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CAN CIGARETTE CUES HAMPER THE ABILTY OF A DEPENDENT SMOKER TO CORRECTLY IDENTIFY A TARGET?

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Abstract

Emotionally salient stimuli can have direct and powerful impacts on an individual's attention. Previous studies have demonstrated that negative or emotional stimuli create an attentional bias that has the ability to negatively affect an individual's immediate thought processing. Similarly, the current study investigated whether exposure to smoking images could be as distracting as negative images (e.g. mutilated bodies) for dependent smokers. The present study used rapid serial visual presentation (RSVP) to show participants 17 images in succession (1ms/image) and then asked the participant to identify the direction the target image was rotated (a building rotated 90° to the left or right). A trial consisted of a stream of landscape pictures with either a neutral, negative, or cigarette image as a critical distractor located either 2 or 8 images after the target image. After each trial, the participant was asked if the target image was rotated to the left or the right. We hypothesized that participants would be less accurate in target rotation identification in the smoking and negative conditions when compared to the neutral condition. The results indicated that smoking cues do not have a significant, negative effect on a smoker's ability to identify a known target. Smoking and neutral conditions yielded comparable results; however the negative condition impaired the participants mean accuracies and increased their reaction times in the lag 2 position. It was discovered that mean reaction time was more dependent on the condition of the critical distractor, rather than the placement and increased when the participant was presented with a negative distractor rather than a smoking or neutral distractor. Mean accuracy was more dependent on the placement of the critical distractor. At lag 2 mean accuracy was decreased in the negative condition; however at lag 8 all conditions were comparable.

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Introduction

It is known that emotional stimuli often distract individuals and interfere with their focus on a particular task (Chun, Most, Witters & Zald, 2005). Many studies have shown that attentional task performance is negatively affected when emotional or arousing stimuli are presented among task relevant stimuli (Chun et al., 2005). Emotional stimuli can monopolize an individual's attention and hamper one's ability to observe surrounding activity (Chun et al., 2005). While it is known that certain stimuli are universally effective at impeding attentional capability, very few studies have evaluated an attentional bias in specific clinical populations.

Knowing that personal preference influences whether or not an individual finds certain stimuli arousing, we were curious to see if smoking stimuli could cause a decrease in attentional task performance in dependent smokers. It is evident that cigarette smoking is a strong addiction associated with significant cognitive and biological effects (Benowitz, 2010). The question we are exploring in this study is just how attention grabbing a smoking image will be to a dependent smoker. It is possible it could be as effective as emotional stimuli due to the subjects smoking addiction, or results could be more comparable to neutral stimuli because cigarettes lack the instinctive response induced by negative stimuli. Through this research we attempted to discover the effect that smoking stimuli has on a smoker's attention and how distracting and thought consuming these stimuli are.

Attention is a very difficult thing to measure effectively and consistently. Often researchers use response time to study how effective a certain stimulus is at taking the focus away from an assigned task (Fox, Russo, Bowles, & Dutton, 2001). Selective attention is crucial in defining the distractive quality of a stimulus (Fox et al., 2001). When an individual is focused on a certain task, his or her attention is primarily attending to the task and

peripheral stimuli seemingly go unnoticed (Dijksterhuis & Aarts, 2009). However, unknowingly, many individuals are distracted from important tasks by irrelevant, emotional stimuli (Chun et al., 2005). This study focuses on just how strongly irrelevant stimuli can influence task performance.

Human behavior, and therefore attention, is usually based on particular goals. Individuals realize what they want and act upon that instinct (Dijksterhuis & Aarts, 2009). Whether it is a simple decision like ordering a slice of pizza over a hamburger or something of greater importance such as purchasing a house, most individuals will report their choice as a completely conscious decision (Dijksterhuis & Aarts, 2009). However, many underestimate the significant role the unconscious mind plays in these conclusions. In 2005, Custer & Aarts illustrated this concept. They had participants partake in pre-tested activities that were deemed neutral such as puzzles or going for a walk. They then conditioned these activities by using positive, negative and neutral words that participants could consciously detect, however not link to the associated activities (Custers & Aarts, 2005). The results revealed that the participants wanted to participate in the positively conditioned activities, but showed little interest in the negative and neutral conditioned activities (Custers & Aarts, 2005). The overall idea taken from their research is when behaviors become unconsciously associated with a positive effect the task becomes goal-like and individuals are motivated to participate (Custers & Aarts, 2005).

The unconscious also plays a substantial role in an individual's attention (Dijksterhuis & Aarts, 2009). Attention is often regarded as the ability to focus on one thing despite thousands of other irrelevant things in one's environment (Dijksterhuis & Aarts, 2009). A person is constantly processing thousands of sensory stimuli from their eyes, ears and skin

(Andreasen, 2010). If one did not have the ability to ignore and filter out irrelevant stimuli, accomplishing tasks would be nearly impossible due to the constant distractions. In fact, a portion of the brain is dedicated to this exact issue (Coon & Mitterer, 2010). The reticular formation in the brain is associated with the task of ignoring repeated or irrelevant stimuli while remaining sensitive to novel or valuable stimuli (Coon & Mitterer, 2010).

