unusual, creative, and uncommon uses for a cup. Instructions for the tasks asked participants to list as many uses as possible without limiting themselves to ideas they had previously seen or heard about.

Following Yang and Yang's (2016) study conducted on participants from Singapore Management University, creative potential was scored on the following dimensions: originality, fluency, and flexibility. *Originality* takes into account the range of responses from all participants, where responses generated by less than 1% (i.e., 1 participant) of the participants will be assigned 2 points and responses

generated by less than 5% (i.e., 8 participants or less) of the participants will be assigned 1 point. *Fluency* was the total number of responses generated. Persistence was scored as *within-category fluency*, the number of unique responses divided by the number of categories they came from (De Dreu et al., 2012). *Flexibility* was the total number of distinct categories in which the responses fall in (normative data based on 300 participants delineated 9 unusual uses of a cup; Yang & Yang, 2016). Two independent raters scored the responses, and intraclass correlation coefficients for each creativity indicator were high (range of ICC = 0.79 to 0.99) except for originality (ICC = 0.19).

Executive function tasks. One of each EF tasks—updating, shifting, and inhibition—was administered (Miyake et al., 2000).

Rotation-span task. Updating of working memory was assessed with the rotation-span task, a spatial analogue of verbal complex span task (adapted from Foster, Shipstead, Harrison, Hicks, Redick, & Engle, 2015). Participants were presented with a sequence of either short or long arrows, each of which pointed in one of eight directions. After each arrow, participants completed a distraction task in which they judged whether a rotated letter was presented correctly or mirrored the letter when in an upright orientation. The distraction task was timed to reduce the tendency to rehearse, and in trials where participants took longer than 2.5 *SD* above their mean reaction time (RT) calculated during practice trials, the program automatically moved on and that trial was counted as an error. (Foster et al., 2015).

During the recall phase, participants were shown all 16 possible combinations of directionality and length of the arrows and asked to click on all

previously presented arrow stimuli in the correct order. The recall phase was untimed and remained on screen until participants completed their responses. Set size (i.e., the total number of arrows to remember in a trial) varied from 2 to 5 per trial and is randomized across two blocks of trials. The dependent measure was the partial-credit unit (PCU) score calculated by the proportion of the total number of correct recall responses in a set (Conway et al., 2005).

Prior to the experiment trials, participants first completed four practice trials to recall the arrow stimuli (i.e., two trials of set sizes two and three each). Subsequently, they attempted 15 practice trials of the rotated letter distractor task where mean RT for each participant was recorded. Finally, participants completed three practice trials comprising both arrow and letter sequences each of set size two.

Color-shape switching task. Task switching was assessed with a paradigm that examined switch costs, reflecting the shifting aspects of EF (Hartanto & Yang, 2016; Monsell, 2003; Rubin & Meiran, 2005). Participants responded as quickly and accurately as possible to either the color (red or green) or shape (circle or triangle) of a bivalent target stimulus, as signalled by a color cue (i.e., color gradient) or shape cue (i.e., a row of small black shapes). There were two bivalent target stimuli: a red triangle or a green circle. Participants then either pressed the left key for “triangle” or “green” and the right key for “circle” or “red” (counterbalanced across participants). Thus, the target stimulus did not match a response on both color and shape. Participants were instructed to respond as fast and accurately as possible, using their right hand for one set of stimuli and left hand for the other set of stimuli.

For each trial, a fixation cross appeared for 350 ms and was followed by a blank screen for 150 ms. Subsequently, the cue was presented for 250 ms, followed by the target. The stimuli remained on the screen until the participant responded to the target or when 4 seconds elapsed. Participants also received a 100 ms auditory feedback cue for incorrect responses.

Each participant completed one practice block (30 trials); two pure blocks (color and shape blocks of 50 trials each, with the order counterbalanced); and four mixed blocks (25 switch and 25 repeat (i.e., non-switch) trials each, semi-randomized with a maximum of 4 consecutive trials of the same task). The dependent variable is *switch cost*, which was computed by subtracting the performance of repeat trials from switch trials. RTs that deviated more than 3 SD from each participant's mean were excluded and scores were reverse-coded (multiplied by -1) such that higher values reflect better shifting ability.

Stroop task. Inhibitory control (specifically, inhibition of prepotent responses) was measured with a nonverbal version of the classic Stroop task (Stroop, 1935). Adapted from Unsworth and McMillan (2014), color words (red, green, yellow, and blue) appeared on the computer screen in either the same (congruent) or a different (incongruent) color—e.g., the word "red" in blue ink. Participants were instructed to press a key marked with the corresponding color stickers on the computer keyboard for its corresponding ink color. Each trial began with a fixation point (500 ms), followed by the target stimulus. The target word remained on the screen until a response was provided. Following a key press, a

blank screen was shown for 1000 ms (i.e., inter-trial interval). The task consisted of 10 practice trials, 126 congruent, and 54 incongruent trials.

The dependent measure was indexed by the difference in accuracy of the incongruent and congruent trials (i.e., Stroop effect). The Stroop effect was calculated by first removing: (a) incorrect trials, (b) trials with RTs below 200 ms, and (c) trials with RTs that deviate more than 3 SD from each participant's mean. Second, each participant's mean RT for congruent trials was subtracted from the RT of every accurate incongruent trial. Last, scores were reverse-coded (multiplied by -1), such that higher values reflected better inhibitory control performance. The task was administered incorrectly for 3 participants, such that the responses for green and blue were switched, and the accuracy for these participants ranged from 0.48 to 0.49. Recoding the green and blue responses yielded high accuracy 0.92 to 0.96, which is comparable to the mean of the remaining sample (0.94). Thus, the data for these participants were recoded and retained for the analyses.

