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Effects of attention and color on motion perception in Rorschach inkblot interpretation

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Abstract

Visual perception facilitates quick reactions to ambiguous stimuli, a crucial survival characteristic in threat appraisal of unfamiliar circumstances. The current study investigated the impact of attention focusing on motion interpretation of ambiguous Rorschach Inkblot images displayed in black or red. Participants focused attention on three characteristics of 4 discrete priming images: identity, color, and motion. Each combination of prime and attentional focus was presented individually and in random order, and then participants were asked to describe a Rorschach Inkblot in open ended form. Motion interpretation was operationalized by the number of responses indicating that an ambiguous inkblot was perceived as in motion. The results showed that conscious focus on anticipating motion of a static image ascribes motion characteristics to a subsequent ambiguous image. We also observed a gender specific interaction, such that males focusing on color responded with fewer motion responses, but only when the inkblot was red. These results offer preliminary findings to help reduce threat appraisal in novel and ambiguous circumstances.

Keywords: ambiguous interpretation, motion, attention, red, gender difference, Rorschach, inkblot

Effects of Attention and Color on Motion Perception in Rorschach Inkblot Interpretation

Visual perception is an adaptive survival characteristic for efficient reactions to stimuli, as rapid interpretation of ambiguous situations is crucial for survival in some instances (Sussman, Jin, & Mohanty, 2016). Through rapid interpretation, related concepts are activated in an individual's mind. This primes their mind to mobilize mental and physical resources at a later time, contingent on a specific motor behavior necessary in that circumstance (Vallverdu, 2014). This behavior could be something as simple as blinking an eye after perception of an incoming projectile. At times, though, heightened anxiety can elicit quick, but incorrect, interpretations of an ambiguous image or situation as threatening. When individuals are exposed to situations involving unfamiliar cultural or societal novelties, they are required to interpret such ambiguous situations. This may result in stigmatization of unfamiliar cultures or individuals, which can impact initial encounters, spanning a wide range of situations, such as job interviews or simple communication at the grocery store. State affect, such as anxiety, modulates this interpretation (Hadwin, Frost, French, & Richards, 1997). To combat potential bias in interpreting ambiguous stimuli, a greater understanding of factors that influence such perception must be achieved.

Two central mechanisms of visual perception are used by the brain to interpret ambiguous visual stimuli: top-down and bottom-up processing (Katsuki, & Constantinidis, 2014; Braun, 1994; Folk, Remington, & Johnson, 1992). Bottom-up processing involves focusing on the basic elements of the stimuli to build a larger impression (Itti & Koch, 2000). In regard to visual perception, through bottom-up processing, the interpretation of a stimulus is predominately driven by physical features that can be visually perceived. In contrast, top-down processing identifies ambiguous stimuli through cognitive interpretation within the context of prior experiences (Connor, Egeth, & Yantis, 2004). It relies on semantic knowledge and expectations to construct a coherent interpretation of what is being viewed. This holistic interpretation of images is used, for example, when individuals perceive faces, to such an extent that faces can be seen in other non-living objects (DeGutis, Wilmer, Mercado, & Cohan, 2013; Taubert, Apthorp, Aagten-Muphy, & Alais, 2011; Tanaka, & Simonyi, 2016). The evolutionary importance of this is demonstrated through infants' automatic recognition of faces, and the fact that it is difficult for people to isolate individual features when perceiving a single face, instead seeing it holistically (Hole, 1994). Further, there is evidence that top-down, holistic processing is used in perception involving attention to stimuli features, for example, the direction and color of dot apertures (Zanto, Rubens, Bollinger, Gazzaley, & 2010). Interpreting novel stimuli is a complex process, which incorporates both the bias of observers and their previous knowledge, including recent contextual attention.