The decision of whether information is attended to and processed on a higher level is determined by bottom up and top down processing (Dijksterhuis & Aarts, 2009). Bottom up attentive processes are involuntary and usually stimulated by instinctive or learned importance and relevance (Dijksterhuis & Aarts, 2009). Most attention is given through top down processes which are usually more goal orientated (Dijksterhuis & Aarts, 2009). Therefore, salient information associated with a particular goal will receive a larger amount of attention than information that is irrelevant to that goal (Dijksterhuis & Aarts, 2009). Dijksterhuis and Aarts used the example of one who is thirsty: in a thirsty individual, drinks are going to receive more attention when compared to items one cannot drink. Ultimately, goals are the main drive behind directing attention and certain things in the attentional span will not be processed consciously (Dijksterhuis & Aarts, 2009). However, that does not denote their influence on the decision process.

Many recent articles confirm the ability of unconsciously processed stimuli to have an effect on behavior. Despite that the stimulus remains outside of conscious awareness, its influence can be effective pending that some degree of attention is paid (Dijksterhuis & Aarts, 2009). Wegner & Smart (1997) distinguished between different levels of attention and consciousness. The two most intriguing and effective levels were the deep activation state and surface activation (Wegner & Smart, 1997). In deep activation, stimuli is attended to but does

not enter consciousness and in surface activation stimuli are not attended to but do enter consciousness, such as a day dream (Wegner & Smart, 1997). Accordingly, stimuli in both the conscious and unconscious mind can be important in decision making and formulating ideas and opinions (Dijksterhuis & Aarts, 2009).

An individual can allocate his or her attentional preference to certain stimuli in order to achieve a specific or underlying goal (Dijksterhuis & Aarts, 2009). It has been suggested through research that the main parts of the brain that guide and manipulate attention are the prefrontal cortex, the anterior cingulate cortex, and the posterior parietal cortex (Dijksterhuis & Aarts, 2009). Working memory tasks seem to be distributed among these brain structures and they all play a role in consciousness. Therefore, both conscious and unconscious goals rely on the same structures to designate attention and complete tasks (Dijksterhuis & Aarts, 2009). This indicates that a constant struggle exists between unconscious and conscious goals which have to compete for an individual's attention (Dijksterhuis & Aarts, 2009). Consequently, attention can be dedicated to a task an individual is unaware of which can possibly hurt his or her ability to achieve a conscious goal (Dijksterhuis & Aarts, 2009). Unconscious goals are driven by attention that operate on high cognitive levels but do not enter consciousness (Dijksterhuis & Aarts, 2009). This statement is the reasoning behind the ability of emotional images to distract individuals despite not having that individual's full attention. These arousing images, especially those that are negative, cause a detrimental effect on an individual's visual processing and performance of identifying other, non-emotional targets (Chun et al., 2005). Steve Most, a researcher at the University of Delaware has extensively studied the topic of selective attention and published his findings on the effects of emotional stimuli on the attention span. In one study (Chun et al., 2005) participants were required to search for a target

within a set of pictures presented in rapid serial visual presentation (RSVP) (Chun et al., 2005). In each RSVP set an emotionally negative or neutral image would be presented either 2 or 8 images before the target image (Chun et al., 2005). Their results showed that an attentional bias to emotional stimuli did exist and caused a negative effect on the participant's ability to accurately identify a target (Chun et al., 2005). Also, this effect was more significant when the emotional image preceded the target image by 2 images rather than 8 (Chun et al., 2005).

From this study, it can be concluded that an attentional bias does exist when viewing negative stimuli and can temporarily impair an individual from processing information relating to an assigned task (Chun et al., 2005). However, the researchers did suggest that this phenomenon could be partially controlled by individual personality factors (Chun et al., 2005). Previous research has also found that high attentional load can reduce the processing of relevant stimuli (Chun et al., 2005). In one study, certain attentional strategies strengthened control over preferential attention in those with certain personality types when specific information about the target was revealed (Chun et al., 2005). All participants, when unsure of their targets, experienced attentional bias when faced with emotional stimuli; however, when given a specific target to identify, different personality traits contributed to the ability to filter out emotional stimuli (Chun et al., 2005). It was also proposed that if given a very specific target, this attentional control could have been achieved by more, if not the majority of the participants (Chun et al., 2005).

They also discovered that placement was an important factor in determining accuracy, as accuracy suffered significantly when the emotional stimuli was presented closer to the target (Chun et al., 2005). This too is believed to be linked to the individual's personality and ability to disengage from negative stimuli (Chun et al., 2005). Despite the personality difference,

performance suffered among all participants when the critical distractor was shown 2 pictures before the target image as opposed to 8 images before (Chun et al., 2005).

Emotionally arousing stimuli has been used to distract the general population, but what if a certain stimulus was used to target the attention of a particular subset of people? In this study we specifically targeted smokers and used images of cigarettes as possibly arousing stimuli.

Currently, about 45 million Americans smoke tobacco and overall smoking related diseases cause 1 in every 5 deaths (Benowitz, 2010). The majority of smokers, about 70%, claim they would like to quit, but 80% of smokers who attempt to quit return to smoking within a month, and only 3% successfully quit each year (Benowitz, 2010). These extreme statistics are most likely due to the psychological and physiological power cigarettes have on addicted individuals.

