The Attentional Blink as an Indicator of Sexual Interest

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Abstract

Using implicit measures in psychological assessment is new in research. The Attentional Blink is a widely supported phenomenon in the cognitive literature. It has been reported that emotionally salient stimuli, particularly those of a sexual nature, can produce it, leading to lower recall of a neutral target presented after the stimulus item. This study looked at the Attentional Blink as a measure of sexual interest. It also looked at the use of computer-generated (CG) images as an alternative to real images. Findings showed that nude images produced the largest Attentional Blink, real images are most effective, and CG images produced some effect. These finding are promising for the development of CG images of children for use in paedophile assessment.

Keywords: *paraphilia; attentional blink; computer generated images*

Introduction

In recent years, there has been an increasing clinical interest shown in sex offending. This is partly due to the increase in acknowledgement of the levels of sex abuse in the past (Towl & Crighton, 1996). The implementation of the UK Criminal Justice Act (1991) has led to assessment and treatment plans being implemented for incarcerated sex offenders, and the number of people being referred for evaluation and treatment is also increasing. Assessment of sex offenders needs to take a number of factors into consideration such as behaviour, cognitions, and social factors. There is no comprehensive system for evaluating sex offenders, and many methods of assessment are used, including self-report methods such as diaries and questionnaires (Towl &

Crighton, 1996) and physiological measures, such as the penile plethysmograph (PPG). The purpose of assessment has three main goals: to look at the risk of recidivism, to identify what treatment plan is most suitable, and to evaluate the outcome of these treatments to see if they have been successful (Beckett, 1994).

One of the main areas of difficulty with assessment of sex offenders is due to the fact that we are not sure who or what we are dealing with. In light of this, many theories of sex offender behaviour have been suggested.

The generic term 'sex offender' applies to those convicted of a sex crime, which includes rape, molestation and sexual harassment (Hill, 2005). The DSM-IV uses the term 'paraphilias' to describe "recurrent, intense sexual urges, fantasies or behaviours that

involve unusual objects, activities or situations and cause clinically significant distress or impairment" (American Psychiatric Association [APA], 2000, p. 571). There are various headings and categories involved in the DSM's formal definition of sexual deviations. In cases where a child and an adult are involved, this is characterised as paedophilia. There are however, further breakdowns of categories (Geffner, Franey & Falconer, 2003) such as gender preference; exclusivity (attracted only to children), or non-exclusivity (also attracted to adults); and if the offence is limited to incest or occurs outside the family also (Green, 2002).These variations are important in the classification of sex offenders so that appropriate treatment methods can be utilised (Geffner et al., 2003). It should be noted that a paedophile is only classed as a sex offender if a sexual offence has been committed.

There is no widely accepted theory of sex offender behaviour at the present time. Many studies suggest abnormalities at a biological level (Fedoroff, Peyser, Franz, & Folstein, 1994; Mendez, Chow, Ringman, Twitchell, & Hinkin, 2000; Saleh & Berlin, 2003). The behavioural theory of sex offending proposes that the behaviours develop due to conditioning, and the development of cognitions that reinforce this behaviour (Becker & Murphy, 1998). This can be due to repeating what has been learnt (e.g. witnessing abuse as a child) or can be reinforced through rewarding behaviour (e.g. masturbation). Becker and Murphy further argue that poor social and interpersonal skills also play a role in behavioural theories.

Current research is focusing on multifactor theories of sex offender behaviour. The Integrated Theory of Sexual Offending (ITSO; Ward & Beech, 2005) proposes an outline to explain onset, development, and maintenance of sexual offending. This theory brings together information gathered from areas including clinical assessment, neuropsychology, and psychopathology. The ITSO posits that there are three sets of factors interacting: biological (such as genetic and brain development), ecological (social, environmental, and cultural), and neuropsychological factors. The current

physical environment may be an important contributor, through the offender manipulating the availability of potential victims and also by creating the specific circumstances that may trigger the offending behaviour.