Covariates. In addition to demographic variables like age and sex, English proficiency (combined self-reports of level of proficiency in speaking, understanding, and reading English on a 10-point scale; Cronbach's $\alpha = 0.94$), non-verbal fluid intelligence, and the openness to experience facet were assessed as covariates because they are related to the key predictors.

Non-verbal fluid intelligence was assessed with the 9-item short form version of the Raven's Standard Progressive Matrices (RSPM-SF; Bilker, Hansen, Brensinger, Richard, Gur, & Gur, 2012), which consists of 3 x 3 matrices with one

piece missing and participants were asked to select the appropriate target from multiple choice answers.

The 4-item Intellect/Imagination subscale of the 20-item Mini-International Personality Item Pool (IPIP; Donnellan, Oswald, Baird, & Lucas, 2006) was used to assess participants' openness to experience. Participants rated the extent to which they agreed that each item applied to themselves on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The items include "I have a vivid imagination" and "I am not interested in abstract ideas" (reverse-coded). Internal consistency was acceptable (Cronbach's $\alpha = 0.67$) and comparable to Donnellan et al., 2006.

Procedure

The data from this study was collected as part of a larger study consisting of three 1-hour sessions which were completed at least a day apart, and within two weeks. All measures were completed on computers in adjacent open cubicles of the laboratory. Participants completed the demographic background, unusual uses task, personality, and fluid intelligence variables in the first session. In the second session, the color-shape switching, and rotation span tasks were administered, followed by a questionnaire which assessed participants' general social media use, normative, interactive, and generative social media use, and approach and avoidance uses of social media. The Stroop task was completed in the final session.

Results

Data Preprocessing

Analyses were conducted using Mplus Version 7.4 (Muthén & Muthén, 2012). First, latent variables of social media were estimated. Indicators of creativity were later regressed on latent variables of social media, and finally, EFs were entered as interaction terms.

Initial data screening revealed that one participant's Stroop score was 6 standard deviations above the mean and their score was excluded from the analyses. Total social media usage, within category fluency, originality, and the Stroop effect were not normally distributed (skewness and kurtosis greatly exceeding absolute values of 1 and 3 respectively) and were transformed prior to the analyses. Creative thinking was indexed by the fluency, flexibility, originality, and within-category fluency (persistence) scores on the divergent thinking task—unusual uses of a cup. Two independent raters scored the task for fluency, flexibility, and originality, and intraclass correlation coefficients for each creativity indicator were high (range = 0.79 to 0.99) except for originality (ICC = 0.19). Thus, mean scores were calculated for all indicators except originality, where only the scores for one rater was used in the analyses. Since originality was measured as infrequent responses, the rater who provided a more comprehensive (i.e., higher number) of valid original responses was chosen. Descriptive statistics for all variables are shown in Table 1 and zero-order correlations can be found in Table 2.

Before constructing the measurement model for SNS, exploratory factor analysis was conducted to examine the factor structures of both the adapted Social

Media Subscale of the MTUAS and the AGQ-R. Creativity and EF indicators were not considered in the measurement model because only one task was examined and there were insufficient indicator variables. Motivations for using social media use was assessed with the AGQ-R, adapted to the social media context. A confirmatory factor analysis was conducted to confirm the approach/avoidance and mastery/performance dimensions of social media use (adapted from the AGQ-R), however the data did not adhere to the existing structure of the AGQ-R. Thus, an EFA with oblimin rotation and maximum likelihood estimation was conducted to explore the factor structure instead. EFA of all 12 items revealed that a 3-factor structure provided a good fit compared to a 2-factor structure ($\Delta\chi^2$ (10) = 84.98, p < .001) or 4-factor structure which had no convergence. Factor loadings for two items (2 and 3) were non-significant, had low loadings below 0.3 (item 1), and cross-loadings of greater than 0.3 for two items (4 and 9; refer to Appendix B for item details). After removal of these items, EFA of the 7 items revealed that a 2-factor structure provided a good fit compared to a 3-factor structure (χ^2 (5) = 26.25, p < .001). The items loaded on the subscales of mastery (items 5, 7, 11; Cronbach's α = 0.73) and performance (items 6, 8, 10, 12; Cronbach's α = 0.94) goals. The mastery and performance distinction was not the focus of this study, thus, only the performance goal motivation subscale was selected and examined as a covariate in the models because while mastery goals involve learning and task-based competence, performance goals are normative and require comparison to others, and are likely more relevant to the nature of social media.

EFA with oblimin rotation and maximum likelihood estimation was used to examine the factor structure of the Social Media Subscale of the MTUAS. EFA of all 9 items revealed that the 3-factor structure provided a good fit compared to a 2-factor structure ($\chi^2(7) = 47.32$, $p < .001$) or 4-factor structure which had no convergence. The items loaded on the proposed subscales of *normative* (Cronbach's $\alpha = 0.91$), *generative* (Cronbach's $\alpha = 0.64$), and *interactive* (Cronbach's $\alpha = 0.75$) uses and factor loadings were high (above 0.52), although item 8, commenting (interactive use), had a significant cross-loading with generative use (0.37). Normative items involve checking social media (items 1 to 3), generative items include posting photos and status updates (items 4, 5), and interactive uses are browsing profiles, reading posts, commenting, and liking (items 6 to 9). The three-factor structure was consistent with Gerson et al.'s (2017) PAUM in the context of Facebook.

Measurement Model

Several fit indices were then used to determine model fit of the measurement model. Excellent model fit was identified when root mean square error of approximation (RMSEA) was below 0.06 (Browne & Cudeck, 1993), Bentler's comparative fit index (CFI) was above 0.95, and standardized root mean-squared residual (SRMR) was below 0.08 (Hu & Bentler, 1999). Missing data were imputed by using a maximum likelihood parameter estimation algorithm.