Nicotine, when inhaled via tobacco, has a substantial effect on cholinergic receptors which ultimately control the release of neurotransmitters (Benowitz, 2010). The neurotransmitter considered to cause the strongest physiological addiction is dopamine (Benowitz, 2010). Dopamine leads to feelings of pleasure and is most likely the critical reinforcer for self-administration of nicotine and other drugs such as cocaine, amphetamines, and methamphetamines (Tsapakis, Guillin, Murray, 2003). However, nicotine is not the sole culprit in smoking addiction. Inhaling tobacco also stimulates monoamine oxidases which catalyze the metabolism of dopamine, norepinephrine and serotonin (Benowitz, 2010). Cigarette smoke has been shown to inhibit monoamine oxidase, therefore slowing the metabolism of dopamine and increasing the body's sense of pleasure (Benowitz, 2010).

Tolerance is also a driving force in the detrimental and powerful effects of nicotine

(Benowitz, 2010). Desensitization of the nicotinic receptor is most likely the cause behind nicotine tolerance (Benowitz, 2010). Research has shown that withdrawal symptoms begin in smokers when desensitized receptors become responsive during periods of withdrawal, which essentially causes physiological feelings of cravings (Benowitz, 2010). Once the smoker resumes smoking the receptors receive the nicotine and the feelings of withdrawal and craving subside (Benowitz, 2010).

Psychological ties to smoking, such as conditioned behavior, are also powerful factors in smoking addiction (Benowitz, 2010). An article in the New England Journal of Medicine on smoking addiction states that, "the urge to resume is recurrent and persistent long after the withdrawal symptoms dissipate" (Benowitz, 2010, p. 2298). This means that despite alleviation of physiological symptoms, over the years a smoker associates moods, situations, activities and other aspects of life with the pleasure of smoking, making them personal "smoking cues." These "smoking cues" have a strong ability to trigger relapse (Benowitz, 2010).

With these extensive physical and emotional addictive qualities, it is not surprising that research has shown that drug users dedicate much of their focus and attention to drug related cues (Littel & Franken, 2010). In attention tasks such as the emotional stroop, dual-task procedures, and attentional cueing tasks, an attentional bias to drug related stimuli has been demonstrated in multiple substance abuse disorders, including nicotine addiction (Littel & Franken, 2010). In a study done by Littel and Franken in 2010, they attempted to define whether this smoking related attentional bias was explicit, implicit or both. They also wanted to discover if most smokers are hypersensitive to emotional images compared to the average non-smoker, which could possibly explain sensitivity to smoking cues (Littel & Franken,

2010). They hypothesized that smokers would not exhibit hypersensitivity to emotional stimuli, but an attentional bias would occur when presented with smoking related stimuli or "cues" in both implicit and explicit conditions (Littel & Franken, 2010). The results supported this theory: when smoking related stimuli was inserted into a stream of neutral images, it attracted the smoker's attention (Littel & Franken, 2010). Also, when the smokers were instructed to pay attention to non-smoking cues, they "unintentionally and automatically" paid attention to the smoking stimuli (Little & Franken, 2010). They also found no significant difference in response to emotional stimuli in smokers vs. non-smokers (Little & Franken, 2010). Ultimately, these two pieces of information suggest that smokers exhibit an attentional bias to smoking related stimuli that cannot be attributed to hyper-reactivity to emotional stimuli but to smoking stimuli alone (Littel & Franken, 2010). Their results also highlight the ability of smoking cues to alter attentional processing in situations where smoking is explicit or implicit (Little & Franken, 2010).

Another popular task that measures attentional bias is the dot-probe task (Salemink, Van den Hout & Kindt, 2007). In this task, two stimuli, one neutral and one specific, are presented side by side on a computer screen (Salemink et al., 2007). They are presented for a short, predetermined length, and then disappear and a dot is presented in the location of one of the former images (Salemink et al., 2007). Participants are instructed to immediately indicate where the dot is located once it appears. If the participant's accuracy and reaction time are improved when the dot is located in the previous position of a specific stimulus, it is often thought that that image created an attentional bias or preference (Salemink et al., 2007). Often this task is used in those with emotional disorders such as depression or anxiety to understand how emotionally relevant stimuli affect their attention (Salemink et al., 2007).

In a study published in 2002, researchers were interested to see if the dot task, when used with smokers and smoking stimuli, would provide comparable results to those obtained using individuals who suffer from emotional disorders and emotional stimuli (Ehrman, Robbins, Bromwell, Lankford, Monterosso, O'Brien, 2002). The results were consistent with previous research done on smoking stimuli and cue reactivity. As expected, current smokers showed a biased attention toward smoking related stimuli (Ehrman et al., 2002). Former smokers showed an intermediate level of attentional bias toward smoking stimuli, but former smoker's results did not significantly differ from either the current smokers or non-smokers results (Ehrman et al., 2002). After initial data analysis multiple confounds such as age were discussed, as the smokers group was significantly younger than the former smokers and nonsmokers groups which could have contributed to reaction time differences (Ehrman et al., 2002).

Since previous research has demonstrated that emotional stimuli and relevant stimuli can create a negative effect on an individual's attention, we tried to capitalize on this idea and see if we could format this theory to pertain to our research on smoking and addictions. We accomplished this by investigating whether exposure to smoking images could be as distracting as negative images in dependent smokers. The results of the study could provide insight on whether an attentional bias toward smoking-related stimuli does exist in dependent smokers and if so, how influential that bias is.