Neuropsychological factors include the motivation/emotion system associated with cortical, limbic and brain stem brain structures. Defects in this system may be due to problems in an individual's cultural upbringing, or negative individual experiences. There may be difficulties in understanding and expressing emotions appropriately (Ward & Beech, 2005). ITSO proposes that the dynamic interaction of these factors can lead to sexual offending. The consequences of the sexually abusive behaviours maintain a positive feedback loop, which maintains further behaviour of the same kind (e.g. improvement in mood through sexual arousal and satisfaction, feelings of power and control) which, in turn, functions as a positive reinforcer.

Other multifactor theories of sexual offending include the Pathways Model (Ward & Siegert, 2002), Marshall and Barbaree's Integrated Theory (1990) and the Relapse Prevention Model (Laws, Hudson, & Ward, 2000). Not all of the theories will be discussed in detail here due to space restrictions. Generally, current theories of sex offenders tend to be multi-factorial in nature.

Due to the nature of sex offending, there are many obstacles in the way of obtaining accurate evaluation. Legal action, social bias, and self-admission can all be barriers to obtaining honest and open information (Clipson, 2003). This is one reason why a variety of methods should be used in the assessment of sex offenders. Some of the most commonly used measures will be discussed here. Most research up to recent years has focused on the use of explicit measures of sexual interest.

The penile plethysmograph (PPG) (Freund, 1963) is the most commonly used psychophysiological measure of sexual arousal in males. This instrument measures changes in penile volume in response to certain stimuli. The PPG can directly measure levels

of sexual arousal to normal stimuli, and compare this to levels of arousal to sexualised stimuli. Tong (2007) suggests that the probability that an individual might act on their arousal is strongly linked to the individual's pattern of sexual arousal, and therefore gaining an accurate assessment of this pattern can be an important step in gauging inclination to sexual deviancy. The PPG is used in up to 1/3 of treatment programs for assessing sex offenders (Knopp, Rosenberg & Stevenson, 1992). It has been found to be particularly useful in differentiating between sexual interest in children and sexual interest in adults (Beckett, 1994). However, it requires highly trained professionals to administer and interpret it, specialised equipment, and long testing sessions. It is limited also to assessing sexual arousal, and not sex drive or cognitive association about sex (Brown, Gray & Snowden, 2009). According to O'Donohue and Letourneau (1992), many studies that have used the PPG had major methodological issues. The PPG is also quite an invasive method of assessment.

Other instruments and methodologies are being examined for their usefulness in assessing sexual offenders. One of these is using implicit measures of sexual interest. These measures are thought to be able to tap into automatic reactions, associations and attitudes, thus avoiding faking and social desirability answers that may taint other methods such as self-reports. Typically, the term implicit measurement refers to methods whose responses are difficult to consciously control (Ciardha & Gormley, 2009). Many utilise speeded categorisation tasks, viewing time tasks and choice reaction time (Gawronski, 2009).

The Abel Assessment for Sexual Interest (AASI) is a psychosexual measure (Able, Huffman, Warberg & Holland, 1998). It consists of two parts: The Abel Screen Visual Reaction Time (VRT), and the Abel Questionnaire for Mean. In the VRT section, participants are presented with 160 digital images of clothed children, adolescents, and adults on a laptop. They are asked to rate the attractiveness of the stimulus image from highly sexually disgusting to highly sexually