The initial classification of normative, generative, and interactive social media uses from the EFA was used as the basis for the measurement model and had a reasonable fit ($\chi^2(24) = 96.35$, $p < 0.001$, CFI = 0.904, TLI = 0.857, RMSEA =

0.133, SRMR = 0.080, AIC = 5567.35, BIC= 5661.42). Upon further inspection of the modification indices, (a) browsing profiles and reading postings (items 6 and 7) were also classified as normative uses, (b) commenting cross-loaded on generative uses (item 8), and (c) browsing and checking (items 1 and 2, and items 1 and 6) were correlated. Since it made theoretical sense and the model was new and exploratory, these indices were used to refit the model. The resulting subscales of *normative* (Cronbach's $\alpha = 0.87$), *generative* (Cronbach's $\alpha = 0.75$), and *interactive* (Cronbach's $\alpha = 0.64$) had acceptable reliability and the resulting model had an excellent fit ($\chi^2(18) = 29.18$, $p = 0.063$, CFI = 0.987, TLI = 0.975, RMSEA = 0.056, SRMR = 0.034, AIC = 5510.18, BIC= 5619.93). All factor loadings were significant, and all latent variables were significantly positively correlated except normative and generative uses were uncorrelated (Fig. 1).

Structural Models

A series of structural equation models were then estimated (refer to Table 3 for all estimates)—first, by regressing average scores of flexibility and persistence on each social media use, and originality and fluency on flexibility and persistence (i.e., as in the DPCM) for a model without covariates (Model 1; unadjusted model), and second, a model with total usage of social media, performance-related motivations for using social media, demographic variables (age and sex), language proficiency, intelligence, and the Intellect/Imagination personality subscale as covariates (Model 2; adjusted model). The latent variables of social media use were not related to any indicator of creativity in the structural model without covariates.

In the adjusted model, normative uses negatively predicted flexibility (β = -.198, *SE* = .097, *t* = -2.039, *p* = .041; Fig. 2).

To examine the role of EFs in moderating the relationship between social media and creativity, social media uses and each EF—working memory (indexed by PCU), task switching (indexed by switch cost), inhibitory control (indexed by Stroop effect)—and their interaction terms were entered in separate models. Social media and EF predictors were first entered in Model 1, interaction terms were then entered in Model 2 (unadjusted models), finally, the full model with covariates were entered (Model 3; adjusted model). For each model, random effects were estimated and a maximum likelihood estimator with robust standard errors using a numerical integration algorithm was used because interaction terms were introduced in the model (Muthén & Muthén, 2012).

The adjusted model with working memory and its interaction with social media uses is illustrated in Figure 3 and all estimates are provided in Table 4. Working memory was positively associated with flexibility (β = .246, *SE* = .078, *t* = 3.139, *p* = .002; Model 1), but this effect was non-significant when interaction terms and covariates were added (β = .143, *SE* = .082, *t* = 1.739, *p* = .082; Model 3). Working memory did not predict persistence in all three models. When interaction terms were added (Model 2), the interaction term of working memory by normative uses was significantly negatively related to persistence (β = -.188, *SE* = .076, *t* = -2.462, *p* = .014), and this association remained significant in the adjusted model (β = -.171, *SE* = .086, *t* = -1.990, *p* = .047; Model 3). The interaction term of working memory by generative uses were negatively related to persistence

in the unadjusted model (β = -.246 *SE* = .114, *t* = -2.157, *p* = .031; Model 2), but was not significant in the adjusted model (β = -.262, *SE* = .137, *t* = -1.914, *p* = .056; Model 3).

Inhibitory control and task switching were not significant moderators in the link between SNS and persistence or flexibility in all models. For instance, the moderation of normative uses and persistence by inhibitory control was not significant in the adjusted model (β = .168, *SE* = .095, *t* = 1.762, *p* = .078; Table 5) and also not significant in the adjusted model for task switching (β = -.159, *SE* = .129, *t* = -1.239, *p* = .215; Table 6).

General Discussion

The key contribution of this study was the concurrent examination of various dimensions of social media in relation to creativity, providing the first application of the DPCM framework in understanding the relationship between social media and creative potential. The additional investigation of EFs as moderators of the relationship between SNS to the flexibility and persistence pathways attempted to address inconsistencies in previous literature and identify boundary conditions in the DPCM (Friedman & Förster; 2000, 2001; Roskes et al., 2012). In line with past findings, flexibility and persistence are significant, divergent routes to creativity (originality and fluency). Specifically, we found that flexibility and persistence both positively predicted originality and fluency in all models, and these effects remained significant after controlling for pertinent covariates such as intelligence and the openness to experience personality facet.

Several operationalizations of social media were examined within the context of the DPCM. First, average time spent on social media per day was neither related to flexibility nor persistence. Second, performance goal orientation for social media use, as a covariate, did not predict either the flexibility of persistence pathways across all models. Since there were no specific predictions about mastery or performance goal orientations, and they do not map on to either the flexibility of persistence pathways, a general performance-oriented motivation was examined as a covariate to glean its effect on creativity indicators. Finally, factor analysis of the social media usage subscale yielded normative, interactive, and generative factors as in the PAUM (i.e., passive, active social, and active non-social respectively; Gerson et al., 2017), with items that cross-loaded: (a) browsing profiles and photos and reading postings on both normative and interactive and (b) commenting on postings, status updates, photos, etc. on both interactive and generative uses. Observed variables for normative and generative uses did not cross-load, and the correlation between the latent variables was not significant, indicating that these uses are distinct, but interactive use shared common variance with both normative and generative use. Normative uses were significantly negatively related to flexibility in adjusted structural model (Figure 2 and Table 2), suggesting that engaging in activities such as browsing, reading, or checking social media was associated with less flexible thinking, or using less holistic processing of many categories.