One outcome of top-down processing is that humans will often interpret ambiguous stimuli based on context, prior experiences, or implicit activation of associated concepts through priming. In a classic paradigm, the Rorschach Inkblot test, features such as direction (representative of motion) and color are seen in the coding used by clinicians to interpret patient responses. The Rorschach inkblot test was originally derived for psychoanalysis in the treatment of mental health illnesses, and it was thought to reveal repressed emotions and unconscious conflicts which precipitated an individual's condition. Despite this original use, is has now been largely abandoned by modern clinicians as a diagnosis paradigm (Wood, Lilienfeld, & Nezworski, 2000). Instead, ambiguous interpretation of these images is used to offer insight into implicit thoughts and attitudes of individuals, including revealing impulsivity and increased activity (hyperkinesia) (Saraiva, & Ferrirea, 2016). For example, children who struggle to control their activity, indicative of increased fight-or-flight arousal and threat appraisal, report seeing movement and the execution of behavior in static Rorschach Inkblot images (Yazigi, & Nashat, 2012). Similarly, in the absence of clarity, attending to features, such as motion, results in threat interpretation in post-traumatic stress disorder patients (Viglione, Towns, & Lindshield, 2012). These implicit thoughts are revealed by unconscious interpretation during ambiguity, such as the Rorschach Inkblot test, and are driven by specified attention, necessitating top-down incorporation of contextual stimuli to make an interpretative judgment.

A key component to interpreting ambiguity is manifested when attention is focused on individual features. For example, during the Rorschach Inkblot test, the ambiguous images can be categorized as static or in motion based on whether or not movement is perceived to be occurring, and this perception is vulnerable to neurological priming, which can temporarily activate brain regions that alter interpretation and performance in associated tasks (Grossman et al., 2000). A corollary to this phenomenon is seen in the Mozart effect, wherein listening to music improves short-term memory performance in spatial reasoning through activation of prefrontal, temporal, and percutaneous brain regions (Jenkins, 2001). Similarly, exposure to visual primers can alter cognition, biasing identification of ambiguous images depending on the neurological area (Leeper, 1935). In addition to neurological activation, priming involves retrieval of preexisting memories, including remembrance of visual components and physiological recall of how movements are conducted (Daelli, Rijsbergen, & Traves, 2010; Akavia, 2013). Physiological memory can be translated into short-term working memory and re-experienced by the observer, possibly resulting in kinesthesia, the phenomenon that causes the action to be experienced internally through parallel muscle contractions, even when the priming image is static (Exner, 1969). Thus, when focusing on movement elements of priming images, people may be more likely to experience kinesthesia when interpreting the target inkblots similar to the manner in which implied action is seen to promote motion perception of static images (Kourtzi, & Kanqisher, 2000).

The human mirror neuron system (MNS), which is activated by watching another engage in activity, is one factor that permits visual priming to exert kinesthetic influence, in that an individual will feel the physiological effects of muscle tension despite perceiving static images (Gao, Bentin, & Shen, 2015). Cognitive rehearsal of observed motion in the observers' working memory results in the stimulation of the corresponding MNS, such that an individual experiences a sense of embodied simulation (Freedberg, & Gallese, 2007). This can occur in the absence of actual observed motion when individuals project intentions, thoughts, or emotions onto those they observe within a priming image, which activates similar cortical circuits to those fired during their own performance of the same activity (Kilner and Lemon, 2013; Porcelli, Giromini, Parolin, Pined, & Viglione, 2013). This is consistent with research showing that internal factors, such as current state of awareness, can alter perception (Carter, Snyder, Fung, & Rubin, 2014). As a result, this awareness, through motion anticipation, can result in motion perception; more motion (M) responses reported when interpreting Rorschach inkblots will reflect this (Rapaport, Gill, & Schafer, 1946). This is demonstrated in children who grew up in threatening or abusive environments, who report more M responses than those who do not have such upbringings (Opaas and Hartmass, 2013), suggesting that anxiety manifested from attentiveness to an adverse stimulus can illicit perception of motion and motility in ambiguous, static images. Therefore, perception of motion is more likely to result in the interpretation of a threat under ambiguous circumstances.