arousing. The computer records the length of time that each slide is viewed. It also records the subjective rating of the image on the scale mentioned above. The theory proposes that the longer the image is viewed for, the more arousing the participant finds it. The Abel Questionnaire for Men makes up the second part of the AASI. It is a self-report measure that looks at problematic sexual behaviours. The questionnaire looks at many aspects of the participant's background including history of arrests, accusations, attempted sexual assault, convictions, type, and number of victims, cognitive distortions, social desirability, and behaviours. A study by Abel et al., (2004) found that the AASI is a valid instrument for identifying molesters. The AASI uses only clothed images, as it is illegal to carry naked images across state lines. This measure was designed to assess for previous sexual offending in participants. Responses are compared to data from 246 offenders. It has been found to have high sensitivity and specificity to prepubescent and pubescent boys and high sensitivity but low specificity to prepubescent and pubescent girls when compared to the PPG (Abel, Jordan, Hand, Holland, & Phipps, 2001; Gray & Plaud, 2005.) The AASI takes less time than the PPG to administer and score, and is less invasive. It also does not appear to have a problem with non-responders, which is seen with the PPG (Tong, 2007). Fischer and Smith (1999) have tested the vulnerability to faking of the AASI, and while Abel proposed that the results were internally consistent, Fischer and Smith commented that the results of the analysis of variance were not published, and that only some of the categories were analysed (Kalmus & Beech, 2005).

Following on from the AASI, and using some similar methodology, Glasgow, Osborne and Croxen (2003) developed the Affinity model to assess expressed sexual interest, and not sexual arousal. They looked at the length of time images were viewed for, which has been reported to be significantly correlated with sexual interest (Abel et al., 1998; Lang, Searles, Lauerman, & Adesso, 1980; Quinsey, Ketsetzis, Earls, & Karamanoukian, 1996; Quinsey, Rice, Harris, & Reid, 1993). 28 males and 28 females in four age categories (toddlers, preadolescents, adolescents, and

adults) are presented. All of these images are clothed, similar to the AASI. Participants are also asked to rate attractiveness. Worling (2006) looked at these methods of assessment for use with adolescents and found that the internal consistency for the measures was acceptable.

One of the most well known implicit measurement techniques is the Implicit Association Test (IAT), developed by Greenwald, McGhee, and Schwartz in 1998. It is similar to cognitive priming procedures as it attempts to measure the underlying automatic evaluations of implicit attitudes. The IAT looks for automatic associations between words. Participants are asked to categorise these words as pleasant or unpleasant. It should be easier to combine pleasant words (e.g. flower and pleasant) and unpleasant words (e.g. insect and weapon words), as these are compatible. This idea is used to look at attitudes such as race. Problems with the IAT include low test-retest reliability (Cunningham, Preacher & Banaji, 2001) and greatly varying ability to predict behaviour across studies (Friese, Hoffman & Schmitt, 2008).

The IAT has been used in the assessment of sex offenders. Gray, Brown, MacCulloch, Smith, and Snowden (2005) developed the child-sex IAT for this use. This follows the aforementioned IAT style test, but involved adult versus child words, and sex versus not sex words. They found that using this method revealed an association between children and sex in a group of child sex offenders. A further study from 2008 (Snowden, Wichter & Gray, 2008) looked at the ability of implicit measures to predict sexuality. They used the IAT and the priming task. Both methods had good ability to predict sexual preference. The measures also correlated strongly with each other. A 2009 study by Brown, Gray, and Snowden looked at cognitive associations between children and sex, in men convicted of paedophilic offences. They found that only child sex offenders had implicit associations between children and sex. Banse, Schmidt and Clarbour (2010) compared results from explicit and implicit measures, and found that specific IAT's and viewing time tasks discriminated between non-offenders and child sex offenders nearly as well as explicit measures in a mostly non-denying sample. This research is promising for newer, more accurate assessment methods.

Another implicit measure that is being researched involves the use of rapid serial visual presentation (RSVP). This measures the "attentional blink" (Raymond, Shapiro, & Arnell, 1992). In this method, a stream of images is presented in very quick succession (approximately 20 milliseconds each). It has been found that if participants only need to search for one target image (T1) in the stream, accuracy is usually high. When participants must look for two targets however, accurate recall of target two (T2) is usually quite low, if it appeared within 200-500 ms of T1. This is due to attentional resources being depleted as a result of attending to T1 (Raymond et al., 1992). When participants view an emotionally salient or arousing image, the attentional blink has been found to be enhanced, resulting in a reduction in accuracy when reporting a target image following later in the image stream (Barnard, Ramponi, Battye, & Mackintosh, 2005). The emotionally salient/arousing images act as an additional target, a T1. Arnell, Killman, and Fijavz (2007) developed an experiment in which participants performed a single target search. The target was preceded by a to–be–ignored image. They found that when this item was a sexual word, the accuracy for the target was reduced. Most, Smith, Cooter, Levy and Zald (2007) also found that erotic pictures produced an even more robust effect than negative images, which had previously been thought to produce the strongest reaction (Most, Chun, Widders, & Zald, 2005).

