Flexible Cognitive Control and Preferences for Artistic Photographs*

John W. Mullennix, Chelsea L. Fallier, Kyle M. Mansueto
University of Pittsburgh at Johnstown, Johnstown, USA

The goal of the present study was to examine the relationship between flexible cognitive control and aesthetic appreciation. Participants viewed black and white artistic photographs. They used a visual scale to indicate their preferences for the photographs and rated the photographs using five semantic differential scales. Participants also performed a Stroop task, with trial-to-trial task performance analyzed to index the degree of flexible cognitive control possessed by each participant. The results showed little evidence that flexible cognitive control was a significant factor affecting impressions and preferences for photographs. The results are discussed in terms of how the degree of flexible cognitive control that a naive viewer possesses may not be sufficient in and of itself to produce a different aesthetic experience.

Keywords: aesthetics, photograph processing, aesthetic appreciation

Introduction

The psychological aspects of aesthetic experience have been studied for many years, with experimental approaches to aesthetics traced back to the beginnings of psychology in the 1800s (Fechner, 1876; Wundt, 1874). Berlyne (1971; 1974) is often credited with fomenting the modern era of experimental aesthetics, with his theoretical framework focusing on the roles of reward and arousal (emotion) in people’s subjective reactions to art. Berlyne’s (1971; 1974) collative-motivational model emphasized the dimensions of interest and pleasure, which in turn were related to collative (structural) attributes of visual stimuli such as novelty and complexity. He believed that these collative factors affected arousal and in turn affected viewers’ aesthetic experiences.

Since the seminal work of Berlyne (1971; 1974), theories about aesthetic appreciation have begun to incorporate concepts drawn from research on human cognition. As an example, the traditional information processing approach to cognition has been incorporated into a comprehensive cognitive model of aesthetic appreciation and judgment by Leder, Belke, Oeberst, and Augustin (2004). In Leder et al.’s (2004) model, the perceiver of art progresses through a sequence of cognitive processing stages (perceptual analyses, memory integration, classification, mastering, and evaluation) which in turn continuously update the affective state of

*Acknowledgements: The authors would like to thank Michael D. Robinson from North Dakota State University and Darya Zabelina from Northwestern University for their help and the use of a software program to run the Stroop task. This project was supported by a College Research Council Grant from the University of Pittsburgh at Johnstown.

John W. Mullennix, Ph.D., professor, Department of Psychology, University of Pittsburgh at Johnstown.
Chelsea L. Fallier, University of Pittsburgh at Johnstown.
Kyle M. Mansueto, University of Pittsburgh at Johnstown.
the perceiver. The end result of this process is the experience of aesthetic emotion and the production of an aesthetic judgment by the perceiver.

**Dual Mode Processing and Aesthetics**

One approach to characterizing the cognitive processes used when experiencing art is to frame these processes via the perspective of dual-mode processing. Dual mode processing was alluded to by William James in his seminal *Principles of Psychology* (1890), where he discusses unconscious inferences and reasoned inferences. Unconscious inferences are based on associative sequences that arise spontaneously without much thought devoted to them, while reasoned inferences require analysis arrived at by voluntary thought. In modern day research, dual mode processing has been proposed to explain how the human attention system works (Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977; Treisman & Gelade, 1980). Based on a series of studies examining visual detection and search, Schneider and Shiffrin (1977) observed a distinction between automatic processing and controlled processing. Automatic processing operates independently of a person’s control and does not require conscious attention or short-term memory capacity. Automatic processes are fast and run in parallel fashion. Controlled processing is characterized by conscious attention to a task and the expenditure of mental effort. Controlled processing is serial, relatively slow, and competes for mental resources used by other cognitive processes (Wickens, 1991). In recent research, the dual mode processing dichotomy has been extended beyond attention theory to help explain higher level cognitive phenomena, such as reasoning and social cognition (Chaiken & Trope, 1999; Evans, 2007; Kahneman, 2011; Smith & Collins, 2009). Kahneman (2011) discusses what he calls System 1 and System 2 processes, which are roughly described as intuition and reasoning. System 1 processes are automatic, fast, stereotypical, subconscious, and emotional. System 2 processes are effortful, slow, logical, calculating, and conscious. Brain imaging research has indicated that dual processing modes have a basis in the brain, with specific brain networks (termed the default mode network and the central executive network) underlying automatic and controlled processes, respectively (Sridharan, Levitin, & Menon, 2008).

In terms of aesthetic appreciation, a dual process explanation was proposed by Hekkert, Snelders, and van Wieringen (2003). Hekkert et al. (2003) examined aesthetic preference for consumer products such as automobiles and tea kettles. They found that typicality and novelty affected preference, with typicality effects observed only when the novelty of compared items was similar. Hekkert et al. (2003) suggested that typicality effects for preference were mediated by an automatic, adaptive mechanism operating without intention. This mechanism handles typically encountered, easily classifiable stimuli. For novelty effects, they suggested that novel or atypical stimuli are processed via a controlled, cognitively mediated mechanism. They concluded that aesthetic judgments reflect the output from these two mechanisms, with the judgment affected by various factors such as time, the aesthetic function of the object, and characteristics of the observer such as expertise.