Working memory, which has been established as a moderator in the avoidance-persistence pathway, was a significant predictor of increased flexibility

in the present study but the relationship was non-significant in the adjusted model (Table 4 and Figure 3). Inhibitory control and task switching however, were not associated with either pathway. No specific hypotheses were made about the direct relation between EFs and flexibility or persistence, but it was interesting that although task switching, which involves shifting between mental sets and often implicated in the idea of cognitive flexibility (Diamond, 2013), was not related to flexibility, further supporting the finding that shifting does not have direct associations with creativity (Benedek et al., 2014b; Lee & Therriault, 2013). However, the ability to maintain and update information in working memory was positively related to flexibility. It is conceivable that the ability to effectively switch between different mental sets is not required for the flexibility pathway, as it was evaluated in the unusual uses task (i.e., the number of conceptual categories of unusual uses of a cup). Working memory, however, might be required to monitor and keep track of responses and the categories they fall under.

Inhibitory control and task switching were not significant moderators in the relationship between social media and persistence, only working memory significantly moderated the relationship between social media and persistence. None of the SNS-flexibility pathways were moderated. Specifically, only the working memory by normative use interaction significantly predicted persistence in the adjusted model. This finding suggests that for individuals with better working memory capacity, using social media for normative purposes was related to lowered persistence, however this effect was the reverse for individuals with poor working memory. This finding was initially counterintuitive because working memory is

involved in focused and systematic maintaining, processing, and recombination of information, which should be beneficial for persistence. However, according to the DPCM, working memory moderates the pathway between avoidance-related states and persistence because these states involve narrowed attentional scope and increased vigilance, and better working memory ability provides additional cognitive resources needed to persist. Therefore, it could be that normative uses are not avoidance-related, rather, they could be driven by some other motivation altogether. For example, one individual could be browsing social media out of habit, to stay updated with current events, or to passively consume social news from their social networks (Burke et al., 2010). Indeed, findings by Young, Kuss, Griffiths, and Howard (2017) suggest this possibility. The authors found that motivations of passive Facebook use (PFU) was unrelated to avoidance, because escapism was not a motivation of PFU—participants were more likely to engage in PFU after experiencing positive events in comparison to negative events. It is also possible that normative uses are not related to avoidance motivation and are more aligned with an approach motivation that primarily influences the persistence pathway negatively (Baas et al., 2013). In other words, normative uses do not require working memory, and having higher working memory capacity is detrimental to persistence but beneficial for those with poor working memory ability. Further research is required to explain this finding.

Due to the lack of studies on how social media affects creativity, new measures were explored in an attempt to distinguish approach- and avoidance-related uses of social media, but one limitation in our study was that these measures

were inadequate and future studies could adapt existing scales that access social media. For instance, Uses and Gratifications Theory (UGT) has been studied in the communications field to explain how individuals choose specific media content to fulfil specific social and psychological needs (LaRose & Eastin, 2004). UGT is applied to diverse types of media usage (LaRose & Eastin, 2004; Lee & Ma, 2012; Leung, 2013), providing various motivational factors for individuals to engage in each type of content. Leung (2013) examined five gratification motives of content generation via social networking sites (SNS) such as Facebook, blogs, and forums: (a) *social/affection needs* (e.g., to show encouragement, to understand myself and others), (b) *venting negative feelings* (e.g., to voice out discontent, fight back against unfairness), (c) *recognition needs* (e.g., to promote own expertise, establish personal identity), (d) *entertainment needs* (e.g., passing time, relaxing), (e) *cognitive needs* (e.g., broaden knowledge base, refine thinking). Approach- and avoidance-related uses could then be distinguished among these uses and gratifications.

Second, creativity was only measured with one task, and the interrater reliability was low for originality. Additional ratings of originality or more tasks are required to establish reliability of the construct and latent variables of creativity could also then be constructed to capture the common or shared variance. Originality has also been operationalized in different ways by different researchers, such as a single holistic judgement for ideas that only very few people could come up with or having participants choose their top two responses for scoring (Silvia, 2011; Silvia et al., 2008; Silvia, Martin, & Nusbaum, 2009). Finally, the definition

of creativity consists of both originality and effectiveness (Runco & Jaeger, 2012), and such an additional indicator might be required to glean a full picture of creativity. Third, each EF was also assessed with a single task, future studies employing the latent variable approach would also reveal purer measures of each core EFs and circumvent task-impurity issues (Miyake et al., 2000). Finally, it is possible that there is a bidirectional influence of social media and creativity, or that the direction of causality proceeds from creativity to social media, where individuals that are creative might choose to engage in social media activities that differ from less creative users. It is also possible that engaging with social media could have a more profound impact on the creativity of individuals who have not been ingrained in the social media environment for most of their lives. Studies have found that older adults who underwent social media intervention displayed improvements in working memory (Myhre, Mehl, & Glisky, 2017) and inhibitory control as assessed by the Stroop task (Quinn, 2018), suggesting that engagement with social media could directly modulate EFs. Additional studies with experimental or longitudinal designs are needed to clarify these relationships.

This study provided a comprehensive examination of social media using multiple indicators (i.e., usage and specific activities) and situated social media uses in the DPCM. The results provide an initial investigation into the impact of social media on the dual pathway and further supports the notion that flexibility and persistence are different routes to creative fluency and originality, although more work is needed to clarify the nature of motivations of using social media.