While state of affect, such as anxiety, is seen to increase M responses to the Rorschach Inkblot test, M responses can also be influenced by color. For example, threat appraisal is prompted by exposure to the color red, thereby inducing anxiety (Jacobs and Suess, 1975; Moller, Elliot, & Maier, 2009). During prompted threat appraisal, participants' speed of movement and strength have both been seen to increase (Nakshian, 1964; O'Connell, Harper, & McAndrew, 1985), suggesting a fight-or-flight response in preparation to combat a threating stimuli.

Based on research supporting the importance of color and cognitive assessment in the appraisal and understanding of ambiguous stimuli, we hypothesized that focusing on motion elements of priming images would result in increased reporting of M responses to Rorschach Inkblot images via pre-activation of MNS and the autonomic nervous system. We additionally hypothesized that inkblots displayed in red would elicit greater motion responses than inkblots displayed in black, with the most M responses reported when participants viewed red inkblots after focusing on motion of a visual prime. This study aimed to supplement the understanding of how perception during everyday interactions may be biased towards motion perception when viewing ambiguous stimuli. Additionally, this study aimed to provide preliminary information regarding the use of attention techniques during novel situations or ambiguous interactions to reduce threat perception through a reduction in perceived motion. The potential implications of the current research could extend to improving contacts and introductions in diplomatic, professional, and social capacities.

Method

Participants

Eighty-four individuals (65 female), ages 18-73, gave informed consent to participate in the current study. Participants were offered an opportunity for extra credit in a psychology course of their choice if they were an Albright student. This study was approved by the IRB of

Albright College. There were an additional six participants who were excluded from the study because they failed to answer quality control questions correctly.

Materials

Data was collected via SurveyMonkey. Images depicting the most common responses to Rorschach’s Inkblots (Burstein, & Loucks, 1989; Piotrowski, 2013; Dana, 2000) located on cards two, three, five, and seven, were used as visual primes to establish judgmental context among participants (Figure 1). Rorschach’s Inkblots (cards two, three, five, and seven) were presented in either red or black, depending on condition (Figure 2).

Procedure

Participants were informed that after viewing and labeling an image, they would view an inkblot and be asked to report their interpretation. Participants were randomly divided into two groups that would see the inkblots in either black or red. Each trial consisted of instructions about what feature to attend to for the prime, the priming image itself, the target stimuli, and then an open-ended question. There were four sets of image combinations consisting of the common-answer image (prime) followed by the corresponding Rorschach Inkblot (target). To draw focus to a specific feature (color, motion, or object identification), participants were randomly asked one of three questions when viewing each prime: "what is the main color of this image?” (color); "what will result from the action depicted in this image?” (motion); and "identify the object(s) that you see in this image" (object identification). After using the preceding questions to focus attention on aspects of the priming image, participants viewed the corresponding target Rorschach Inkblot. Participants answered an open-ended question asking what they believed they saw in the inkblot. If participants left blank the question boxes, or answered control questions inappropriately, they were excluded from the study. Participants viewed each of the four prime-inkblot combinations three times, each time with a different preceding question to alter attention focus (color, motion, or object identification) in a randomized order. After all twelve trials were viewed, participants completed a demographic form asking for gender, age, ethnicity, and whether they categorized themselves as having an anxious personality.

Analysis

Motion interpretation was evaluated through coding of open-ended responses received from participants when asked to report what they saw in the ambiguous Rorschach Inkblot image. This was used as a way to operationalize threat appraisal. An indication that the participant interpreted that an image was in motion was made through their use of one or more verbs. The report and use of any verb in the open-ended response was coded as an M response. No use of a verb was coded as a static (non-motion) response. Number of M responses were summed for each separate attention condition, resulting in three within-participant data values differentiated by prompt accompanying priming image. This was how we operationalized threat appraisal.

Results

To test the hypothesis that attention and color would influence motion responses, a 3 (attention focus) x 2 (inkblot color) mixed design ANOVA analyzed the total number of motion responses for each of the three focus conditions within participants, and the effects of inkblot color between participants (Figure 3). The means and standard deviations for all treatment conditions are displayed in Table 1. Results showed a significant main effect for attention $F(2, 81) = 4.051$, $p < .05$. Consistent with prior research, a post hoc Tukey test showed that the participants focusing on motion anticipation reported significantly more motion responses than participants attending to color at $p < .01$ (but not to object identification). There was no significant main effect of inkblot color and no interaction effect. This suggests that anticipating motion places participants in a judgmental context that promotes the perception of movement when viewing an ambiguous stimulus.