To examine the dual processing idea further, Mullennix, Foytik, Chan, Dragun, Maloney, and Polaski (n.d.) conducted a study where aesthetic judgments were studied from the perspective of dual mode attentional theory (Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977; Treisman & Gelade, 1980). The purpose of Mullennix et al.’s (n.d.) study was to assess whether automatic or controlled processes were used while making aesthetic judgments about artistic photographs. To determine what processes were used, a concurrent load task was instituted, where viewers of photographs were asked to remember random sets of numbers while making preference judgments. Concurrent loads tasks have been used to index automatic and controlled processing. For
example, Schneider and Shiffrin (1977) found that visual search performance deteriorated when memory load increased, if participants were using controlled processing to perform the task. Conversely, increases in memory load had no effect if automatic processes were used. Mullennix et al. (n.d.) found that increases in memory load had little effect on the pattern of preference judgments across memory load conditions, suggesting that automatic processes were used by the viewers when making preference judgments about artistic photographs.

**Flexible Cognitive Control and Aesthetics**

In the present study, the goal was to further refine our understanding of the cognitive processes underlying aesthetic appreciation. One idea that emerges from the dual mode processing framework is the concept of flexible cognitive control. Cognitive control can be defined as, “The ability to behave in accord with rules, goals, or intentions, even when this runs counter to reflexive or otherwise highly compelling competing responses... A hallmark of cognitive control in humans is its remarkable flexibility” (Rougier, Noelle, Braver, Cohen, & O’Reilly, 2005, p. 7338). Brain imaging research has indicated that neural networks located in the prefrontal cortex, the anterior cingulate cortex, and the posterior parietal cortex are involved in cognitive control (Kerns, Cohen, MacDonald III, Cho, Stenger, & Carter, 2004; Liston, Matalon, Hare, Davidson, & Casey, 2006; Miller & Cohen, 2001; Rougier, Noelle, Braver, Cohen, & O’Reilly, 2005). Cognitive control is evident when there is conflict occurring in the information-processing system (van Veen & Carter, 2006). When irrelevant information is automatically processed, cognitive control may exert itself and correct the error by suppressing the irrelevant information and selecting relevant information. The amount of conflict appears to determine how much control is exerted (van Veen & Carter, 2006). Thus, it appears that in certain situations, people are able to switch back and forth between processing modes when needed.

In terms of how cognitive control is related to aesthetics, there appears to be a link between the flexibility of cognitive control and creativity. Zabelina and Robinson (2010) indicate that there are competing explanations for creativity rooted in the automatic and controlled processing dichotomy. On the one hand, they note that unfocused or defocused attention, which could be interpreted as synonymous with automatic, parallel processes, could facilitate creative thinking. These processes are associated with low levels of cognitive control. These are processes that may be used during the “brainstorming” phase of working on a project, when one is looking to combine multiple concepts together to create something novel and useful (Vartanian, 2009). On the other hand, Zabelina and Robinson (2010) suggested that creativity may involve controlled processes, requiring “Some degree of focused mental efforts” (p. 136). So, what processes are engaged by a creative individual? The answer may be both. Vartanian (2009) suggested that a creative problem solver may switch back and forth between defocused and focused attention at different stages in the problem-solving process. Zabelina and Robinson (2010) concurred with this general idea, “Creative individuals, we suggest, are those whose minds are more capable of switching rapidly between these two processing modes in a manner suited to the present processing context” (p. 137). In their study, Zabelina and Robinson (2010) obtained empirical evidence that flexible cognitive control, as indexed by participants’ regulation of trial to trial performance in a Stroop (1935) color task, was correlated with creativity.

It seems likely that individuals who are successful creative artists possess a substantial degree of flexible cognitive control. This suggests that, during the creative process, they are better able to switch modes when the task demands require it. But what about the viewer of art? The viewer of art may be creative as well. Or if not
creative, the viewer may possess a high degree of flexible cognitive control for reasons unrelated to creativity. The question we address is whether a viewer of art who has a high degree of flexible cognitive control views and processes aesthetic objects differently than a viewer who has less control. There is some evidence that those artists and skilled viewers are able to take advantage of attentional flexibility and use it to circumvent our tendency to automatically process perceptual information in our environment (Cupchik & Winston, 1996). Furthermore, Cupchik, Vartanian, Crawley, and Mikulis (2009) suggested that top-down control and an intentional shifting of conscious attention are necessary to produce an aesthetic experience in the viewer of an artwork.

The Present Study

In the present study, we examined whether a connection exists between aesthetic processing on the part of the viewer of art (as evidenced by their preferences for visual art) and flexible cognitive control (the ability to switch processing modes and exert attentional control). Although a number of studies have shown that experts in art and novices in art judge aesthetic objects differently (Axelsson, 2007; Cupchik & Gebotys, 1990; Eysenck & Castle, 1970; Hekkert, Peper, & van Wieringen, 1994; Hekkert & van Wieringen, 1996; Leder, Gerger, Dressler, & Schabmann, 2012; Schmidt, McLaughlin, & Leighten, 1989; Silvia, 2013; Winston & Cupchik, 1992), we decided to focus on the naive viewer of art who does not have a formal background in photography or the visual arts. The reason we chose naive viewers was that they represent most of the viewers of art in real life situations. If we are to encourage the arts, in terms of enhancing our cultural experiences, it seems desirable to examine what naive viewers do. With that in mind, our focus was on assessing flexible cognitive control in naive viewers and examining whether individual differences in control affect how art is processed and judged. In Mullennix et al.’s (n.d.) study, they found that, overall, naive viewers of art processed visual art automatically. However, the degree of flexible cognitive control possessed by participants was not explicitly assessed by them and individual differences in control were not analyzed.