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Table 1. *Descriptive Statistics for Social Media, Creativity, Executive Function Tasks, and Covariates.*

	Mean (*SD*)	Skewness	Kurtosis	Reliability
Social Media[1]				
Normative uses	7.60 (1.39)	-0.64	1.09	0.87
Interactive uses	6.30 (1.69)	-0.35	0.32	0.75
Generative uses	3.50 (1.60)	0.27	-0.67	0.64
Creativity				
Flexibility	3.84 (1.22)	0.31	0.22	0.79
Persistence	3.62 (1.98)	0.67	1.74	0.83
Originality	1.43 (2.54)	-0.81	-0.93	-
Fluency	12.93 (5.68)	0.95	1.31	0.90
EF				
Updating (WM PCU)	5.89 (1.44)	-1.28	1.96	0.63
Inhibition (Stroop Effect)	-0.05 (0.07)	1.23	2.13	0.83
Shifting (Switch Cost)	-158.67 (164.38)	-1.26	2.35	0.93
Covariates				
Total social media usage (in minutes)	269.73 (144.26)	0.14	0.68	-
Performance motivation	2.45 (0.97)	0.10	-0.96	0.94
Age	21.61 (1.98)	0.63	0.38	-
Sex (% female)	68.2	0.79	-1.39	-
English proficiency (out of 10)	8.86 (0.98)	-0.68	0.36	0.94
Intelligence (RSPM score, out of 9)	6.41 (1.93)	-0.77	0.25	0.67
Personality - Intellect	3.63 (0.73)	-0.20	-0.37	0.67

Note: Means and reliability of untransformed values, and skewness and kurtosis of transformed values are reported where applicable (i.e., persistence, originality, Stroop effect, and social media usage).

[1] Means of various social media uses; rated by how often one does each activity: 1 = *never*, 3 = *several times a month*, 5 = *several times a week*, 7 = *several times a day*, 10 = *all the time*

Table 2. *Zero-order Correlations between Social Media, Creativity, Executive Function Tasks, and Other Covariates.*

	1	2	3	4	5	6	7	8
1. Normative uses								
2. Interactive uses	.777**							
3. Generative uses	.313**	.629**						
4. Flexibility	-.204*	-.166*	-.059					
5. Persistence	.005	-.031	-.037	-.284**				
6. Originality	-.036	.015	.021	.227**	.326**			
7. Fluency	-.147	-.135	-.056	.446**	.680**	.475**		
8. Working memory	-.100	-.110	-.104	.258**	.011	.064	.155*	
9. Inhibitory control	.095	.079	.020	-.031	-.005	-.024	-.046	-.116
10. Task switching	.050	.066	.087	.049	.023	.082	.043	.015
11. Social media usage	.211**	.137	.088	.001	.086	-.028	.088	.089
12. Social media motivation	.128	.258**	.333**	-.135	-.034	-.146	-.149	-.107
13. Age	-.013	-.027	-.019	.200**	-.188*	.027	-.058	.048
14. Sex	.043	-.009	-.149	.192*	-.106	.185*	.033	.049
15. English Proficiency	.100	.148	.118	.110	.073	.084	.155*	.051
16. Intelligence	-.085	-.128	-.051	.335**	-.063	.093	.174*	.332**
17. Personality - Intellect	.101	.107	.146	.158*	.180*	.256**	.294**	-.080

Note. *$p < .05$, **$p < .01$

Table 2 (continued). *Zero-order Correlations between Social Media, Creativity, Executive Function Tasks, and Other Covariates.*

	9	10	11	12	13	14	15	16
9. Inhibitory control								
10. Task switching	-.042							
11. Social media usage	.149	-.034						
12. Social media motivation	.174*	-.006	.093					
13. Age	.045	.038	-.033	-.089				
14. Sex	.085	-.026	-.160*	-.139	.575**			
15. English Proficiency	-.099	.162*	-.049	-.015	-.087	-.122		
16. Intelligence	-.130	-.022	-.162*	-.156*	.028	.119	.142	
17. Personality - Intellect	.099	.010	-.041	-.062	-.070	-.016	.342*	.180*

Note. *$p < .05$, **$p < .01$

Table 3. *Standardized Coefficient Estimates for Social Media Uses (Normative, Interactive, and Generative)*

	Flexibility				Persistence			
	Model 1		Model 2		Model 1		Model 2	
	Estimates	*SE*	Estimates	*SE*	Estimates	*SE*	Estimates	*SE*
Predictors								
Normative	-0.088	0.107	-0.198*	0.097	0.007	0.108	0.007	0.106
Interactive	-0.093	0.142	0.006	0.132	-0.038	0.143	-0.102	0.141
Generative	-0.031	0.115	-0.012	0.109	-0.025	0.118	-0.028	0.118
Covariates								
Total usage			0.129†	0.072			0.097	0.078
Social media motivation			-0.043	0.073			-0.026	0.079
Age			0.148†	0.084			-0.187*	0.090
Sex			0.106	0.088			0.022	0.096
English proficiency			0.077	0.075			0.034	0.080
Intelligence			0.293**	0.069			-0.102	0.077
Personality - Intellect			0.109	0.073			0.186*	0.078

Note. † $p < .10$. * $p < .05$. ** $p < .001$.

Table 3 (continued). *Standardized Coefficient Estimates for Social Media Uses (Normative, Interactive, and Generative)*

	Originality				Fluency			
	Model 1		Model 2		Model 1		Model 2	
	Estimates	*SE*	Estimates	*SE*	Estimates	*SE*	Estimates	*SE*
Predictors								
Flexibility	0.333**	0.063	0.290**	0.070	0.597**	0.032	0.601**	0.035
Persistence	0.407**	0.060	0.381**	0.064	0.753**	0.026	0.748**	0.031
Covariates								
Total usage			-0.028	0.066			0.015	0.021
Social media motivation			-0.064	0.065			-0.026	0.021
Age			-0.069	0.079			-0.039	0.025
Sex			0.197*	0.081			0.016	0.025
English proficiency			-0.004	0.069			0.008	0.022
Intelligence			-0.042	0.069			-0.010	0.022
Personality - Intellect			0.135†	0.070			0.022	0.022

Note. † $p < .10$. * $p < .05$. ** $p < .001$.