Beech et al. (2008) focused on these findings and used them to examine the effects of using images of children as a distractor target in a sample of paedophiles. They proposed that more errors would be made by a group of child sex offenders when presented with images of children compared to a control group. This proposal was upheld by the findings. The child molester group made more errors when the distractor target was that of a child, than when it was of an animal, that is, the child had an attention capturing

effect, which could indicate an abnormal interest in children (Beech et al., 2008).

Part of the difficulty of assessing paedophiles is the problem of using real nude images of children. It is illegal and highly unethical. Recently, the use of computerised images has been suggested to avoid these issues. If these images elicit the same reaction as real images, they would be extremely useful for assessing paedophiles.

Aims of Study

The purpose of this study is to examine if the Attentional Blink can indicate sexual attraction. A second aim is to discover if clothed images have the same effect as nude images, and thirdly, to see if computer-generated images have the same effect as real images. Stability over time will also be assessed.

Method

Participants

The participants of this study consisted of the members of a Human Sexuality module of third year Applied Psychology in U.C.C.

Demographics of the Sample

There were 145 participants, 121 females (83.4%) and 24 males (16.6%). The average age was 21 years, ranging from 19 to 45. Three participants were listed as bi-sexual (2.1%), with the remainder reporting as heterosexual.

Materials.

Images were displayed on a blank projector screen that was present in the lecture hall. Participants' responses were recorded on forms prepared by the experimenter, with a cover page collecting demographic information including age, sex, and sexual orientation. These forms were identical for first test and second test. The computer program that was used was developed as part of the RSVP study by Dr. S. Hammond. The program was written in Delphi and runs on a

Windows platform. Data was analysed using PASW Statistics 17.

Design

This experiment was a repeated measures design. The participants completed the experiment twice, with a one-week gap. The experiment was repeated to test reliability. Reliability in this case is concerned with consistency over time; therefore, a test-retest method is used. There should be a high positive correlation of the results from the first and second tests to indicate reliability. The stimulus image was used as the independent variable (Appendix). There were two presentations of each type of stimulus image, a total of 32 stimulus images (16 variations of stimulus images, each presented twice). The programme consists of 32 sets of a series of eight images (seven neutral, one stimulus) displayed for 20 ms each. Stimulus images were whole body, and the age differentiation was between "young adult" (<30 years approx.; >20years approx.) and "older adult" (>60 years approx.). All images were colour. Computer generated images of children were not used in this study due to difficulties in gaining ethical approval in a limited timeframe. The interval between images was 0 ms. To control for primacy and recency effects, the first and last images were always neutral images (chair, apple etc.). In between images were randomised by the programme and presentation order was the same for the first and second tests. The stimulus image was used to investigate whether sexual attraction to the stimulus image resulted in decreased accuracy in identifying the target image (the image immediately following the stimulus). The accuracy of target identification was used for data analysis. An incorrect image (an image that did not appear in the set) was listed as one of the options to identify guessing/selecting all options.

Procedure

Participants were instructed on how to complete the experiment. They were told that a series of images would be shown on the projector and following this, another screen would be shown with a list of six items.

Participants were to tick the box next to each items name that they had seen presented. They were allowed approximately 20 seconds to complete this before presentation of the next set of images. This was repeated for all 32 sets of images. The participants were thanked, and the experiment was finished. Presentation for second test was the same.