In the following study, participants were shown artistic photographs and were asked to make aesthetic judgments about them, including their preferences for the photographs and their ratings of the photographs on a few scales. The degree of flexible cognitive control possessed by each participant was indexed via a Stroop (1935) color naming task. A number of researchers have identified the Stroop (1935) task as useful in assessing flexible cognitive control (Botvinick, Cohen, & Carter, 2004; Kerns et al., 2004; van Veen & Carter, 2006; Zabelina & Robinson, 2010). Flexible cognitive control has been assessed by analyzing trial to trial performance in the Stroop (1935) task. As stated by Zabelina and Robinson (2012),

Flexible cognitive control is indicated to the extent that Stroop (1935) interference costs for target trials are lower after previous trials that did (i.e., incongruent prime trials) versus did not (i.e., congruent prime trials) require cognitive control requirement... In other words, flexible cognitive control is defined in terms of up- or down-regulating cognitive control depending on whether its use was needed on the previous trial. (p. 137)

In the present study, an analysis of trial to trial Stroop performance provided an individual measure of flexible cognitive control for each participant.

In terms of predictions, we focused on whether viewers with greater cognitive flexibility preferred different photographs than viewers with less flexibility. If flexibility is a factor in aesthetic experience, then we expected that those with higher flexibility may prefer photographs that are more abstract and more complex (e.g., more demanding to process). We also expected those with lower flexibility to prefer photographs rated as
pleasant and familiar (e.g., easy to process). In terms of the ratings of the photographs on semantic differential scales, we expected that if flexible cognitive control affects how one forms impressions of artistic photographs, the pattern of ratings across scales should differ as a function of flexibility.

Method

Participants

Twenty-seven undergraduate students (6 men and 21 women) at the University of Pittsburgh at Johnstown participated in the study. Average age of participants was 19.33 years (SD = 1.21). Participants were solicited from Introductory Psychology courses and received course credit for their participation. Each person took part in one experimental session lasting less than one hour.

To assess the amount of experience that participants had with photography and the visual arts, they were asked a series of questions (see Appendix A). Questions 1–6 were designed to assess their experience and knowledge about photography. Questions 7–14 were taken from the visual arts subset of the CAQ (creative achievement questionnaire) (Carson, Peterson, & Higgins, 2005) and modified slightly. Nine participants answered affirmative to at least one of the CAQ questions, with three of those participants also answering affirmative to over half the photography questions. No other participants answered affirmative to over half the photography questions. Following the scoring scheme from Carson et al. (2005), points were totaled for the nine participants’ answers on the CAQ visual arts scale subset. The average number of points was 5.56 (SD = 3.64), out of a score of 28 possible points minimum on the scale. The sparse affirmative responses to the photography questions and the low scores on the CAQ visual arts subset suggest that although 9 of 27 participants possessed some experience with photography and/or the visual arts, their experience was limited. In addition, their age precluded any lengthy track record in these areas. For these reasons, experience with photography and/or visual art was deemed not to be a significant factor in this study.

Materials

Thirty-two black and white artistic photographs printed on commercially available standard sized postcards were used. The photographs were from well-known photographers (such as Herb Ritts and Helmut Newton) or from lesser-known photographers who offered their photographs for online purchase. As discussed by Mullennix et al. (n.d.), photographs were chosen that varied as much as possible across 27 nine-point semantic differential scales used to pilot test the stimuli. Our choices were somewhat subjective, as the combinatorial possibilities of choosing stimuli based on 27 scales precluded any algorithmic manner of selection. A few example photographs with a few selected corresponding ratings are shown in Appendix B. The 32 photographs were the same photographs used in the Mullennix et al.’s (n.d.) study.

Design and Procedure

Each participant performed three tasks. The first task was a preference scaling task. This task was designed to collect information on the personal preferences of participants for the artistic photographs. The photographs were randomly ordered and given to participants in a stack. A 60 in (1.52 m) visual preference scale was constructed on a table top. The scale endpoints were 0 and 10 (0 corresponding to least liked and 10 corresponding to most liked) with a 6 in interval between numbers on the scale. Participants were told they were going to look at artistic photographs and physically place each photograph on the scale corresponding to their personal preference, with photographs placed on the scale in a way that the distances on the scale
corresponded to how much they preferred the photographs in relation to each other. In other words, they were told that the photographs did not have to be placed at equal distances from each other on the scale on the table and that the photographs could be bunched together in clumps or groups if they preferred. In terms of the scale, they were told that a value of 0 meant that they could not think of any photograph they had ever seen that they would prefer less. A value of 10 meant that they could not think of any photograph they had ever seen that they would prefer more. When each participant finished arranging the photographs on the scale, the experimenter registered the scale values by asking the participant to tell them what scale value, within one decimal point, he/she intended for each photograph.