Table 4. *Standardized Coefficient Estimates for Normative, Interactive, and Generative Uses of Social Media, Working Memory (WM), and their Interactions (WM x Social Media).*

	Flexibility						Persistence					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
	Estimates	*SE*	Estimates	*SE*	Estimates	*SE*	Estimates	*SE*	Estimates	*SE*	Estimates	*SE*
Predictors												
Normative	-0.077	0.120	-0.219	0.469	-0.499	0.455	0.007	0.124	0.787*	0.351	0.748†	0.406
Interactive	-0.087	0.195	-0.057	0.701	0.241	0.756	-0.036	0.184	-0.584*	0.451	-0.816	0.586
Generative	-0.013	0.147	-0.552	0.558	-0.611	0.582	-0.027	0.137	0.969	0.491	1.044†	0.606
WM	0.246*	0.078	0.251*	0.077	0.143†	0.082	0.007	0.088	-0.003	0.075	0.068	0.087
WM x Normative			0.035	0.106	0.074	0.100			-0.188*	0.076	-0.171*	0.086
WM x Interactive			-0.009	0.153	-0.059	0.162			0.129	0.090	0.166	0.119
WM x Generative			0.138	0.123	0.153	0.129			-0.246*	0.114	-0.262†	0.137
Covariates												
Total usage					0.136†	0.071					0.035	0.080
Social media motivation					-0.045	0.072					-0.007	0.071
Age					0.122	0.084					-0.157	0.106
Sex					0.130	0.090					-0.021	0.095
English proficiency					0.091	0.072					-0.005	0.073
Intelligence					0.229*	0.088					-0.115	0.090
Personality - Intellect					0.120	0.077					0.210*	0.073

Note. † $p < .10$. * $p < .05$. ** $p < .001$.

Table 5. *Standardized Coefficient Estimates for Normative, Interactive, and Generative Uses of Social Media, Inhibitory Control (IC), and their Interactions (IC x Social Media).*

	Flexibility						Persistence					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
	Estimates	*SE*	Estimates	*SE*	Estimates	*SE*	Estimates	*SE*	Estimates	*SE*	Estimates	*SE*
Predictors												
Normative	-0.057	0.141	1.404	2.157	-0.093	0.188	-0.020	0.139	-0.538	0.636	-0.074	0.140
Interactive	-0.150	0.229	-3.364	4.715	-0.105	0.344	0.040	0.210	1.147	1.130	-0.105	0.231
Generative	0.038	0.160	2.563	3.807	0.165	0.215	-0.100	0.142	-1.062	0.901	-0.161	0.158
IC	-0.018	0.071	0.024	0.094	-0.009	0.076	-0.006	0.081	-0.033	0.073	-0.049	0.070
IC x Normative			-0.357	0.369	-0.145	0.116			-0.010	0.293	0.168†	0.095
IC x Interactive			0.597	0.665	0.103	0.218			0.236	0.466	-0.003	0.165
IC x Generative			-0.487	0.545	-0.149	0.136			-0.065	0.344	0.139	0.116
Covariates												
Total usage					0.139†	0.071					-0.087	0.072
Social media motivation					-0.064	0.077					0.009	0.074
Age					0.127	0.084					-0.163	0.109
Sex					0.125	0.091					0.011	0.101
English proficiency					0.083	0.073					0.026	0.071
Intelligence					0.297**	0.081					-0.126	0.080
Personality – Intellect					0.098	0.078					0.223*	0.072

Note. † $p < .10$. * $p < .05$. ** $p < .001$.

Table 6. *Standardized Coefficient Estimates for Normative, Interactive, and Generative Uses of Social Media, Task Switching (TS), and their Interactions (TS x Social Media).*

	Flexibility						Persistence					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
	Estimates	*SE*	Estimates	*SE*	Estimates	*SE*	Estimates	*SE*	Estimates	*SE*	Estimates	*SE*
Predictors												
Normative	-0.091	0.128	-0.140	0.228	-0.262	0.211	0.006	0.128	-0.157	0.2217	-0.117	0.217
Interactive	-0.093	0.203	0.094	0.415	0.128	0.354	-0.038	0.186	-0.044	0.393	-0.140	0.369
Generative	-0.035	0.149	-0.154	0.299	-0.049	0.267	-0.026	0.139	-0.021	0.295	-0.064	0.292
TS	0.061	0.075	0.049	0.079	0.058	0.078	0.026	0.078	0.044	0.080	0.047	0.072
TS x Normative			-0.033	0.139	-0.063	0.147			-0.210†	0.127	-0.159	0.129
TS x Interactive			0.160	0.222	0.117	0.231			-0.024	0.200	-0.018	0.211
TS x Generative			-0.108	0.201	-0.026	0.209			-0.008	0.183	-0.042	0.181
Covariates												
Total usage					0.132†	0.072					0.105	0.072
Social media motivation					-0.031	0.078					-0.013	0.078
Age					0.144	0.092					-0.185†	0.105
Sex					0.109	0.089					0.019	0.100
English proficiency					0.070	0.076					0.030	0.069
Intelligence					0.299**	0.082					-0.085	0.079
Personality – Intellect					0.100	0.075					0.183*	0.073

Note. † $p < .10$. * $p < .05$. ** $p < .001$.