To control for the potential confound of gender, an additional 3 (attention focus) x 2 (blot color) x 2 (gender) ANOVA was conducted. Two participants were removed from the analysis because they did not identify gender. The means and standard deviations for all treatment conditions are displayed in Table 2. Similar to the first ANOVA, results showed a main effect of attention focus, $F(2,77) = 4.407$, $p < .05$, but not a main effect of blot color, $F(1,77) = 1.692$, $p = .197$. Additionally, results showed a significant 3-way interaction between attention, blot color and gender, $F(1,77) = 5.947$, $p < .01$. When primed to focus on color, males reported fewer motion responses when interpreting red inkblots than males primed to focus attention on color in the black inkblot stimuli group. In contrast, when primed to focus on color, females reported a greater number of motion responses when interpreting red inkblots than females primed to focus attention on color in the black inkblot stimuli group. When primed to focus on and anticipate motion, males reported a greater number of motion responses when interpreting red inkblots than motion anticipation-primed males in the black inkblot stimuli group. Similarly, when primed to anticipate motion, females reported a greater number of motion responses when interpreting red inkblots than motion-primed females in the black inkblot stimuli group, but with a larger degree of difference between inkblot color groups. This interaction is displayed in Figure 4. This analysis suggests that gender may serve as an influencing factor during the interpretation of ambiguous inkblots that vary in color and deviate from simple black display. No other main effects or interaction effects were significant.

To control for the potential confound of baseline anxiety, a 3 (attention focus) x 2 (self-reported anxiety) mixed design ANOVA was conducted. The means and standard deviations of motion responses for all treatment conditions are displayed in Table 3. Results showed a significant main effect of attention similar to that of the first ANOVA, $F(2,81) = 4.208$, $p < .05$. Results showed no significant main effect of anxiety $F(1,81) = 0.711$, $p = .401$. Participants self-reporting having a personality high in anxiety did not indicate more M responses than individuals who self-reported having low anxiety. Results showed no significant interaction effect between attention condition and anxiety $F(2, 81) = 0.081$, $p = .922$. This suggests that self-reported trait anxiety may not affect quantity of motion responses under different attention focus conditions and, therefore, should not be considered a confound in the current study.

Discussion

Our results suggest a significant difference in motion responses reported after viewing an ambiguous stimulus when participants focused on different aspects of a prime, specifically when concentrating on elements of motion. This supports our primary hypothesis that the act of anticipating motion will increase motion responses reported in Rorschach Inkblot interpretations. This is consistent with findings by Maldonato and Dell'Orco (2013), who observed speculating the potential action of an object activates mirror neuron systems that serve as the basis for embodied simulation, which is evident even with the use of static images (Akavia, 2013). Since a priming image can initiate a fight or flight response prior to viewing an ambiguous stimulus through parallel activation of the automatic nervous system, this perceived motion is a way to operationalize threat appraisal. This detection is evolutionarily advantageous for accurate and efficient threat identification, permitting a protective response since the individual will be primed for movement. While this could result in a threat detected in error, the cost benefit ratio still ensures that a potential danger can be recognized even when it is not in motion.

Contrary to expectations, we did not observe an overall increase in M responses when the target inkblots were red, as opposed to black. In daily life, the color red has been used to represent danger and threat (e.g. signs, alarms, ambulances, etc.). With this association, red would be expected to increase threat perception, and subsequent motion responses (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001).

Our results suggest anxiety did not influence motion perception, possibly because of how it was operationalized. While previous research has found that state anxiety leads to an elevated stress response (Jakovcevski, Schachner, and Morellini, 2008), we only considered a self-report of generalized trait anxiety. Future research should consider the use of standardized measures of anxiety, such as the Implicit Association Test of Anxiety (Schmukle and Egloff, 2004), which is independent of state affect and evaluates an anxious personality more objectively. Additionally, further research on this subject should evaluate whether the red inkblot altered state anxiety, using quantitative measures such as pulse rate and galvanic skin response.