The second task was a variation of the classic Stroop (1935) color naming task, as adapted by Zabelina and Robinson (2010). This task was designed to assess flexible cognitive control. Presentation of stimuli and collection of data were performed using the E-Prime 2.0 software package (Psychology Software Tools, Pittsburgh, PA) on a Dell Precision T3400 desktop computer. Participants were presented with words on a computer screen and were asked to make forced-choice reaction time responses to them. They were told to categorize each word in terms of the font color the word was presented in. They were instructed to attend closely to the font color and ignore what the word said. Words were presented in red or green font color on a black screen background, with participants pressing one of two keys “f” or “j” on a computer keyboard to indicate “red” or “green” font color. The words themselves were the color words “red” or “green”. Half the trials were presented in red font and half in green font. Half the trials were congruent, meaning that the font color and color word matched (i.e., the word “red” presented in red font and the word “green” presented in green font). Half of the trials were incongruent, meaning that the word and font color mismatched (i.e., the word “red” presented in green font and the word “green” presented in red font). Correct responses were followed by a 150 ms blank screen to prepare for the next trial. Error responses were followed by a 1,000 ms error message screen to inform the participant of their error. A total of 160 trials were run.

The third task was a rating task where participants rated each photograph using a series of nine-point semantic differential scales. Participants were given a randomized stack of the same photographs used for the preference task. They examined the photographs one at a time and rated each photograph before moving on to the next photograph. The five scales used were unpleasant-pleasant, simple-complex, abstract-concrete, unfamiliar-familiar, and uninteresting-interesting. These particular scales were chosen because the represented the attributes of artistic photographs that participants appear to place the most importance on, in terms of how they form their impressions of them (Axelsson, 2007; Mullennix et al., n.d.). The rating scale adjective items were presented on computer using E-Prime 2.0. For each photograph, the five rating scale items were presented in a randomized sequence, one at a time. Participants selected a point on the scale that corresponded to their impression of the photograph and responded by pressing one of the number keys from 1 to 9 at the top of the computer keyboard. After they responded, the program presented the next scale item. After all five ratings for a photograph were completed, the program prompted participants to select the next photograph and repeat the procedure. Participants were told to ask the experimenter to clarify the meaning of any ambiguous adjectives on the scale; if these terms were still unclear, participants were instructed to simply rate the photograph using the adjectives to the best of their ability.

All participants performed the tasks in the same sequence, with the preference task first, the Stroop (1935) task second, and the rating task last.
Results

Preference Scaling Task Data

The preference scale values were tabulated for each photograph for each participant. A one-way ANOVA for photograph (the preference value assigned to the photograph) was conducted on the data. The main effect of photograph was significant, $F_{(31,806)} = 16.52, p = 0.0, \eta^2 = 0.39$. The preference values across photographs varied significantly, which was expected. Preference values ranged from a low of 2.03 to a high of 8.24, with $M = 5.11, SD = 1.75$.

Semantic Differential Rating Data

To examine the semantic differential ratings for the photographs, a two-way repeated measure ANOVA (analysis of variance) was conducted on the data for the variables of photograph (32 different photographs) and scale (five different rating scales). There was a significant main effect of photograph, $F_{(31,806)} = 17.91, p = 0.0, \eta^2 = 0.41$ and a significant main effect of scale, $F_{(4,104)} = 14.08, p = 0.0, \eta^2 = 0.35$. There was also a significant interaction of photograph with scale, $F_{(124, 3224)} = 13.11, p = 0.0, \eta^2 = 0.33$. The interaction indicated that different photographs received different ratings across the five scales, which was expected.

Regression of Semantic Differential Ratings to Preference Ratings

To explore the attributes of the photographs that factored into the preference ratings, a series of linear regression analyses were conducted where the five semantic differential scale ratings for each of the 32 photographs were regressed against the preference rating for each photograph. The results are shown in Table 1. Out of 32 photographs, the preference ratings for 21 photographs were significantly related to the semantic differential ratings on one or more scales. And out of 160 possible relationships between scale ratings and preference ratings (5 scales × 32 photographs), 30 were significant (18.7%). The uninteresting-interesting scale factored into preferences for 12 photographs, the simple-complex scale and unfamiliar-familiar scale factored into six photographs, the unpleasant-pleasant scale factored into five photographs, and the abstract-concrete scale factored into one photograph.

Table 1

Linear Regression Analysis Assessing Contribution of Rating Scale Items Toward Photograph Preference Ratings. Only the First Adjective From Each Rating Scale Pair of Adjectives Is shown. The Preference Rating for the Photograph and the Semantic Differential Scale Rating for the Scale Item Are Also Listed

