The Effects of Rhythmic and Arrhythmic Eye Movements on Memory Recall

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The Effects of Rhythmic and Arrhythmic Eye Movements on Memory Recall

A thesis submitted in partial fulfillment of the requirement for the degree of Bachelors of Arts in Psychology from The College of William and Mary

by

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Abstract

Eye-Movement Desensitization and Reprocessing (EMDR), a therapy that treats many trauma-related disorders by requiring patients to perform rapid eye movements, has raised controversy because it lacks the support of a proven theoretical rationale. A recent theoretical explanation proposes that the eye movements reduce the vividness of the distressing images by disrupting the function of the visuospatial sketchpad (VSSP) of working memory, but support for this model has been weakened by methodological flaws that the current study attempted to overcome. The present study compared the effects of tracking rhythmic and arrhythmic stimuli on the recall of arousing television shock-ads. Eye-movement conditions did not significantly differ in terms of vividness, emotionality, or accuracy of memory as compared to the control condition. Arrhythmic targets increased the negative emotional response and decreased the vividness of the memories, but neither rhythmic nor arrhythmic target patterns produced responses that differed from the control condition. Heart rate recordings taken throughout the study did not suggest that arousal mediates the relationship between eye-movement patterns and vividness. The present study does not support the VSSP theory but provides valuable insights on the direction of future research.
The Effects of Rhythmic and Arrhythmic Eye Movements on Memory Recall

In 1989, Francine Shapiro introduced Eye Movement Desensitization and Reprocessing (EMDR) as a treatment for psychological trauma. As described by Shapiro (1995), EMDR is a nondirective therapy during which clients experience brief but highly intense exposure to traumatic memories. During the therapy, the client is asked to focus on the distressing memory, the associated cognitions, and any physical sensations related to their anxiety. While doing so, the client is instructed to move his or her eyes laterally for about 15 to 20 s, following the therapist’s moving finger or pointer. These sessions continue until the client reports that a desensitization of the traumatic memory has occurred and that positive self-cognitions have replaced the previously-existing negative self-cognitions. Many researchers have found that EMDR reduces the symptoms of not only PTSD but also produces clinical change on a variety of other measures such as anxiety, depression, global distress, and dimensions of personality (Lazrose, Triffleman, Kite, McGlasshan, & Rounsaville, 1998; Levin, Lazrose, & van der Kolk, 1999).

Although EMDR has proven to be popular, researchers have questioned the efficacy of the treatment. Herbert and Meuser (1992) believe that much of the research investigating EMDR is methodologically flawed, specifically by the absence of appropriate controls. Another cause for concern is that there is, as yet, no plausible theoretical rationale to support it (Tallis & Smith, 1994). Initially, some researchers explained the therapy by claiming that it is merely an exposure therapy. However, the methodology of EMDR therapy is unlike that of other exposure therapies. EMDR’s high-intensity exposures, incomplete exposure to all details of the target experience, and nondirective approach distinguish it from other exposure therapies, making this theory unlikely (Rogers and Silver, 2002.)
Shapiro (1995) claims that EMDR is not simply an exposure therapy and explains the beneficial effects of EMDR by her Adaptive Information Processing Model. Her model purports that eye movements help adaptively process the traumatic event. Eye movements catalyze biochemical rebalancing of the nervous system, which shifts information that is trapped in the central nervous system. Although it sounds logical, Allen and Lewis (1996) found this model to be neurobiologically implausible. Shapiro’s explanation is further refuted by the observation that the effects of EMDR remain the same when eye movements are replaced by other tasks such as finger tapping (Cahill, Carrigan, & Fueh, 1999.)

A more plausible working memory theory has recently emerged as a candidate. The VSSP theory uses the working memory model to explain the role that eye movements play in EMDR. Baddeley (1986) describes the working memory as being made up of a central executive (CE) and two temporary storage systems – the phonological loop (PL), which processes auditory information, and the visuospatial sketchpad (VSSP), which manages visual and spatial information. The PL and the VSSP both have a limited capacity, meaning that they have a finite amount of resources that can be utilized when attending to auditory or visual tasks respectively. This implies that if a person attempts to recall a complex visual memory while concurrently performing another visuospatial task, the amount of visual information about the memory that can be held in the working memory will be reduced. Andrade, Kavanagh, and Baddeley (1997) propose that loading the VSSP with another visuospatial task while recalling a memory will decrease not only the vividness but also the emotionality of that memory. When the memory moves from the working memory to long term memory, the loss in vividness will result in less of an emotional impact when recalled later. Eye movements have been found to disrupt visuospatial working memory (Idzikowski, Baddeley, Dimbleby, & Park, 1982). Thus, the
effects of EMDR could be explained as a result of the competition for VSSP resources between the eye movements and the traumatic memory.