Our results did not support the secondary hypothesis that there would be an interaction effect between motion anticipation and inkblot color. Participants interpreting red inkblots did not report significantly more motion responses nor did we show an additive effect between red inkblot display and motion anticipation. We did, however, observe a novel, significant interaction between attention focus and inkblot color when considering gender. These findings, however, are preliminary and should be investigated further. This interaction was most profound between males and females when focusing on color of the priming image. When viewing the red ambiguous inkblot, males reported significantly fewer motion responses after focusing their attention on color than females. For the male population, red is additionally associated with sexual readiness, arousal, and attraction (Setchell, 2005; Elliot & Niesta, 2008), all of which contribute to positive associations (Puccinelli, Chandrashekaran, Grewal, & Suri, 2013). By focusing attention on color, interpretation of the red ambiguous stimuli may have been implicitly biased towards mating and attraction, as opposed to motion and threat appraisal as hypothesized.

Motion perception, like interpretation of all other visual stimuli, occurs through a combination of bottom-up and top-down processing. Previous research suggests that females rely more on bottom-up processing while male visual perception is largely driven by holistic integration and interpretation of schemas and themes within visual stimuli (Meyers-Levey, & Tybout, 1989; Meyer-Levey, & Mashewaran, 1991). If this gender difference exists, having participants focus on color may have interfered with the holistic, automatic interpretation of the image for males more so than females. Cognitive interference can alter automatic processing, as famously illustrated by the Stroop effect (Stroop, 1935), in which reaction time and accuracy are impaired when participants have to report the color of text, when the word itself is spells the name of a different color. The automatic and implicit processing of reading words interfered with accuracy of color report. This disruption of automaticity offers a potential explanation for the interaction effect displayed when males focused on the color of the prime. In the Stroop task, parallel processing mechanisms are used in visual perception, and language comprehension is needed for participants to focus on and label color (Kaschak et al., 2005). Focusing on discrete elements of the priming stimulus may have distracted males during inkblot interpretation. As a result, the bottom-up processing stream may have been more likely to be activated. Deviation from holistic, top-down processing may have resulted in interference that caused males to report fewer motion responses.

Further research should assess this potential gender difference in the influence of color when focusing on discrete elements of stimuli. Cognitive differences between males and females are widely noted, for example, lateralized componential processes, such as language have differential effects on working memory depending on gender (Szaflarski et al., 2012; Bishop, 2013). Similarly, previous research has demonstrated greater spatial (Kaufman, 2007) and object (Lejbak, Crossley, & Vrbancic, 2011) working memory for males compared to females, who demonstrate greater working memory geared towards linguistic skills (Bae, Choy, Geddes, Sable, & Snyder, 2000; Lewin, Wolgers, & Herlitz, 2001). With male working memory slightly biased towards elements of spatial relations and objects identity, priming associated with these areas may be more readily activated. Conversely, for males more so than females, attention to specific, individual attributes of an image (such as color) results in weaker cortical activation in temporal and parietal lobes, which are associated with spatial processing and navigation (Bell, Wilson, Wilman, Dave, & Silverstone, 2006). In our study, weaker activation when focusing on the color of a priming image may have reduced motion interpretation for males because of the shared cortical brain regions used in both motion perception and spatial understanding.

In sum, our findings suggest that perception and anticipation of motion can be altered through simple focus techniques. Since motion perception is associated with threat appraisal, one potential application of this research is determining how to minimize threat appraisal in social situations that are ambiguous in nature, especially between disparate cultures (Jansson, Johanson, & Ramstrom, 2007). We identified key factors that could minimize motion interpretation of an ambiguous stimulus, specifically on what to focus on before a novel encounter or ambiguous situation. Our results suggest that, in novel social circumstances, all parties should be sensitive to focusing on motion. Individuals portraying themselves in a manner that prompts motion anticipation in the observer may increase the likelihood they will be perceived as threatening. Future research may explore this avenue through investigating whether simple postural changes reduce perceived threat. The current research additionally suggests a need for investigating gender differences that may mitigate threat appraisal, and if supported, the need for gender-sensitive techniques if attempting to alter threat perception in novel situations.