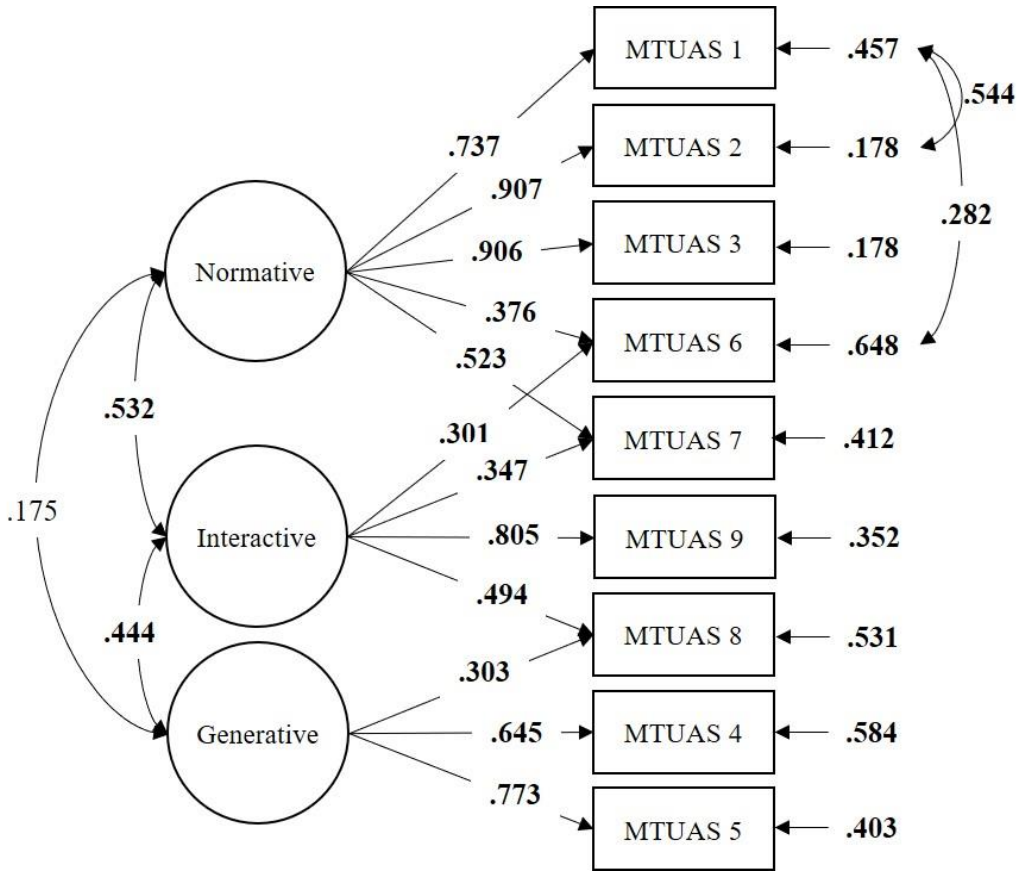

Figure 1. Measurement model of Normative, Interactive, and Generative uses of social media. Circles represent the three latent variables and rectangles represent individual survey items (manifest variables). Curved double-headed arrows connecting the latent variables to each other denote correlations between the constructs. Numbers next to single-headed arrows connecting latent variables to manifest variables represent the standardized factor loading. Bolded correlations and factor loadings are all significant at the .05 level. Numbers shown at the end of the shorter single-headed arrows pointing to the manifest variables are error terms.

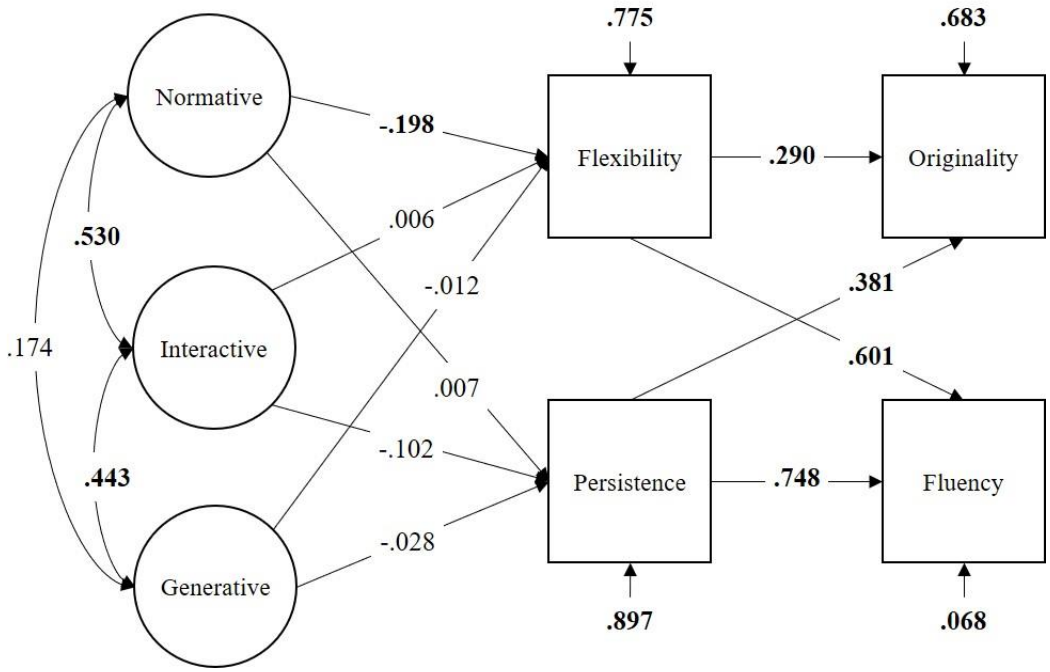

Figure 2. Adjusted structural model of creativity indicators regressed on Normative, Interactive, and Generative uses of social media, with covariates entered in the model (not pictured). Circles represent the three latent variables and rectangles represent manifest variables, which are the mean values of various indicators of creativity as scored by two independent raters (except for originality). Curved double-headed arrows connecting the latent variables to each other denote correlations between the constructs. Bolded values are significant at the .05 level. Numbers shown at the end of the shorter single-headed arrows pointing to the manifest variables are error terms.