The VSSP theory has emerged to be one of the most prominent theoretical rationales for EMDR, as evidenced by the growing body of literature supporting the theory (Andrade et al., 1997; Kavanagh, Freese, Andrade, & May, 2001; Kemps & Tiggemann, 2007; Van den Hout, Muris, Salemink, & Kindt, 2001). Although the theory appears logical and well-supported, methodological flaws become apparent after examining the research. First, VSSP theorists often prompt participants to recall emotional autobiographical memories while concurrently performing eye movements. While some participants may recall a minor negative experience, others may think of a traumatizing event (Kemps & Tiggemann, 2007). Relying on the recall of autobiographical memories means that the researchers cannot control for individual differences in the memories, such as how distressing they are.

In addition, previous researchers utilized a repeated-measures design in which the participants performed all of the eye movement conditions. Since all the participants performed eye movements, it is difficult to compare the effect of eye movements versus mere exposure. The researchers were also unable to exclude the possibility that the results were affected by participants’ expectancies. Requiring the participants to perform both the treatment and the control conditions left open the possibility that the participants determined the true nature of the study and were affected by demand characteristics, reporting a change in vividness because they believed that is what they should have experienced.

The current study presented the same arousing stimuli to all participants to test the effect of eye movements on vividness and emotion ratings of recall. Rather than prompting participants to recall previous life experiences, presenting consistent arousing stimuli controlled
for the varied levels of emotion that participants may associate with their autobiographical memories. It also allowed the experimenters to test the accuracy of the memory after treatment. Participants viewed television advertisements that have been broadcasted in other countries (e.g. Australia, England) by government-sponsored agencies to discourage unsafe driving practices, such as speeding and not wearing a seatbelt. The ads contained graphic depictions of car accidents and generated some degree of arousal in the viewer when seen for the first time. Shock-ad videos have been used successfully by other researchers when investigating memories for stressful events.

The current study used a between-subjects design, creating a control group that did not perform eye movements. The experimenters also disguised the true nature of the study in order to eradicate demand characteristics. Participants were told that the purpose of the study was to evaluate the factors that influence the effectiveness of this type of television campaign, and they completed several fillers tasks. If the working memory theory is accurate, these methodological changes on the previous research should not interfere with the eye movements’ reduction of the vividness and emotionality of memories.

The present study also used several different visuospatial tasks to further investigate the plausibility of the working memory theory. After watching the television shock ads, participants were asked to fix their eyes on a moving, a blinking, or a stationary target. According to VSSP theorists, participants who performed eye movements would have reduced vividness and emotionality of their memory recall as compared to those who focused on a blinking or a stationary target. Beyond the traditional moving, blinking, and stationary target conditions, the present study also had a condition that used an arrhythmically-moving target. Logie, Cocchini, Delia Sala, and Baddeley (2004) found that increasing the demand of a tracking task impaired
participants’ performance on other concurrent cognitive tasks. The purpose of adding arrhythmic stimuli was to test a more complex visuospatial task. The current experimenters hypothesize that the increased visual control necessary to track an arrhythmically moving target will make it a more demanding task on the VSSP’s limited resources. If the VSSP theory is accurate, this more complex task would reduce the vividness and emotionality of memory recall even more than performing rhythmic eye movements.

Finally, the current study also collected data on the frequency and emotionality of memory intrusions. Memory intrusions are the involuntary recall of an image or an event, and they commonly occur in PTSD patients. Previous research claims that EMDR treats memory intrusions, lessening their frequency and vividness (Wilson, Becker, & Tinker, 1995). The experimenters intended to examine memory intrusions of an arousing but not traumatizing memory, and whether eye movements diminish their effects. The experimenters hoped that investigating memory intrusions alongside the other previously-mentioned goals of this study would result in new insights on the effects of eye movements on memory recall.