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Table 1.

Mean and Stand Deviations of Motion Responses for Black and Red Inkblot Following Attention Directed to Color, Motion Anticipation, and Identification

	Red Inkblot		Black Inkblot	
Motion Responses	*M*	*SD*	*M*	*SD*
Color Attention	1.577	1.184	1.318	0.910
Motion Anticipation	1.885	1.121	1.489	0.985
Identification Attention	1.641	1.063	1.489	1.020

Table 2.

Mean and Standard Deviations of Motion Responses According to Inkblot Color and Gender with Each Level Separated by Attention Focus

	Red Inkblot				Black Inkblot			
	Male		Female		Male		Female	
Motion Responses	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Color Attention	0.667	0.516	1.6935	1.212	1.637	0.674	1.212	0.96
Motion Anticipation	1.833	0.753	1.887	1.195	1.727	0.786	1.409	1.042
Identification Attention	1.667	0.817	1.613	1.116	1.591	0.801	1.455	1.092

Table 3.

Mean and Standard Deviations of Motion Reponses Across Attention Conditions for Participants with High and Low Anxiety Based on Participant Self-Report.

	High Anxiety		Low Anxiety	
Motion Responses	*M*	*SD*	*M*	*SD*
Color Attention	1.337	1.075	1.556	1.027
Motion Anticipation	1.609	1.069	1.778	1.072
Identification Attention	1.500	0.983	1.653	1.120