Methods

Subjects

A total of six dependent smokers were used as participants in this study. They were recruited using flyers and radio advertisements around the State College area. There was an

equal gender distribution (three male, three female) and the mean age was 31.8 with a range of 20-44 (SD = 22.6). All participants were Caucasian. The participants smoked an average of 12.67 (SD= 3.66) cigarettes per day and were pre-screened and deemed eligible for the study. Participants received $10 per hour and the entire study (which contained other tasks not associated with this thesis) took approximately 2.5 hours. They also had the opportunity to earn 10 additional dollars depending on their performance on a working memory task that was irrelevant to this thesis. All subjects signed a written, informed consent form and the study was approved by the Institutional Review Board through The Pennsylvania State University.

Apparatus and stimuli

The RSVP task was created and presented using E-Prime version 2.0. The program was run on a Dell Computer with a 17 inch monitor. The images used in the RSVP task were taken from three different sources. The neutral and negative images were taken from the International Affective Picture System (IAPS), the smoking pictures were taken from the International Smoking Image Series (ISIS) (Gilbert & Rabinovic, 2003) and the target pictures were architectural pictures obtained using Flickr creative commons (Lang, Bradley & Cuthbert, 2008). All pictures were formatted to 400 x 600 images using Adobe photo shop and overall 56 emotionally negative, neutral and smoking images were used along with 252 landscape or architectural images and 84 target images. The emotionally negative pictures obtained through IAPS had a mean valence of 1.84.

Response time was recorded by having the participants indicate on a computer keyboard which way a target image was rotated using the right and left arrow keys. Responses were recorded to the closest 10^{th} of the second.

Procedure

Subjects reported to the laboratory, located in 213 Ritenhour on Penn State University's campus, for a single testing session. The study consisted of one session that included demographic and smoking related questionnaires, a working memory task, the RSVP task, and a MOT (multiple object tracking) task. Only the results of the RSVP task are discussed in this thesis.

Participants were greeted by the experimenter, given both a written and verbal informed consent, and once consent was given through a signature, the participant's carbon monoxide breath level was taken using a carbon monoxide monitor. To be eligible for the study the carbon reading must equal or exceed 10 parts per million. If the participant's carbon monoxide level was qualifying, females were asked to take a pregnancy test to ensure they were not pregnant, as smoking has been associated with causing negative health effects on a fetus (Zdravkovic, 2005).

If the participants still qualified after carbon breath and pregnancy testing, they were instructed to smoke a cigarette of their preferred brand in a ventilated room created for this purpose. This was to ensure that all participants were at the same level of deprivation when completing the tasks. Once they were finished smoking, the experiment commenced. First, the participants completed demographic and smoking related questionnaires on the computer, followed by a working memory task, the RSVP task, and a MOT task.

The RSVP task consisted of 17 images presented for 100 msec (Figure 1). All of the images were upright landscape or architecture images expect for two images: the target image and the critical distractor. Depending on the trial, the critical distractor was placed either 2 or 8 images before the target image. These conditions will be referred to as lag 2 and lag 8

positions. Overall there were six different conditions: the distractor 4th, with the target lag 2 or lag 8; the distractor 6th, with the target lag 2 or lag 8; or the distractor 8th, with the target lag 2 or lag 8 (Figure 1).

Once the participant was ready to begin the RSVP task, the experimenter read the instructions from a prepared script which emphasized that the target image would be a rotated architectural or landscape image, the importance of accurately identifying the direction the image was rotated, and not to get distracted by other images. The participants first completed 16 practice trials that contained no images used in the actual experiment to accustom them to the task. Once the actual task began each participant completed 6 blocks of 28 trials. Because each image was only presented for 100 msec, each trial was extremely fast, approximately 1.7 seconds. After each trial they were informed to indicate if the target image was rotated to the left or the right using the arrows on the keyboard. After each block of 28 trials they were informed of the percentage of the experiment they had completed and the remaining blocks they had yet to complete. Overall the task was approximately 25 minutes. After the RSVP task was completed, they alerted the experimenter and the session continued with a MOT task.

Figure 1.