**Method**

**Participants**

Sixty undergraduate (32 females; 28 males) students from the College of William and Mary participated in the study. They were required to be over 18 years of age and were given course credit for their participation.

**Apparatus**

Participants were shown five short commercials regarding unsafe driving practices. The visual content of the commercials was presented on a 17” computer monitor and the participants
wore headphones to hear the auditory content. The first commercial (one minute duration) showed a speeding car impacting a stationary jeep, which consequently hit two pedestrians who were crossing the street. The final scene showed the female pedestrian lying unconscious on the road while her son stood nearby. The second commercial (one minute duration) depicted a car with four young passengers, one of whom was not wearing a seatbelt. The car was hit from behind, and the four people were shown crashing into each other and the sides of the car. The boy not wearing a seatbelt smashed into the other passengers, killing him and two others. The third commercial (30 s duration) began with a man stopping his car at a T-intersection. As the car pulled out, an unseen motorcycle hit the side of the car, throwing the motorcyclist off his bike. The fourth commercial (one minute duration) presented a dramatic hospital scene that occurred after a fatal drunk-driving accident. The scene included physical fighting, injured bodies, and tearful victims. The fifth commercial (one minute duration) showed a fatigued man and his girlfriend driving through the night. The man fell asleep at the wheel, during which his van drifted across lanes and crashed into an oncoming truck.

Participants’ heart rates were measured by a Polar 625X Running Computer heart rate monitor. The monitor consisted of a chest strap that was worn directly against the skin above the sternum and a wristwatch, which displayed the heart rate readings.

**Design**

Participants were randomly assigned to one of five eye-tracking conditions before they arrived: rhythmic moving target, arrhythmic moving target, rhythmic blinking target, arrhythmic blinking target, and stationary target. All of the conditions used a PowerPoint presentation that presented a black circle (2” diameter) on a 17” white background. The rhythmic moving target participants focused on the moving black circle, which moved from left to right every 500 ms,
resulting in two eye movements per second. The arrhythmic moving target participants focused on the moving black circle, which moved from left to right at different time intervals ranging from 200 ms to 1500 ms, creating an arrhythmic movement. For both of the eyes-moving conditions, the black circle never disappeared from the screen, resulting in the participants performing smooth pursuit eye movements. The rhythmic blinking target participants focused on a stationary black circle, which pulsed every 500 ms. The arrhythmic blinking target participants focused on a black circle that pulsed at intervals ranging from 200 ms to 1500 ms. The stationary target participants focused on a motionless black circle. In all of the conditions, the black circle remained on the screen for 30 s.

Figure 1. Schematic Representation of Research Design
**Procedure**

Each participant met the experimenter in the Human Cognition Laboratory and filled out the Informed Consent form. The experimenter explained how to attach the Polar heart rate monitor around the chest, and the participant put the monitor on under his/her clothes in a separate room. The participant sat approximately 18” in front of the computer monitor while the experimenter calibrated the heart rate monitor. The participant watched the first commercial while the experimenter recorded the participant’s heart rates at the beginning, the middle, and the end of the commercial. The experimenter asked the participant to rate how upset the ad made them feel on a 10-point scale. The participant also rated the realism of the ad, the effectiveness of the ad, the appropriateness of the ad on American television, and reported the most disturbing aspect of the ad (refer to Appendix A). This procedure was repeated for the next four commercials.

After viewing all five ads, participants completed a filler task involving a short personality questionnaire, which took between two and three minutes to complete (Saucier’s Mini-Marker personality questionnaire, refer to Appendix B). The participant’s heart rate was recorded after completing the 40-item questionnaire. The following instructions then appeared on the screen: “Please recall the video that you just saw. During the recall, focus your eyes on the black circle on the screen in front of you.” After the participant acknowledged that he/she read the instructions, the condition-appropriate PowerPoint presentation was presented. The participant’s heart rate was recorded when the circle appeared on the screen, 15 s later, and when the circle disappeared 30 s later.

The participant then responded to questions about each of the ads in the order that they had been viewed. He/she rated the vividness of the visual and auditory content of the ads on a 7-
point scale and provided distress ratings using the Subjective Unit of Distress Scale (SUDS), a measure commonly used in EMDR protocol. For this measure, the instructor asked the participant how upsetting the ad was for him/her, which the participant rated on a 7-point scale. The numerical scale ranged from a score of one being “not at all upset” to a score of seven meaning “very upset.” Finally, the participant responded to questions about the visual and auditory details of each ad in order to assess the accuracy of their memory (refer to Appendix C).