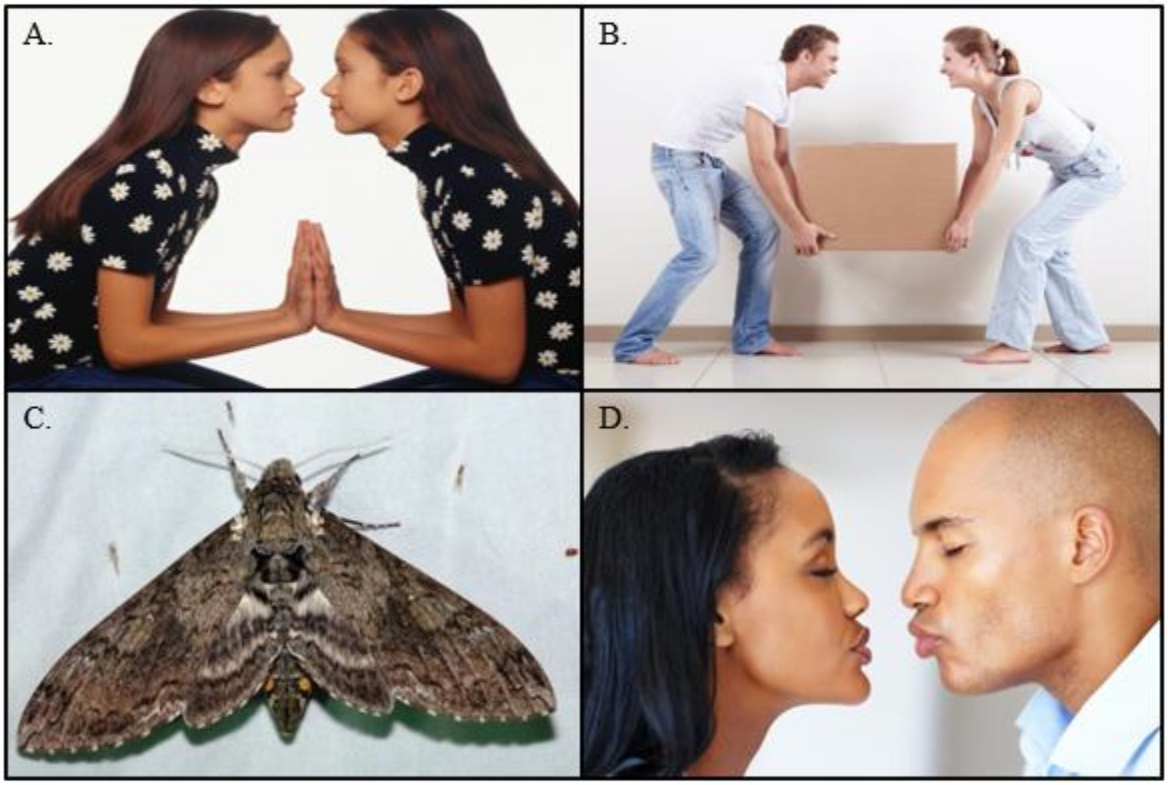

Figure 1. Images used as visual primes. Panel A represents card two (Penoyar). Panel B represent card three (LuckyImages). Panel C represents card five (Larson, 2016). Panel D represents card seven (Squaredpixels).

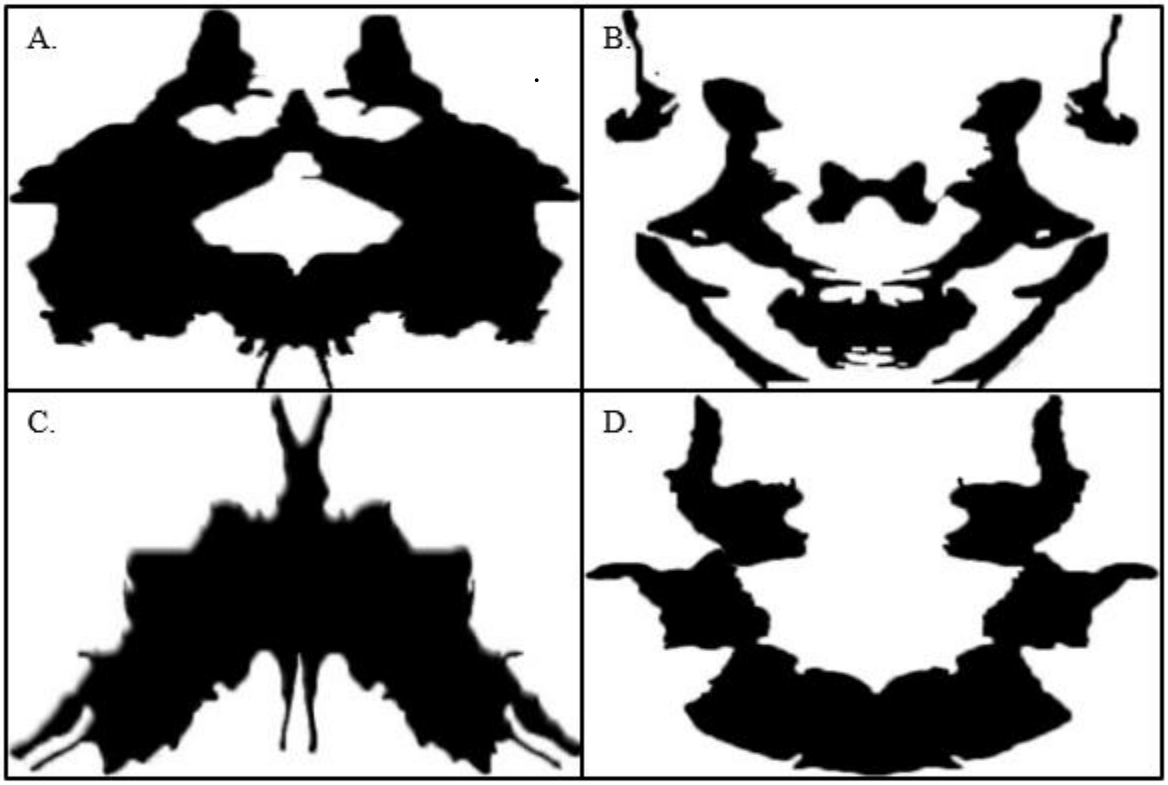

Figure 2. Rorschach Inkblot Images. Panel A shows card two. Panel B shows card three. Panel C shows card five. Panel D shows card seven.