| Photograph # | Rating scale   | Beta | $t$  | Scale rating | Preference rating |
|--------------|----------------|------|------|--------------|------------------|
| #2           | Uninteresting  | 0.59 | 2.37 | 3.70         | 2.85             |
| #4           | Unpleasant     | 0.41 | 2.48 | 8.30         | 7.99             |
| #6           | Interesting    | 0.48 | 2.08 | 7.74         | 6.75             |
| #7           | Abstract       | -0.46| -2.09| 5.44         | 5.89             |
| #10          | Unfamiliar     | -0.38| -2.60| 5.93         | 5.47             |
|              | Uninteresting  | 0.46 | 2.67 | 4.63         |                  |
|              | Unpleasant     | 0.44 | 2.44 | 6.11         |                  |
|              | Simple         | 0.36 | 2.39 | 3.59         |                  |
| #11          | Unfamiliar     | 0.39 | 2.24 | 8.26         | 5.25             |
|              | Uninteresting  | 0.42 | 2.24 | 5.22         |                  |
|              | Simple         | -0.36| -2.10| 2.89         |                  |
When examining the relationships between preference and semantic differential ratings, they resembled the findings with these scales observed by Mullennix et al. (n.d.). This is not surprising, since the photographs used in the present study were also used by Mullennix et al. (n.d.). The semantic differential ratings indicated that, overall, photographs were preferred more if they were rated as more interesting, more pleasant, more familiar, and simpler.

### Stroop Task Data

To assess the degree to which flexible cognitive control was present, as indicated by the Stroop task, trial to trial performance was analyzed. Flexible cognitive control is present when the participant is mentally “prepared” to respond quickly on a trial by virtue of the type of trial they just experienced. Trials can be congruent (the font color and color word match) or incongruent (the font color and color word mismatch). A two-way repeated measures ANOVA was conducted for the variables of color congruence (whether the color word and font color matched) and preceding trial (whether the preceding trial was congruent or incongruent). A significant main effect of color congruence was observed, $F_{(1,26)} = 9.60, p = 0.005$, $\eta^2_p = 0.27$. Response times were faster for congruent trials ($M = 496.1$ ms) compared to incongruent trials ($M = 529.79$ ms). This is the standard Stroop effect. A significant effect of preceding trial was not observed ($F < 2.6$). However, a significant interaction of color congruence with preceding trial was obtained, $F_{(1,26)} = 17.56, p = 0.00, \eta^2_p = 0.40$. The interaction shows that flexible cognitive control for responding to the Stroop stimuli existed. The response times across conditions are shown in Table 2. For trials preceded by congruent trials, there was a robust standard Stroop interference effect, with congruent trials responded to faster than incongruent trials (78.2 ms difference), $t_{(27)} = -5.52, p = 0.000$. For trials preceded by incongruent trials, the pattern was reversed, with incongruent trials responded to faster than congruent trials (10.8 ms difference), although this difference was not significant ($t < 0.7$). Even so, this pattern of response times shows that, overall, participants are able to

### Table 1 continued

| Photograph # | Rating scale | Beta | $t$  | Scale rating | Preference rating |
|--------------|--------------|------|------|--------------|------------------|
| #13          | Familiar     | 0.41 | 2.22 | 7.07         | 6.92             |
|              | Uninteresting| 0.61 | 3.10 | 6.48         |                  |
| #14          | Uninteresting| 0.68 | 3.41 | 4.85         | 4.98             |
|              | Simple       | 0.42 | 2.65 | 5.04         |                  |
| #15          | Uninteresting| 0.65 | 3.14 | 6.30         | 5.25             |
| #18          | Uninteresting| 0.68 | 3.18 | 5.00         | 4.53             |
| #20          | Simple       | 0.40 | 2.13 | 4.07         | 6.56             |
| #22          | Unpleasant   | 0.47 | 2.11 | 7.37         | 7.32             |
| #23          | Uninteresting| 0.48 | 2.29 | 7.85         | 7.87             |
|              | Simple       | 0.38 | 2.30 | 7.26         |                  |
| #24          | Uninteresting| 0.62 | 3.10 | 5.48         | 5.54             |
| #25          | Uninteresting| 0.71 | 3.32 | 3.93         | 3.40             |
| #26          | Unpleasant   | 0.54 | 2.25 | 3.11         | 2.80             |
| #28          | Unfamiliar   | -0.53| -2.45| 4.59         | 3.82             |
| #30          | Unfamiliar   | 0.46 | 2.45 | 3.81         | 5.31             |
| #31          | Uninteresting| 0.50 | 2.49 | 3.04         | 2.75             |
| #32          | Unfamiliar   | -0.48| -2.18| 6.59         | 7.65             |

*Note: Listed items are significant at the $p < 0.05$ level.*
mentally prepare for a congruent or incongruent trial based on the type of trial they just experienced. These results replicate the findings of Zabelina and Robinson (2010), with the magnitude of response time differences across conditions in their study (70 ms and 23 ms, respectively) similar to the ranges reported in the present study.

Table 2
Mean Response Times for Congruent and Incongruent Conditions as a Function of the Preceding Trial (Whether the Preceding Trial Was Congruent or Incongruent) in ms

| Trial preceded by a congruent trial | Trial preceded by an incongruent trial |
|------------------------------------|---------------------------------------|
| Congruent trial                    | 466.4 (SD = 82.8)                     | 525.8 (SD = 87.4) |
| Incongruent trial                  | 544.6 (SD = 118.5)                    | 515.0 (SD = 104.8) |