After the participant completed the questionnaire for each ad, the experimenter recorded the participant’s heart rate. The experimenter explained that the participant would receive a follow-up questionnaire by e-mail, and one final heart rate was recorded. The participant removed the heart-rate monitor and exited the lab.

Exactly one week after the experiment, the participant received an e-mail asking how often images of the ads had come to mind, how distressed he/she felt when thinking about them, and if he/she had been affected by a car accident before viewing the ads (refer to Appendix D). Finally, the participant received a debriefing e-mail that described the goals of the experiment.

**Results**

All five shock ads were viewed by the participants as reasonably realistic ($M = 7.14; SD = 1.05$) and upsetting ($M = 6.24; SD = 1.36$). The participants felt the ads would be fairly effective in changing the attitudes of young people towards unsafe driving practices ($M = 5.21; SD = 1.85$). Those participants who had a previous experience with car accidents ($n = 21$) found the ads upsetting ($M = 6.57; SD = 1.24$) and realistic ($M = 7.59; SD = 1.15$), suggesting the ads were comparable to an arousing real-life situation.
A one-way analysis-of-variance was used to compare the eye-movement conditions. The analysis found that the eye-movement conditions did not have a significant effect on the vividness of the auditory components, $F(4, 55) = 0.96, p > .05$, or the visual components of the memory, $F(4, 55) = 0.97, p > .05$. There was also no significant effect of the eye-movement conditions on the accuracy of the memory, $F(4, 55) = 0.65, p > .05$, as measured by the cued-recall for the content of the ads.

The one-way analysis-of-variance for SUDS scores almost reached significance, $F(4, 55) = 0.65, p = .065$. A two-way analysis-of-variance compared the two rhythmic eye-manipulation conditions with the two arrhythmic eye-manipulation conditions. This two-way ANOVA found that the arrhythmic conditions produced SUDS scores ($M = 4.44, SD = 0.22$) which were significantly higher than the rhythmic conditions ($M = 3.55, SD = 0.22$), $F(1, 44) = 8.23, p = .01$. Compared to the rhythmic conditions, the arrhythmic conditions also produced trends for decreased auditory vividness, $F(1, 44) = 2.93, p > .05$, and decreased visual vividness, $F(1, 44) = 2.18, p > .05$. There were no significant differences between the two groups on the measures of memory vividness, accuracy, or emotional ratings, $p > .05$.

There were no differences between any of the eye-movement conditions for heart rate at any time during the experiment, $p > .05$. Average heart rates during the entire experiment were not significantly correlated with ratings of being upset immediately after viewing the ads, $r(57) = 0.01, p > .05$, or SUDS scores that measured distress after the eye-manipulations, $r(57) = 0.08, p > .05$.

Fifty-seven participants responded to follow-up questions seven days after the study. A large majority (82%) of the responding participants reported one or more memory intrusions during the seven days. Overall, they reported feeling distressed when thinking about the five
shock ads ($M = 4.84; SD = 2.13$). There were no significant differences in the number of memory intrusions or current level of distress between those who had a previous experience with a car accident and those who had not, $p > .05$. There were also no significant differences across conditions in either frequency or emotionality of intrusions, $p > .05$.

**Discussion**

The current study intended to evaluate the VSSP theorists’ explanation for the success of using rapid eye movements to treat traumatic memories. They suggested a memory would be less emotional and less vivid after simultaneously recalling the memory and performing a second visuospatial task such as eye movements. Their claim was not supported by this study, as performing eye movements did not have a significant effect on ratings of vividness, emotionality, or accuracy of memory recall. The present study used standardized arousing stimuli and an experimental design to overcome concerns of demand characteristics. After correcting methodological flaws of previous research, the effects commonly found by VSSP theorists’ disappeared.