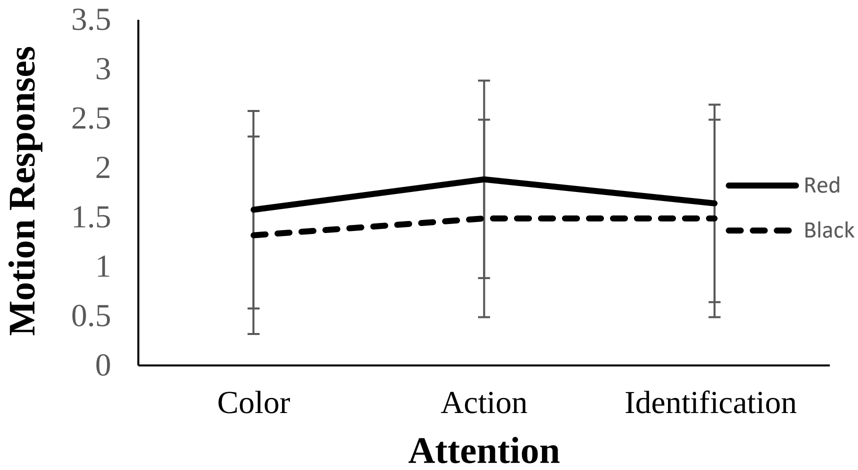

Figure 3. Total number of inkblot responses reported under three focusing conditions. There was a significant difference of focus condition, driven by the difference between focusing on action and focusing on color. When primed to focus on action, participants reported greater number of motion responses, $p < .01$.

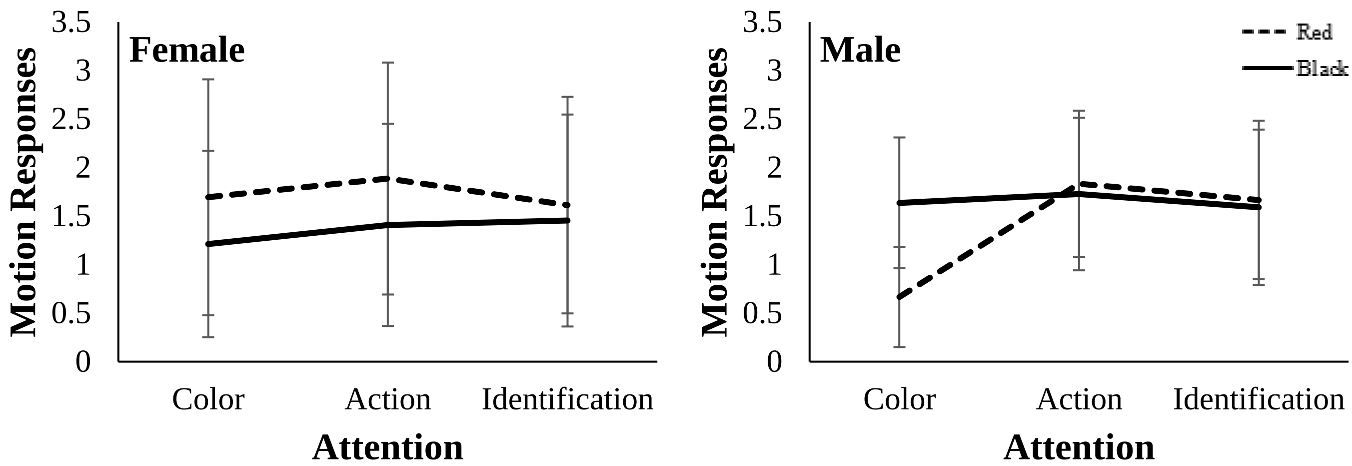

Figure 4. Total number of motion responses reported to inkblot image displayed in either red or black across three attention conditions. Graphs separate female and male participants. The 3-way interaction was significant, $p < .01$