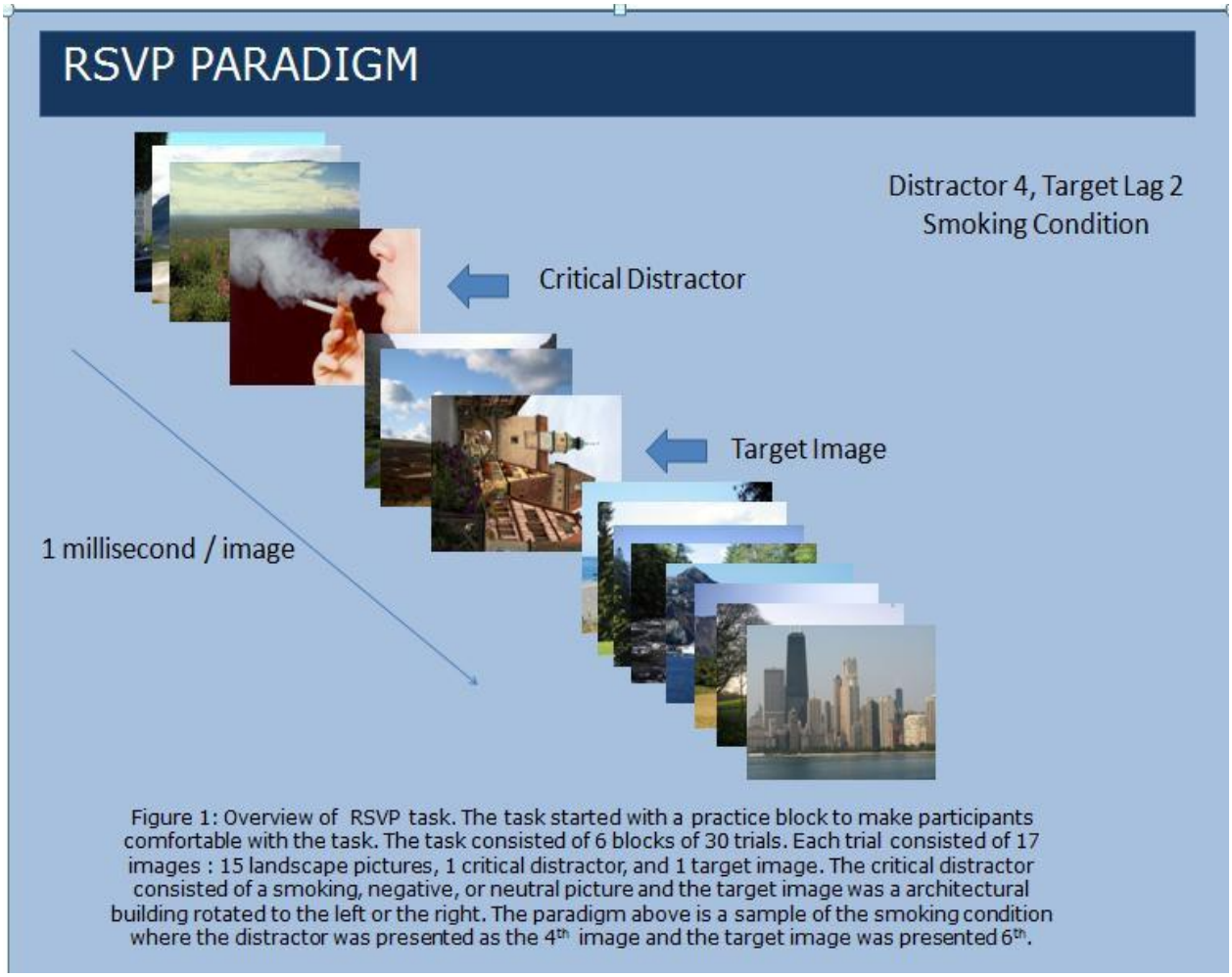


Figure 1: Overview of RSVP task. The task started with a practice block to make participants comfortable with the task. The task consisted of 6 blocks of 30 trials. Each trial consisted of 17 images : 15 landscape pictures, 1 critical distractor, and 1 target image. The critical distractor consisted of a smoking, negative, or neutral picture and the target image was a architectural building rotated to the left or the right. The paradigm above is a sample of the smoking condition where the distractor was presented as the 4th image and the target image was presented 6th.

Results

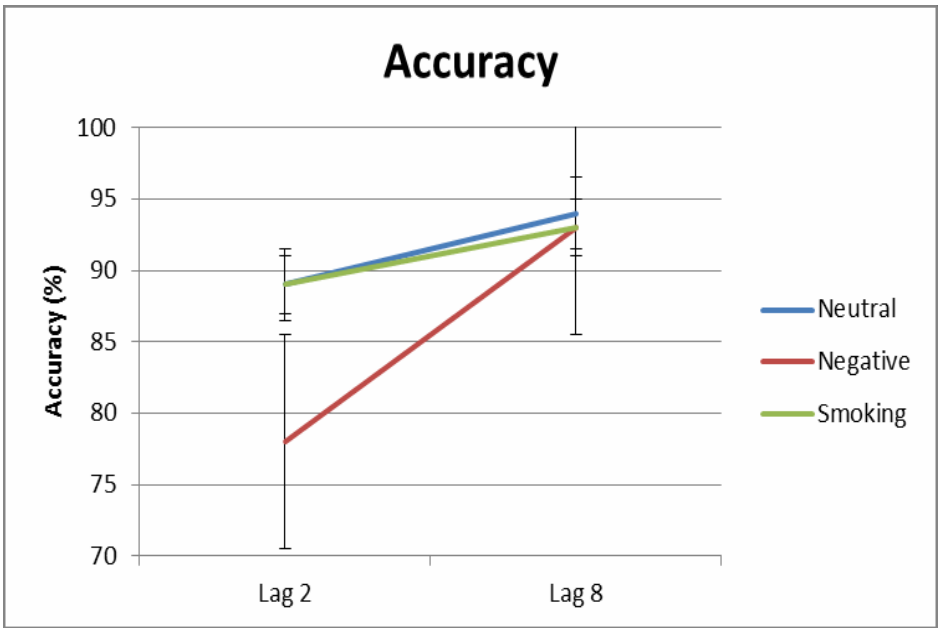
Mean Accuracy

The results indicated that mean accuracy varied based on the placement of the critical distractor. The placement of the critical distractor at lag 2 caused a significant effect on mean accuracy which was driven primarily by the negative condition (Graph 1). When the critical distractor was placed in the lag 8 position, mean accuracy increased and was comparable in all

conditions. Though the negative condition possesses the strongest correlation, the neutral and smoking conditions showed the same trend. Ultimately, mean accuracy was negatively impacted when the critical distractor was placed in the lag 2 position, but was unaffected in the lag 8 position ($F(1, 5) = 40.33$, p value=.001, $\eta p2 = .890$).