Ethics

Before taking part in this experiment, participants were advised that naked images would be presented on screen, and that they did not have to participate if this would make them uncomfortable. Participants had the right to withdraw at any stage of the study, and were given the contact details of a sexual orientation organisation. Participants remained anonymous throughout the study, by using a self-selected password. Any questions or concerns could be forwarded to the experimenter, and an email address was provided for this.

Results

Examination of the Main Effects of the Experiment

A five-way Analysis of Variance (2 sex of participant by 2 sex of target by 2 age of target by 2 target image type by 2 clothed status of target) was performed. A split plot design was employed in which all target effects were repeated measures. The results of this are shown in Table 1.

The sex of the participant was not significant, neither was the sex of the target. However, three factors were found to have a significant main effect. These were the age of the target image, the image type, and whether the target image was nude or clothed. The main effect means are presented in Table 2.

Mean Attentional Blink is based on the number of correct target identifications made after presentation of the stimulus image. Images of younger individuals caused a greater Attentional Blink than those of older people. However, the effect size is small (0.097), despite its statistical significance. The image type also had a significant result with real images creating a greater Attentional Blink than CG images. This had quite a large effect size of 0.131. Finally, whether the image was clothed or nude had a highly significant effect. Nude images produced a much larger Attentional Blink than clothed images. The effect size was also high, with partial eta squared being 0.436.

Table 1

Main effects of Multiple Analysis of Variance

Effect	F	p	η^2
Sex of participant	2.992	.087	0.020
Sex of target	1.010	.317	0.007
Age of target	15.38	< .001	0.097
Image type (CGI/Real)	21.601	< .001	0.131
Clother Status	110.567	< .001	0.436

Table 2

Mean Attentional Blink for the Three Significant Main Effects

Main Effect	Means		S.E.	
Young vs. Old	0.77	0.90	0.04	0.04
CGI vs. Real	0.93	0.75	0.04	0.04
Clothed vs. Nude	1.01	0.66	0.04	0.04

Commentary

Nude images work best in eliciting an Attentional Blink. CG images are not as effective as real images so the option of using CG images as an alternative to real photographic images has less promise than was anticipated. The low effect size found with the sex of the target is not unexpected because it does not take the sex of the participant into account. For this reason the effects are best analysed in interaction with the sex of the participant.

Examination of the Interaction Effects of the Experiment

In Table 3, the 2-way interactions with participant sex are presented.

It is surprising that the interactions with participant sex by sex were not greater than observed in Table 3. No effect manifested statistical significance at the 5% level although a weak 10% level of significance was observed for sex of target and clothed status. The interaction of participant sex by target sex is plotted in Figure 1. This shows that the main effect occurs for males, in that female stimuli trigger greater Attentional Blink than male stimuli. While the opposite effect is found for females, this is at a much lower level indicating the differential effect of the technique for males and females. This suggests that Attentional Blink as an assessment technique may work more effectively with males.

It also might have been expected that the Attentional Blink in male participants would be more triggered by nude images than it was in the female participants; however, the Attentional Blink is equally triggered by nude images for males and females in this study.

Other Significant Effects

A number of other significant interactions were observed that throw some light onto the manner in which Attentional Blink is generated. These are presented in Table 4.

Other significant findings in the data analysis included the interactions between the age of the target and the type of image, type of image and clothed status, and also a three-way interaction between the target sex, age of target and clothed status.

Table 3

Interactions with Sex of the Participant

Effect	F	p	η^2
Sex of Target	3.217	.075	0.022
Age of Target	0.021	.884	0.000
Image type (CGI/Real)	0.963	.328	0.007

It was found that when the image type was CG, this discriminates the older adult images from young adult images better than real images. The young images caused a greater Attentional Blink than the older CG images. This had a moderate to large effect size of