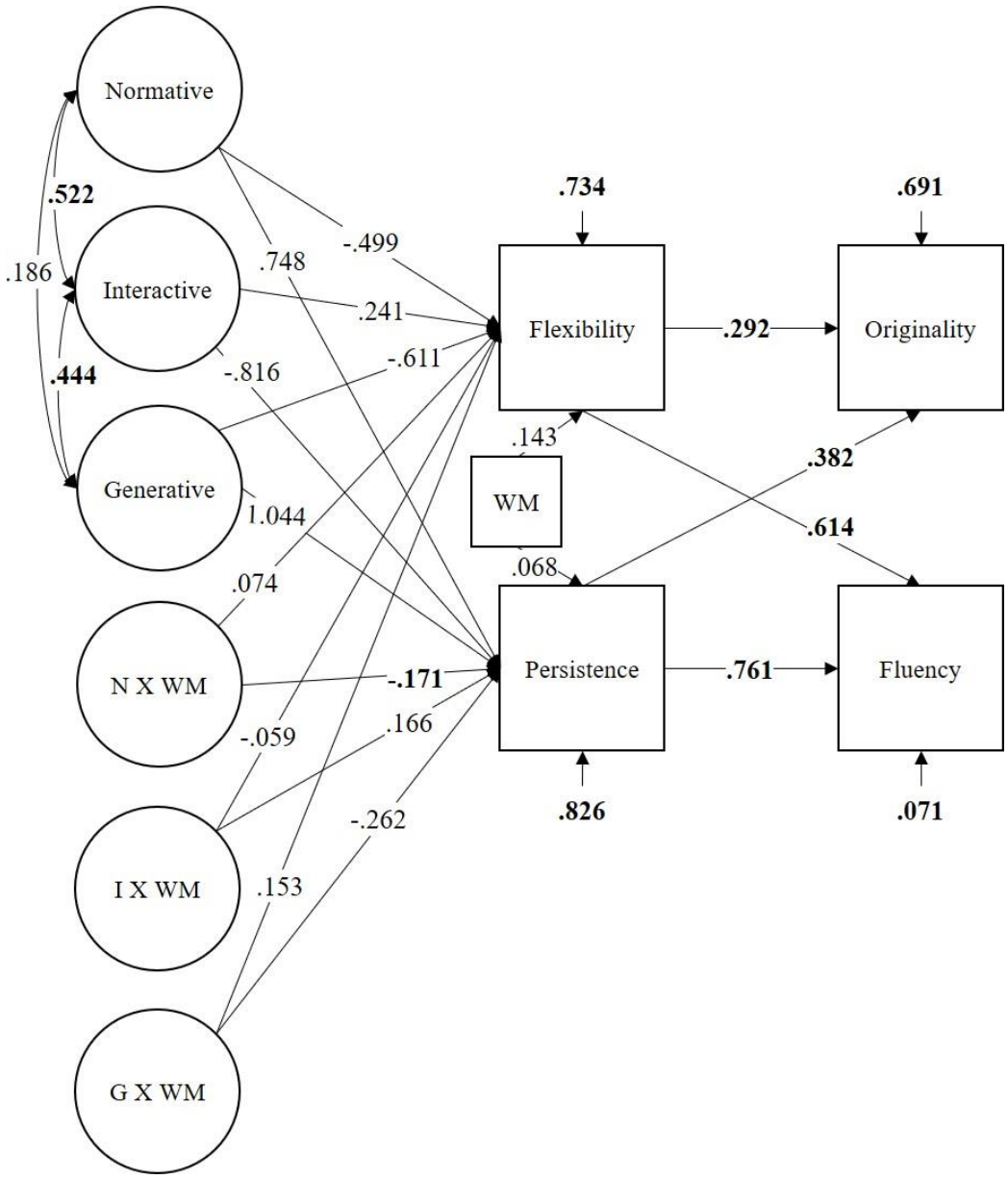

Figure 3. Adjusted structural model of Normative (N), Interactive (I), and Generative (G) uses of social media and their interactions with working memory (WM); with covariates included (not pictured). Circles represent latent variables and rectangles represent manifest variables, which are the mean values of various indicators of creativity scored by two independent raters (except for originality) and PCU (an index of working memory). Curved double-headed arrows connecting the latent variables to each other denote correlations between the constructs. Bolded values are significant at the .05 level. Numbers shown at the end of the shorter single-headed arrows pointing to the manifest variables are error terms.

Appendix A: Media and Technology Usage and Attitudes Scale (Adapted General Social Media Usage Subscale, 9 Items)

INSTRUCTIONS
How often do you do each of the following activities on social media?

1. Check your social media.
2. Check your social media from your smartphone.
3. Check social media at work or school.
4. Post status updates.
5. Post photos.
6. Browse profiles and photos.
7. Read postings.
8. Comment on postings, status updates, photos, etc.
9. Click “Like” to a posting, photo, etc.

RESPONSE FORMAT
1 = never; 2 = once a month; 3 = several times a month ; 4 = once a week; 5 = several times a week; 6 = once a day; 7 = several times a day; 8 = once an hour; 9 = several times an hour; 10 = all the time.

Appendix B: Adapted Achievement Goal Questionnaire-Revised (Elliot & Murayama, 2008)

Mastery-approach goal items
1. My aim is to completely master the material presented in social media.
7. I am striving to understand social media as thoroughly as possible.
3. My goal is to learn as much as possible from social media.

Mastery-avoidance goal items
5. My aim is to avoid learning less than I possibly could in social media.
11. I am striving to avoid an incomplete understanding of social media.
9. My goal is to avoid learning less than it is possible to learn from social media.

Performance-approach goal items
4. My aim is to perform well relative to others on social media.
2. I am striving to do well compared to others on social media.
8. My goal is to perform better than others on social media.

Performance-avoidance goal items
12. My aim is to avoid doing worse than others on social media.
10. I am striving to avoid performing worse than others on social media.
6. My goal is to avoid performing poorly compared to others on social media.

RESPONSE FORMAT
1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; 5 = strongly agree.