At lag 2, mean accuracy varied based on the condition of the critical distractor. In the negative condition mean accuracy was the lowest at 78% with a standard deviation of 12%. The negative and neutral conditions yielded nearly identical results with mean accuracies at lag 2 of 89% with the neutral condition having a standard deviation of 9% and the smoking condition having a standard deviation of 5%. However, at lag 8, participants' mean accuracies were comparable in all conditions. The smoking and negative condition both had mean accuracies of 93% (negative, SD = 10%; smoking, SD = 5%) and the neutral condition had a mean accuracy of 94% (neutral, SD = 3%).

Graph 1.



Graph 1. The graph demonstrates the relationship between the accuracy of the individual's responses and the placement and condition of the critical distractor. Accuracy is lowest when the image is negative and presented lag 2. At lag 8, all conditions provided comparable results.

Reaction Time

The results indicate that mean reaction times vary based on the condition of the critical distractor, the relationship again being driven by the negative condition ($F(2, 4) = 24.33$, p-value = .006, $\eta p2 = .925$). However, it is noted that in the negative condition reaction times are more delayed at lag 2 than at lag 8.

At lag 2, neutral and smoking conditions were similar (neutral, M = 539.4 ms, SD = 72.4ms; smoking, M =583.2 ms, SD = 72.4) and negative conditions yielded longer reaction times (negative, M = 766.2 ms, SD = 118.4 ms). At lag 8, participants' reaction times were comparable in the smoking and neutral conditions (smoking, M =543.5 ms, SD = 65ms; neutral, M = 578.4 ms, SD = 122.2 ms); and higher in the negative condition (M = 627.4, SD = 87.3 ms).

Graph 2.

Graph 2. This graph demonstrates the relationship between the participant's reaction time and the placement and condition of the critical distractor. The negative condition drives this relationship, as seen in the graph. This shows that when the target is placed lag 2, the individual's reaction time is increased in the negative and smoking conditions, but decreased in the neutral condition.

Conclusions

Contrary to our hypothesis, smoking cues did not have a significant, negative effect on a smoker's ability to identify a known target on the RSVP task. In the negative condition, participants showed the lowest mean accuracies and highest mean reaction times in the lag 2 position. Smoking and neutral conditions yielded comparable results in both mean accuracy and reaction time.

Mean reaction times were more dependent on the condition of the critical distractor than the placement of the distractor. Reaction time was increased when the participant was presented with a negative distractor rather than a smoking or neutral distractor. The smoking condition followed a similar trend but results were not significant. Mean accuracy was more dependent on the placement of the critical distractor; at lag 2 there was a discrepancy between

the negative condition and the smoking and neutral conditions. At lag 8, all conditions were comparable.

Discussion

Our results showed that smokers do not seem to be significantly affected by cigarette stimuli when trying to complete an attention based task. These results disagreed with our hypothesis, as we believed the smoking condition and negative condition would yield similar results. There are multiple potential explanations for the results of the experiment.

One possible explanation could be that we had the participants smoke before completing the experiment. In order to ensure that all participants had the same level of deprivation we had participants smoke a cigarette after all primary tests were passed prior to the experiment. However, after accessing the effects cigarettes have on human physiology, we may have been giving the participants an advantage. Previous research has revealed that nicotine administration in various forms enhances certain aspects of human performance such as motor ability, memory, learning, and sustained attention (Parrott & Roberts, 1991). This change is physiologically based on the ability of nicotine to activate cholinergic neurons which increase acetylcholine in the cerebral cortex causing heightened arousal and information processing (Parrott & Roberts, 1991). In fact, in 1983 Wesnes and Warburton conducted a study that has been confirmed by subsequent research showing that cigarette smoking and nicotine tablets improve performance on rapid serial information tasks (Wesnes & Warburton, 1983). Multiple studies have also suggested that nicotine has the ability to increase accuracy and speed across all tasks due to its stimulant properties (Provost & Woodward, 1991). Different dosages of nicotine have also been used to see if performance is affected by varying nicotine levels and have had inconsistent results. Therefore, the results of our study may have

varied greatly if participants were told to abstain for a number of hours. Ultimately, if the study was done using three group conditions a clearer view of the effects of smoking stimuli on a smoker's attention could have been assessed by ruling out the confound of nicotine level. If one group was instructed to smoke just prior to the study, one group was instructed to abstain from smoking for 6 hours, and another group was instructed to abstain from smoking for 12 hours, the results in each group many have been significantly different and could have exposed the effect of nicotine level on performance.

As noted in the introduction, attention is largely determined by goals (Dijksterhuis & Aarts, 2009). Because we allowed the participants to smoke just prior to the study, all had high levels of nicotine and the tasks that were conducted before the RSVP task showed low levels of craving. These low levels of craving suggest that many smokers did not have a strong urge to smoke. Therefore, smoking was most likely not one of their personal goals at that moment. Perhaps if they had been deprived, the smoking images would have correlated to their personal goals at the moment (i.e. wanting to smoke) and would have captured their attention more strongly, impairing their results. It is possible that because smoking was not a priority at the time, the negative images, which could be associated with a common goal of avoiding harm, caused a much greater attentional bias and impairment in performance. However, if the participants had been deprived for 12 hours, smoking may have been an important goal at the time and the attentional bias caused by smoking stimuli may have been stronger.