Table 3
Flexible Cognitive Control Scores Listed for Each of the 27 Participants (in ms)

| Flexible cognitive control scores |
|-----------------------------------|
| 39.1                              |
| 109.5                             |
| 247.6                             |
| 56.2                              |
| 180.2                             |
| 195.9                             |
| 116.1                             |
| -133.3                            |
| 48.9                              |
| -237.9                            |
| 168.4                             |
| -52.4                             |
| 238.8                             |
| 270.2                             |
| 205.0                             |
| 39.2                              |
| 63.1                              |
| 64.4                              |
| 32.2                              |
| 91.6                              |
| 101.0                             |
| 131.6                             |
| 89.2                              |
| 141.3                             |
| 36.1                              |
| 89.0                              |
| 74.0                              |

Correlation of Flexible Cognitive Control to Preference and Semantic Differential Ratings

To examine whether the degree of flexible cognitive control a participant possessed was related to his/her preferences for photographs and his/her ratings for them, a number of correlational analyses were carried out. A measure of flexible cognitive control was calculated for each participant. The measure we used was similar to that of Zabelina and Robinson (2010) and was based on the four-trial types: incongruent-primed/congruent trial, congruent-primed/incongruent trial, congruent-primed/congruent trial, and incongruent-primed/incongruent trial. The formula reflects response times for trials where the preceding trial type matched the present trial type (i.e., congruent/congruent or incongruent/incongruent) and response times for trials where the preceding trial mismatched the present trial type (congruent/incongruent or incongruent/congruent). The formula is as follows: (congruent/incongruent + incongruent/congruent) – (congruent/congruent + incongruent/incongruent) = flexible cognitive control score.

The flexible cognitive control scores are shown for each participant in Table 3. Note that the values could be positive or negative depending on the pattern of RT (reaction times)’s across conditions for the participant. Only 2 of 27 flexibility scores were negative. As indicated by a rather large standard deviation in scores, there was a substantial amount of variation across participants (\(M = 89.1, SD = 110.5\)). This indicated that there was ample opportunity to observe individual differences in flexible cognitive control and how those differences affected judgments of the photographs.

To examine the relationship of flexible cognitive control to preference ratings for the photographs, a series of correlational analyses were conducted, where the flexible cognitive control score for each participant was correlated with their preference rating for each photograph. Out of 32 photographs, only one correlation between flexible cognitive control and preference was significant, that being for Photo #13, \(r_{(27)} = 0.40, p =\)
0.038. Five other correlations were marginally significant, with $p$-values between 0.05 and 0.10.

Correlational analyses were also conducted to assess whether flexible cognitive control was related to the semantic differential ratings of the photographs. Only two significant correlations were obtained, one for the unpleasant/pleasant scale for Photo #30, $r_{(27)} = -0.38, p = 0.049$ and one for the abstract/concrete scale for Photo #8, $r_{(27)} = -0.39, p = 0.042$. There were eight other correlations that fell into the marginal range of $p$-values between 0.05 and 0.10.

Even if one included the marginally significant correlations between the flexible cognitive control scores and the preference ratings, these analyses presented little evidence that flexible cognitive control, as indexed via trial to trial Stroop (1935) task data, was related to preference choices for photographs. In addition, the paucity of correlations between flexible cognitive control scores and semantic differential ratings indicated that there was few evidence that flexibility had a unique impact on ratings for the photographs.

**Discussion**

Overall, the results of the present study suggested that flexible cognitive control on the part of the naive viewer of art had little effect on what they prefer. We found little correlation between the indexed amount of flexible cognitive control a viewer possessed (based on trial to trial Stroop task performance) and preference, as well as little correlation between flexible cognitive control and their ratings of the photographs on five semantic differential scales.

In considering these findings, we stress that participants were young college students with little experience in photography and the visual arts. Because we wished to emulate some aspects of a real life situation where visual art is encountered and a viewer judges what they see, we were careful about our instructions to participants. In a study by Cupchik, Vartanian, Crawley, and Mikulis (2009), they showed that instructional manipulations to participants with no formal training in the visual arts affected how they processed paintings, with different brain areas activated under pragmatic and aesthetic instructional conditions. In contrast to their study, we did not provide explicit instructions for an aesthetic-based emphasis to use while judging the photographs, because viewers in a typical real life situation are not told how to approach an artwork. It is a question of ecological validity. It is possible that if such instructions had been provided, this would have engaged cognitive control (i.e., controlled processing) for participants to a greater degree, possibly allowing the differences in flexible cognitive control across participants to affect the preference and rating tasks.

This brings up an important possibility regarding flexible cognitive control and aesthetic experience, which is that flexible cognitive control may be necessary but not sufficient to produce a different aesthetic experience in the viewer. As Cupchik et al. (2009) demonstrated, directing the viewer’s attention to the artwork “In a subjective and engaged manner, experiencing the mood of the work and the feeling it evokes, and to focus on its colours, tones, composition, and shapes...” (p. 86) engaged the viewer in a different manner. And as previously noted, experience and expertise in art affects how art is processed (Axelsson, 2007; Cupchik & Gebotys, 1990; Eysenck & Castle, 1970; Hekkert et al., 1994; Hekkert & van Wieringen, 1996; Leder, Gerger, Dressler, & Schabmann, 2012; Schmidt, McLaughlin, & Leighten, 1989; Silvia, 2013; Winston & Cupchik, 1992). In future research, it would be worthwhile to decouple flexible cognitive control from instructional manipulations and expertise in order to properly assess whether flexible cognitive control is a significant factor in producing an aesthetic experience in the viewer of artworks.