0.126. It is interesting to see that CG images can discriminate between ages better than real images. This can be seen plotted in Figure 2.
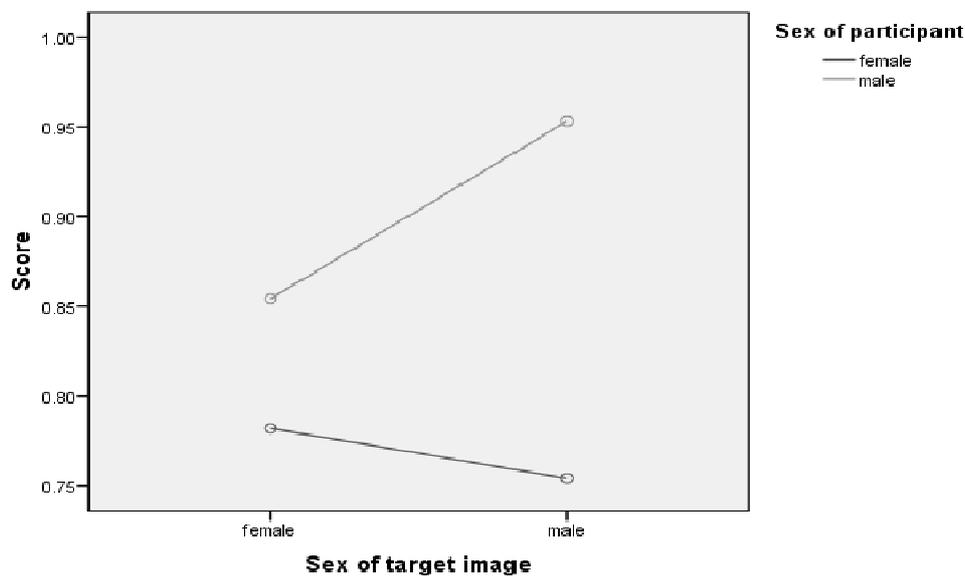

Figure 1. Interaction plot of sex of participant by sex of target image. Plot shows that the main effect occurs for males only.

Table 4

Other significant interactions

Effect	F	p	η^2
Age x Image	20.553	< .001	0.126
Image x Clothed	11.151	.001	0.072
Sex x age x clothed	21.240	< .001	0.129

Note: Age = Young/old target image. Image= CGI/real. Sex=sex of target image. Clothed=Clothed status.
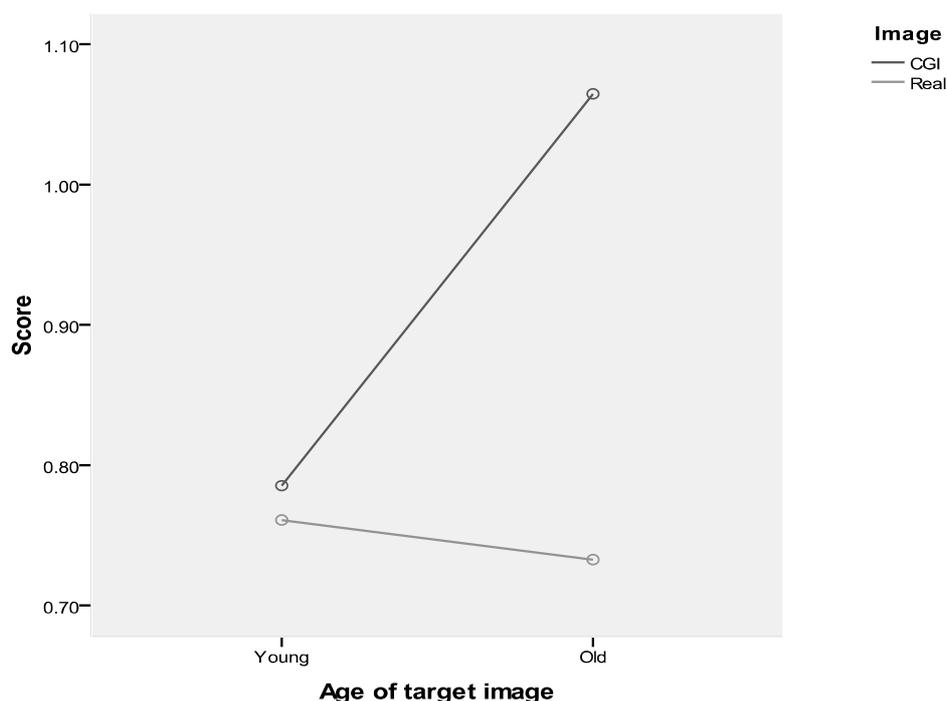
Figure 2. Plot comparing image type to the age of the target image. Young CG images cause a much larger Attentional Blink than old CG images.