Another caveat in the experimental design was that no reward was offered for accurate completion on this task. Studies have shown that performance based rewards have a much stronger effect on performance than completion rewards (Aronson, Wilson & Akert,

2010). Because the participants knew they would receive the same compensation whether they intently focused on the RSVP task or paid minor attention to it, most participants were most likely not very motivated to focus on the task. This is a possible explanation because some results of the experiment are not consistent. The overall results of the study suggested that all conditions presented at lag 2 had a much greater effect on the participant's performance than when placed in the lag 8 positions. However, in mean reaction time for the neural condition, mean reaction times increased in the lag 8 positions (Graph 2). This inconsistency could be an example of low focus on the task and the possible reason why only extremely negative images had an effect on the participant. If a reward was given for accuracy on this task the participants would have most likely allotted more focus to the RSVP task and results may have been more consistent with our hypothesis.

Many studies have used negative stimuli as a comparison to other stimuli in order to determine which was most "attention grabbing." In all studies I researched, negative stimuli always had an overpowering attentional bias when compared to other stimuli in the experiment (Van Dillen & Koole, 2009). These results are seen across multiple different tasks and stimuli. Whether in the form of a threatening face or a gruesome picture, negative stimuli causes the most attentional bias and performance impairment (Van Dillen & Koole, 2009). This universal bias has been linked back to the primary instincts of our ancestors (Van Dillen & Koole, 2009). The theory of the automatic vigilance mechanism has claims that this strong attention to negative stimuli has essentially been programed within humans due to natural evolution (Van Dillen & Koole, 2009). For primitive man, this attentional bias was most likely important to survival and though the world has rapidly changed, evolution has yet to adjust and that is why anxiety and this attentional bias still exist (Bishop, 2007). Due to the extreme

power of negative stimuli, which has been embedded within the human mind for generations, to assume other stimuli could attain such an attentional bias is reaching. Also, our mean valance for negative images was a 1.84, meaning most of our images were highly disturbing such as decapitated bodies, rape victims, and surgery images. In retrospect, for smokers who were not in a deprivation state, it seems very plausible that these negative images would cause a much larger attentional bias than smoking stimuli. Results may have been more consistent with our hypothesis if we had chosen less jarring negative stimuli such as faces showing negative expressions.

Another aspect that was not completely controlled in our study was severity of smoking addiction. Although all smokers had been smoking 10 or more cigarettes for at least 1 year or more, the variability between subjects was notable. For example, one participant smoked an average of 12 cigarettes per day for 26 years while another smoked an average of 20 cigarettes a day, but only for 3 years. This gap in addiction could have contributed to the inconsistencies in our results.

In a study done at the University of North Carolina, it was discovered that while active smokers show sensitivity to smoking cues in attention based tasks, severity of the smoking habit greatly influences the correlation (Chanon, Boettiger, Sours, 2010). This information complicates the application of our results and suggests our results would have been more consistent if we made the requirements more precise. While that would have lowered external validity, it may have provided our results with a more accurate definition of the relationship between smoking stimuli and a smoker's attentional ability. It could have also demonstrated if the relationship varied by addiction level.

Our results were consistent with our hypothesis in the sense that the negative and

smoking conditions would cause more significant negative effects when the target image was placed in the lag 2 position rather than the lag 8. Other studies have found similar results showing that an attentional blink is apparent when presenting the target soon after the distractor; however, this impairment is no longer present when the target is delayed for 8 images (Chun et al., 2005). This importance of placement in mean accuracy shows the short but essential time necessary for one's attention to adjust and processes a distracting image. This delay in processing is most likely due to the brains inclination to direct attention to salient or emotional stimuli rather than emotionally neutral stimuli (a rotated building) (Ciesielski, Armstrong, Zald & Olatunji, 2010).

This shows that while attention is fixated on an emotional image it causes a processing interference with succeeding images. However, once the emotional stimulus has been processed, attentional abilities are revamped. Therefore, when the target image was presented at lag 2, the participant was most likely still partially focused on the critical distractor. This could have consequently made the participant unable to direct all of his or her attention to processing the target image and correctly identifying the direction it was rotated (Ciesielski et al., 2010).

This information could be beneficial to smokers who are attempting to quit, showing that high attentional load can ultimately deter an individual's focus to achieve a goal. Before a serious attempt to quit smoking, one should sort out and organize his or her life to lower stress load and speak to friends and family about support to help minimize distractions which lead to a high risk of relapse.

Personality has also been suggested to be a possible factor in performance abilities on attention based tasks (Chun et al., 2005). In 2001, a pencil and paper study was done using

small pictures of clocks set at different times as the paradigm. The participants were told to mark all the clocks that were set at 5 o'clock in a predetermined amount of time (Necka & Szymura, 2001). While the majority of clocks were simply distractors set at random hours, distractors were considered to be those set at 4 o'clock (Necka & Szymura, 2001). Using this experimental model, it was discovered that neurotic individuals committed more errors than the average, stable participant (Eliasz, Hampson & Raad, 2005). In another study done by the same research group, the speed of recognition and the detection process also were significantly different in neurotic individuals when compared with norms (Eliasz et al., 2005). The results ultimately showed that neurotic individuals consistently score lower mean accuracies as well as greater mean reaction times on attention based tasks (Eliasz et al., 2005). Neuroticism has also been suggested to play a role in the development of cigarette smoking and therefore, it is very possible that some of our subjects could have been considered neurotic individuals.