The current study also hypothesized that if the VSSP explanation is accurate, tracking an arrhythmically-moving target would reduce the vividness and emotionality of a memory more than a rhythmically-moving target. In this study, the arrhythmic stimuli produced higher ratings of distress (i.e. SUDS scores), with the difference between rhythmic and arrhythmic conditions approaching significance. In addition, participants in the arrhythmic conditions rated lower auditory and visual vividness of their memory recall. However, neither the arrhythmic nor rhythmic conditions produced responses that differed from the control condition. If the effects of the arrhythmic conditions on memory recall were due to the utilization of the VSSP’s resources,
one would expect to find a significant difference in responses between the arrhythmic and the control conditions. Although the present study did not establish a significant relationship between arrhythmic eye-movements and memory recall, the results suggest that arrhythm’s effects on memory recall might be caused by factors other than those described in the VSSP theory.

The experimenters speculated that the possible relationship between arrhythm and memory recall could be mediated by physiological arousal. The results suggest otherwise, as neither arrhythm nor eye movements had a significant effect on heart rate. For all participants, heart rates increased during the beginning of the ads in response to viewing novel stimuli and then decreased during the showing of the ad as the participants habituated to the stimuli. Participants’ heart rates significantly decreased during the 30 s of eye manipulations regardless of condition, and none of the conditions had a significant effect on heart rates during any period of the study.

The current study also investigated the frequency and emotionality of memory intrusions caused by viewing negative stimuli. Memory intrusions are repeated invasive images of an event that are often exceptionally vivid, and they often occur after traumatic experiences (Brewin and Holmes, 2003). A large majority of the participants reported experiencing distressing memory intrusions, but neither the frequency nor the emotionality of the intrusions were affected by the eye-movement conditions. This evidences that memory intrusions occur after arousing but not traumatizing events, and it also provides little support for claims that eye movements have an effect on memory intrusions.

Although the results suggest that eye-movements have little effect on the emotionality, vividness, and accuracy of memory recall, the lack of significant findings makes it difficult to
make any strong conclusions on the VSSP theory. Examining the limitations of the current study is beneficial to research of eye-movements, though, because it provides great insight on how future research should be conducted. One suggestion is that future studies should look at the effects of increasing the length and frequency of eye movement sessions. Perhaps one-30 s session of eye movements was insufficient, although this procedure is consistent with previous research. Participants could perform eye movements after viewing each of the ads to give them adequate time to recall every aspect of the memory, rather than asking them to recall the details of all five ads during one session. If they add multiple eye movement sessions, researchers would have to ensure that the purpose of the study is imperceptible to control for the demand characteristics commonly found in the research of VSSP theorists’.

Beyond adding longer and more frequent eye movement sessions, future research should use visuospatial tasks that vary in complexity. The experimenters hypothesized that arrhythmic eye-movements would demand more of the VSSP’s resources, but further research is necessary to determine if that is true. It is possible that arrhythmic eye-movements simply demanded more motor control of the participant’s eyes rather than working memory resources. Future studies should test the effects of performing more complex visuospatial tasks (i.e. completing a maze) on memory recall. However, researchers must ensure that the task is not too complex, otherwise there will be inadequate VSSP resources left to attend to the memory.

Finally, future researchers need to focus on the types of eye-movements generated by tracking a target. The targets in the current study never disappeared from the screen and intended to produce smooth pursuit eye movements, which is consistent with the EMDR protocol. However, many of the VSSP theorists’ use saccadic eye movements in their research, and this discrepancy may have affected the results of the current study. Further, it is unclear
whether tracking arrhythmic and rhythmic targets produces the same type of eye movement. Although the arrhythmic target never disappeared from the screen, the unexpected bursts of movement from side-to-side may have facilitated saccadic eye movements. Perhaps slowing the movement of the moving target would facilitate smooth pursuit eye movements, enabling the participants to follow the full range of the target across the screen. Since previous research has found that saccadic and smooth pursuit eye movements have different effects on episodic memory retrieval (Christman, Garvey, Propper, & Phaneuf, 2003), it is important for future researchers to generate a consistent type of eye movement.

The current study does not provide support for the VSSP theory, but this explanation remains a plausible rationale for the effects of eye movements on memory recall. Future research should consider the methodological suggestions made by this study in order to evaluate the role that eye movements play in EMDR therapy.
References


reprocessing (EMDR) treatment for psychologically traumatized individuals. *Journal of Consulting and Clinical Psychology, 63, 928 – 937.*
Appendix A.

Please answer each question with respect to how you are feeling at the moment after just viewing each television ad for the first time.