One possible criticism of the results of the present study is that the sample size was not large enough to
properly ascertain the influence of flexible cognitive control. This criticism is faulty for two reasons. The first reason is that we had sufficient power to observe significant differences across photographs in preference ratings and semantic differential ratings, with the partial eta squared values indicating large effect sizes (Cohen, 1988). The Stroop data also showed a large effect size. The second reason is that we observed a fairly wide range of variation in the flexible cognitive control scores (see Table 3). Thus, compression of scores was not an issue.

In closing, one last issue is that creativity was not assessed in the present study. We do not know if participants with greater flexible cognitive control were more creative, although the findings of Zabelina and Robinson (2010) would suggest that this is the case. In some sense, we have a chicken and the egg problem. Do creative artists naturally have the ability to switch processing modes quickly and efficiently based on task demands, or did the ability to switch processing modes develop through training and experience in art? For viewers of artworks, if one does not naturally possess the ability to switch processing modes quickly and efficiently, does this have a negative effect on aesthetic appreciation? Or does the ability to switch modes also develop in viewers as they gain more experience with art? Future studies examining the role of flexible cognitive control should not only examine expertise, but the type of expertise, the type of formal training in art a viewer has had, and the amount of experience with art they possess. In this way, we can gain a more comprehensive picture of how cognitive processing, as considered under the dual mode processing framework, is involved in producing an aesthetic experience in the person who views aesthetic objects.

References

Axelsson, O. (2007). Individual differences in preferences to photographs. *Psychology of Aesthetics, Creativity, and the Arts, 1*, 61-72.

Berlyne, D. E. (1971). *Aesthetics and psychobiology*. New York, N.Y.: Appleton-Century-Crofts.

Berlyne, D. E. (1974). *Studies in the new experimental aesthetics: Steps toward an objective psychology of aesthetic appreciation*. Washington, D.C.: Hemisphere Publishing.

Botvinick, M. M., Cohen, J. D., & Carter, C. S. (2004). Conflict monitoring and anterior cingulate cortex: An update. *Trends in Cognitive Sciences, 18*(12), 539-546.

Carson, S. H., Peterson, J. B., & Higgins, D. M. (2005). Reliability, validity, and factor structure of the creative achievement questionnaire. *Creativity Research Journal, 17*(1), 37-50.

Chaiken, S., & Trope, Y. T. (Eds.). (1999). *Dual-process theories in social psychology*. New York: Guilford Press.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, N.J.: Erlbaum.

Cupchik, G. C., & Gebotys, R. J. (1990). Interest and pleasure as dimensions of aesthetic response. *Empirical Studies of the Arts, 8*, 1-14.

Cupchik, G. C., & Winston, A. S. (1996). Confluence and divergence in empirical aesthetics, philosophy, and mainstream psychology. In M. P. Friedman, & E. C. Carterette (Eds.), *Handbook of perception and cognition, cognitive ecology* (pp. 61-85). San Diego, C.A.: Academic Press.

Cupchik, G. C., Vartanian, O., Crawley, A., & Mikulis, D. J. (2009). Viewing artworks: Contributions of cognitive control and perceptual facilitation to aesthetic experience. *Brain and Cognition, 70*, 84-91.

Evans, J. B. T. (2007). *Hypothetical thinking: Dual processes in reasoning and judgment*. Hove: Psychology Press.

Eysenck, H. J., & Castle, M. (1970). Training in art as a factor in the determination of preference judgments for polygons. *British Journal of Psychology, 61*, 65-81.

Fechner, G. T. (1876). *Vorschule der aesthetik*. Leipzig: von Breitkopf & Hartel.

Hekkert, P., & van Wieringen, P. C. W. (1996). Beauty in the eye of expert and nonexpert beholders: A study in the appraisal of art. *American Journal of Psychology, 109*, 389-407.

Hekkert, P., Peper, L. E., & van Wieringen, P. C. W. (1994). The effect of verbal instruction and artistic background on the aesthetic judgment of rectangles. *Empirical Studies of the Arts, 12*, 185-203.
Hekkert, P., Snelders, D., & van Wieringen, P. C. W. (2003). “Most advanced, yet acceptable”: Typicality and novelty as joint predictors of aesthetic preference in industrial design. British Journal of Psychology, 94, 111-124.

James, W. (1890/1950). The principles of psychology. Dover: New York.

Kahneman, D. (2011). Thinking fast and slow. New York: Farrar, Straus, and Giroux.

Kerns, J. G., Cohen, J. D., MacDonald III, A. W., Cho, R. Y., Stenger, V. A., & Carter, C. S. (2004). Anterior cingulate conflict monitoring and adjustments in control. Science, 303, 1023-1026.

Leder, H., Belke, B., Oeberst, A., & Augustin, D. (2004). A model of aesthetic appreciation and aesthetic judgments. British Journal of Psychology, 95, 489-508.

Leder, H., Gerger, G., Dressler, S. G., & Schabmann, A. (2012). How art is appreciated. Psychology of Aesthetics, Creativity, and the Arts, 6(1), 2-10.

Liston, C., Malaton, S., Hare, T. A., Davidson, M. C., & Casey, B. J. (2006). Anterior cingulate and posterior parietal cortices are sensitive to dissociable forms of conflict in a task-switching paradigm. Neuron, 50, 643-653.