Introverts and extroverts also seem to have significant differences in performance on attention based activities (Eliasz et al., 2005). Notoriously, introverts prefer well practiced tasks, while extroverts crave environmental stimuli and would be most interested in novel tasks (Eliasz et al., 2005). In studies done comparing introverts and extroverts, attentional ability results have been varied. However, research has shown that introverts generally outperform extroverts in attention based tasks (Eliasz et al., 2005). This is especially seen in easy tasks rather than difficult tasks, which supports the hypothesis that introverts enjoy well practiced, simpler tasks (Eliasz et al., 2005).

Personality has been hypothesized to play a role in cognitive tasks and has been shown to provide some volitional control over the attentional blink (Chun et al., 2005). While it is

known that a high attentional load causes impairments in processing stimuli, this phenomenon can vary in severity due to personality traits (Chun et al., 2005). Preferential processing despite a high attention load can be mildly controlled by attentional strategy (Chun et al., 2005). However, this ability is modulated by individual personality traits (Chun et al., 2005).

Chun et al. (2005) proposed that harm avoidance was a specific personality trait that contributed to one's ability to control this emotional blink. Those characterized as high harm avoidance, even when given information about the specific target, were unable direct all of their attention to the indicated target and were continually distracted by irrelevant, emotional stimuli (Chun et al., 2005). However, those considered to be low harm avoidance, when given information about a specific target, could use this knowledge to aid them in ignoring extraneous stimuli (Chun et al., 2005). Ultimately, trait anxiety seems to have an overall negative effect on attentional control which leads to a longer fixation on negative stimuli and decreased task performance.

Overall it seems personality can be a powerful contributor to attentional control and performance on attention based tasks. Accordingly, various personality traits could have contributed to the results of our study presenting possible confounds. It also appears that many of the personality traits involved in attentional control are common in many smokers (Mroczek, Spiro, Turiano, 2009). Smoking has been linked to personality traits such as neuroticism and trait anxiety and therefore many of our subjects may have been anxious and/or neurotic (Mroczek et al., 2009). This could explain why there was such a large gap in accuracy and response time between the smoking and negative conditions. Those who are anxious or neurotic would most likely identify as high harm avoidance and therefore possess an increased sensitivity and reaction to negative stimuli. Because negative stimuli innately

suggests harm, those categorized as high harm avoidance would feel a greater to pull towards a harm inducing image rather than a smoking image which many smokers would associate with calming or positive pleasure feelings. Therefore, future studies should assess personality traits to reduce the ambiguity behind the causation of results and individual attentional control should be evaluated.

Outside of the lab, the information attained from this study could contribute to identifying smokers who have a high risk of relapse as well as providing individual coping strategies. This information could also be beneficial in investigating if a link exists between the severity of smoking habits and performance on the RSVP attention task. Cue induced craving is a common precipitant to relapse, even over physiological symptoms of withdrawal such as insomnia, headaches and nausea (Benowitz, 2010). This alludes to a strong psychological component of nicotine addiction and the ability to filter out cigarette cues may be an extreme advantage in quitting attempts.

Although our results did not show a significant relationship between smoking stimuli, accuracy, and mean reaction time; other factors could have led to these results. It seems dependent smokers do have a small inclination, especially in mean reaction time, to have an increased attentional bias toward cigarette images when compared to neutral images. An interesting addition to this study that would aid in clarifying this relationship would be administering the RSVP task to nonsmokers and determining if a significant difference exists in mean accuracy and reaction time in smokers vs. nonsmokers in the smoking condition of the task. It would also be beneficial to determine the effect of smoking stimuli on abstinent smokers to see if nicotine level had an effect on performance.

A further development of this study could be used to help individual smokers build

attentional control over cigarette cues and possibly identify certain smokers as high or low risk candidates for smoking relapse. This could be beneficial in aiding smokers who are particularly susceptible to cue induced relapse to encourage them to avoid situations where they will be faced with personal or explicit smoking cues. While our data did not fully support our hypothesis, this study provided a base of knowledge for future research to expand upon.

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Academic Vita

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Schreyer Honors College
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UNDERGRADUATE POSITIONS:

Penn State University – University Park, PA August 2010-Present
Mammalian Anatomy Teaching Assistant
- Prepare teaching materials to lead discussion in laboratory section and office hours
- Evaluate examinations and manage grading
- Prepare dissections, specimens, and anatomical models for learning

The Smoking Research Lab at Penn State University – University Park, PA January 2010 - Present
Undergraduate Research Assistant
- Screen participants for eligibility, run experiments, schedule screenings and MRI scanning visits

PRESENTATIONS: **Penn State University Undergraduate Exhibition –** University Park, PA April 2011
- Presented Honors Thesis, "Can cigarette cues hamper the ability of a dependent smoker to correctly identify a target?"

INTERNSHIPS/FELLOWSHIPS:

Foundation for the International Medical Relief of Children - Las Delicias, El Salvador June 2011
Summer International Health Fellowship
- Volunteered with program aimed at aiding the healthcare needs of low income communities
- Administered immunizations, measured blood pressure and blood sugar, evaluated heart and lung sounds
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ACTIVITIES: **Gamma Phi Beta International Sorority**
Ritual Chair Woman/Active Alumnae
- Organized, implemented, and led events to cultivate membership education

FOTO, THON Organization
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