TV-AD#1

1. How upsetting was this ad for you? ____ (1 = Not at all…10 = Very upsetting)

2. How realistic was the accident depicted in this ad? ____ (1 = Not at all…10 = Very realistic)

3. How effective do you believe this ad would be in changing young people’s attitudes and behaviors to this particular unsafe driving practice? ____ (1 = Not at all…10 = Very effective)

4. Do you think this ad (or a very similar one) should be shown on American television? Yes/No

5. What was the most disturbing aspect of this ad for you?

TV-AD#2

1. How upsetting was this ad for you? ____ (1 = Not at all…10 = Very upsetting)

2. How realistic was the accident depicted in this ad? ____ (1 = Not at all…10 = Very realistic)

3. How effective do you believe this ad would be in changing young people’s attitudes and behaviors to this particular unsafe driving practice? ____ (1 = Not at all…10 = Very effective)

4. Do you think this ad (or a very similar one) should be shown on American television? Yes/No

5. What was the most disturbing aspect of this ad for you?

TV-AD#3

1. How upsetting was this ad for you? ____ (1 = Not at all…10 = Very upsetting)

2. How realistic was the accident depicted in this ad? ____ (1 = Not at all…10 = Very realistic)
3. How effective do you believe this ad would be in changing young people’s attitudes and behaviors to this particular unsafe driving practice? ____ (1 = Not at all…10 = Very effective)

4. Do you think this ad (or a very similar one) should be shown on American television? Yes/No

5. What was the most disturbing aspect of this ad for you?

TV-AD#4

1. How upsetting was this ad for you? ____ (1 = Not at all…10 = Very upsetting)

2. How realistic was the accident depicted in this ad? ____ (1 = Not at all…10 = Very realistic)

3. How effective do you believe this ad would be in changing young people’s attitudes and behaviors to this particular unsafe driving practice? ____ (1 = Not at all…10 = Very effective)

4. Do you think this ad (or a very similar one) should be shown on American television? Yes/No

5. What was the most disturbing aspect of this ad for you?

TV-AD#5

1. How upsetting was this ad for you? ____ (1 = Not at all…10 = Very upsetting)

2. How realistic was the accident depicted in this ad? ____ (1 = Not at all…10 = Very realistic)

3. How effective do you believe this ad would be in changing young people’s attitudes and behaviors to this particular unsafe driving practice? ____ (1 = Not at all…10 = Very effective)

4. Do you think this ad (or a very similar one) should be shown on American television? Yes/No

5. What was the most disturbing aspect of this ad for you?
Appendix B. Saucier’s Mini-Marker Personality Questionnaire.

Please use this list of common human traits to describe your self as accurately as possible. Describe yourself as you see yourself at the present time, not as you wish to be in the future. Describe yourself as you are generally or typically, as compared with other persons you know of the same sex and of roughly the same age. Before each trait, please write a number indicating how accurately that trait described you, using the following scale:

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Appendix C.

AD#1: Speeding

How vivid is your memory of this ad?

<table>
<thead>
<tr>
<th>not at all</th>
<th>extremely vivid</th>
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<tr>
<td>Visual images of the ad</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>Auditory content of the ad</td>
<td>1 2 3 4 5 6 7</td>
</tr>
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</table>

How does the memory of the ad make you feel now?

<table>
<thead>
<tr>
<th>No effect</th>
<th>1 2 3 4 5 6 7</th>
<th>Very upset</th>
</tr>
</thead>
</table>

1. The driver has a flashback of the accident. What is the object he sees on the road?
2. What is the driver of the speeding car sitting next to on his train trip?
3. Was there a person sitting in front of him on the train ride?
4. What did the passenger ask the driver of the speeding car before the accident?
5. Was the driver wearing sunglasses or glasses when he had the accident?
6. What color was the car that he hits?
7. What gender was the driver of the car that he hits?
8. What did the driver of the speeding car say to the driver of the car he hit?
9. What was the position of the body lying on the road – on their back, front, or side?
10. What was the relationship between the two people hit in the accident?
11. Can you provide the message displayed at the end of the commercial?
AD#2: Seatbelt

How vivid is your memory of this ad?

<table>
<thead>
<tr>
<th>Visual images of the ad</th>
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<th>3</th>
<th>4</th>
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How does the memory of the ad make you feel now?