Miller, E. K., & Cohen, J. D. (2001). An integrative theory of prefrontal cortex function. Annual Review of Neuroscience, 24, 167-202.

Mullennix, J. W., Foytik, L. R., Chan, C. H., Dragun, B. R., Maloney, M., & Polaski, L. (n.d.). Automaticity and the processing of artistic photographs. Empirical Studies of the Arts.

Rougier, N. P., Noelle, D. C., Braver, T. S., Cohen, J. D., & O’Reilly, R. C. (2005). Prefrontal cortex and flexible cognitive control: Rules without symbols. Proceedings of the National Academy of Sciences of the United States of America, 102(20), 7338-7343.

Schmidt, J. A., McLaughlin, J. P., & Leighton, P. (1989). Novice strategies for understanding paintings. Applied Cognitive Psychology, 3, 65-72.

Schneider, W., & Shiffrin, R. M. (1977). Controlled and automatic human information processing: I. Detection, search, and attention. Psychological Review, 84(1), 1-66.

Shiffrin, R. M., & Schneider, W. (1977). Controlled and automatic human information processing: II. Perceptual learning, automatic attending, and a general theory. Psychological Review, 84(2), 127-190.

Silvia, P. J. (2013). Interested experts, confused novices: Art expertise and the knowledge emotions. Empirical Studies of the Arts, 3(1), 107-115.

Smith, E. R., & Collins, E. C. (2009). Dual-process models: A social psychological perspective. In J. B. T. Evans, & K. Frankish (Eds.), Two minds: Dual processes and beyond (pp. 197-216). Oxford: Oxford University Press.

Sridharan, D., Levitin, D. J., & Menon, V. (2008). A critical role for the right fronto-insular cortex in switching between central-executive and default-mode networks. Proceedings of the National Academy of Sciences of the United States of America, 105(34), 12569-12574.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. Journal of Experimental Psychology, 18, 643-662.

Tresiman, A.M., & Gelade, G. (1980). A feature-integration theory of attention. Cognitive Psychology, 12, 97-136.

van Veen, V., & Carter, C. S. (2006). Conflict and cognitive control in the brain. Current Directions in Psychological Science, 15(5), 237-240.

Vartanian, O. (2009). Variable attention facilitates creative problem solving. Psychology of Aesthetics, Creativity, and the Arts, 3, 57-59.

Wickens, C. D. (1991). Processing resources and attention. In D. L. Damos (Ed.), Multiple-task performance (pp. 3-34). London: Taylor & Francis.

Winston, A. S., & Cupchik, G. C. (1992). The evaluation of high art and popular art by naive and experienced viewers. Visual Arts Research, 18(1), 1-14.

Wundt, W. M. (1974). Grundzüge der physiologischen psychologie. Leipzig: Wilhelm Engelmann (Reprinted Bristol: Thoemmes Press, 1999).

Zabelina, D. L., & Robinson, M. D. (2010). Creativity as flexible cognitive control. Psychology of Aesthetics, Creativity, and the Arts, 3, 136-143.

Appendix A

1. Have you ever worked as a photographer or have you ever been paid for doing photographic processing (i.e., darkroom, Photoshop)?
2. Have you ever exhibited photographs in a public venue such as a gallery, or have you ever had photographs published in a newspaper, magazine, or website?

3. Have you ever submitted photographs to a contest?

4. When you take photographs, do you manually set features on your camera such as the ISO, white balance, aperture, or shutter speed?

5. When you take photographs, do you observe the “Rule of Thirds”?

6. Have you ever taken a class in photography?

7. Do you have any training in visual arts such as painting or sculpture?

8. Have you ever taken lessons in visual arts such as painting or sculpture?

9. Have people commented on your talent in painting or sculpture?

10. Have you won a prize or prizes at a juried art show?

11. Have you ever had a showing of your artwork in a gallery?

12. Have you ever sold a piece of artwork?

13. Has your artwork ever been critiqued in a local publication?

14. Has your artwork ever been critiqued in a national publication?

Note: Questions 7–14 are based on the CAQ Visual Arts subset

Appendix B

A few example stimuli from the present study, with ratings from the five semantic differential scales from the present study (1-9 scale).

| Photograph #8 | Unpleasant-Pleasant | Simple-Complex | Abstract-Concrete | Unfamiliar-Familiar | Uninteresting-Interesting |
|---------------|---------------------|----------------|-------------------|--------------------|-------------------------|
|               | 4.59                | 5.63           | 2.74              | 3.44               | 4.56                    |
| Photograph #12|                     |                |                   |                    |                         |
|               | 5.07                | 6.30           | 2.48              | 4.37               | 5.33                    |
| Photograph #13|                     |                |                   |                    |                         |
|               | 6.48                | 3.19           | 6.44              | 7.07               | 6.48                    |
| Photograph  | 5.52 | 5.52 | 2.74 | 4.11 | 6.30 |
|-------------|------|------|------|------|------|
| Photograph  | 3.67 | 2.74 | 7.85 | 4.00 | 3.85 |
| Photograph  | 8.26 | 2.63 | 8.00 | 8.48 | 7.37 |