<table>
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<tr>
<th>No effect</th>
<th>1</th>
<th>2</th>
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<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>Very upset</th>
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</thead>
</table>

1. What were the young couple doing as their ride drove up?
2. What was the color of the car that picked them up?
3. What was the gender of the driver of the car that picked them up?
4. Was the car containing the couple stationary or moving when hit for the first time?
5. What was the color of the first car that hit them?
6. Where did the second car hit them?
7. Where was the passenger sitting that clashed heads with the passenger not wearing a seatbelt?
8. How many passengers in the car containing the young couple were killed in the accident?
9. Who did the policeman blame for the deaths?
10. Can you provide the message displayed at the end of the commercial?
AD#3: Bike Accident

How vivid is your memory of this ad?

<table>
<thead>
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<th>not at all</th>
<th>extremely vivid</th>
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<tbody>
<tr>
<td>Visual images of the ad</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>Auditory content of the ad</td>
<td>1 2 3 4 5 6 7</td>
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</tbody>
</table>

How does the memory of the ad make you feel now?

| No effect | 1 2 3 4 5 6 7 | Very upset |

1. What type of intersection did the accident occur at?
2. What was the gender of the car driver involved in the accident?
3. Was the car driver wearing a seatbelt?
4. Was the car driver wearing glasses?
5. What was the motorcyclist wearing on his back?
6. Which side of the car did the motorcycle hit?
7. What color was the motorcycle?
8. Was the motorcyclist wearing a helmet?
9. Who was the first person to check on the motorcyclist hit by the car?
10. Can you provide the message displayed at the end of the commercial?
AD#4: Drunk Driving

How vivid is your memory of this ad?

<table>
<thead>
<tr>
<th>not at all</th>
<th>extremely vivid</th>
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<tbody>
<tr>
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<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>Auditory content of the ad</td>
<td>1 2 3 4 5 6 7</td>
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</tbody>
</table>

How does the memory of the ad make you feel now?

| No effect | 1 2 3 4 5 6 7 | Very upset |

1. During what holiday period did the accident occur?
2. What did the nurse say to the patient lying on the table in the operating room?
3. What was the gender of the injured child who called out for their mother?
4. What was the person wearing who was seen to vomit?
5. How many people were seen physically fighting?
6. Did the passenger in the other car die?
7. What did the driver of the car who caused the accident declare out loud?
8. What was being mopped off the floor in the operating room?
9. Can you provide the message displayed at the end of the commercial?
AD#5: Fatigue

How vivid is your memory of this ad?

not at all 1 2 3 4 5 6 7 extremely vivid

Visual images of the ad

not at all 1 2 3 4 5 6 7 extremely vivid

Auditory content of the ad

How does the memory of the ad make you feel now?

No effect 1 2 3 4 5 6 7 Very upset

1. What was the gender of the passenger in the van?
2. Was the driver of the van wearing a seatbelt?
3. What did the passenger ask the driver of the van to do?
4. What did the driver of the van ask the passenger to do?
5. What did the driver of the van do to wake himself up while driving?
6. What time did the van clock show?
7. How fast was the van traveling just before it was hit?
8. What did the truck driver do when the van first crossed the middle of the road?
9. Where did the van hit the truck?
10. What happened to the van after it was hit by the truck?
11. Can you provide the message displayed at the end of the commercial?
Appendix D.

Dear Participant,

Thank you again for participating in our experiment that is evaluating the factors that may play a role in the effectiveness of “shock ad” television campaigns used by many government-sponsored agencies in other countries to reduce unsafe driving practices. It has now been a week since you viewed the ads and we would like to know how often during this time images or information from the ads may have come to mind. Please reply back to this email with your responses to the following questions. Once we have received your responses we will grant you credit for participation in this study.

How often have images from the ads come to mind during the past week? Please try to give an accurate estimate of the number of times it has happened.

If images did come to mind during this time, what percentage of instances did the images come to mind involuntarily without a premeditated attempt on your part to retrieve this information from memory?

If you think about the ads now, how disturbing or upsetting do you find them now (1 = not at all … 10 = very disturbing)?

Have you ever been involved in a serious car accident or been significantly affected by one?

Thank you again for participating in this study and we hope that you found it an interesting experience. If you are having any intrusive memories of the ads or of some related event reminded by these ads, please consider contacting one of the many excellent counselors at the college’s Counseling Center.