Looking at the image type by clothed status interaction shows that CG images do not discriminate nude from clothed as well as the real images do. There were however, lower scores (and therefore more of an Attentional Blink) from nude CG images than from clothed real images and clothed CG images, which indicates that the CG images may be useful.

A further significant interaction was seen between sex of target, age of target, and whether the image was clothed/nude. When the images were clothed, the largest Attentional Blink was seen for young females. This was followed by old males, old females and the least Attentional Blink was found for young males. See Figure 3. This would seem to indicate that sexual interest is most apparent for young females. When looking at the nude condition however, we see that young males caused the largest Attentional Blink. See Figure 4. These results are more like what was expected, as the majority of the participants were young heterosexual females, and therefore would be expected to show the most sexual interest for males.

Test-Retest Reliability (Stability)

An important consideration when developing an assessment device is its stability over time. In this study, 45 individuals performed the task twice, one week apart. A correlational analysis was used to test the reliability of scores between first test and second test. . The Pearson correlations were for Male images AB: $r = 0.47$, $n=45$, $p<0.01$; for female images AB: $r = 0.48$, $n=45$, $p<0.01$; for CG images AB: $r = 0.47$, $n=45$, $p<0.01$; and for Real images AB: $r = 0.35$, $n=45$, $p<0.05$. All of these results are statistically significant, showing moderate stability over time. However, it should be clear that, interpreted as reliability coefficients, these correlations are quite small, raising questions about the temporal consistency of Attentional Blink for this task.
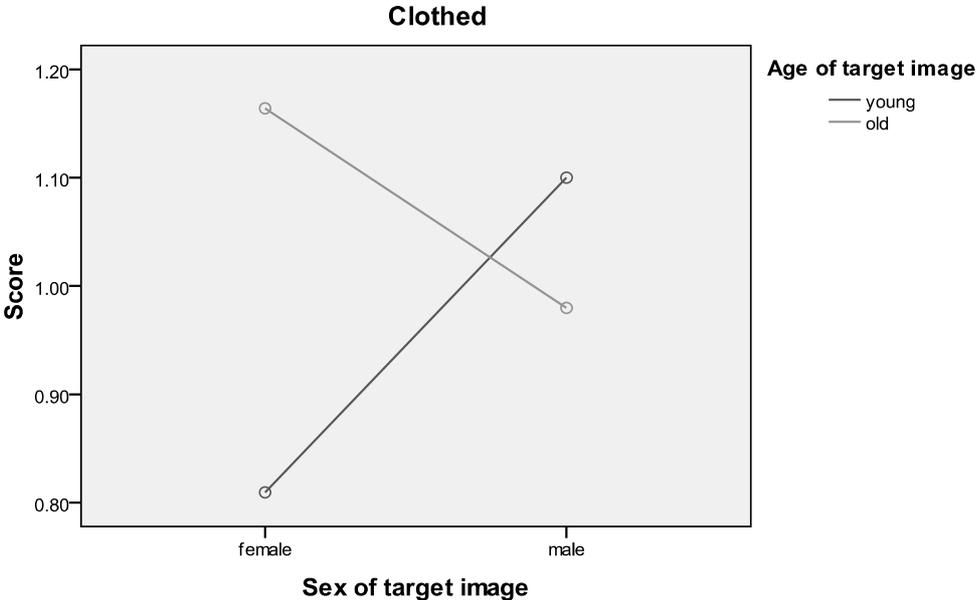
Clothed

Figure 3. Plot showing interaction between clothed images, sex of target, and age of target image. Young females caused the largest Attentional Blink in this condition.
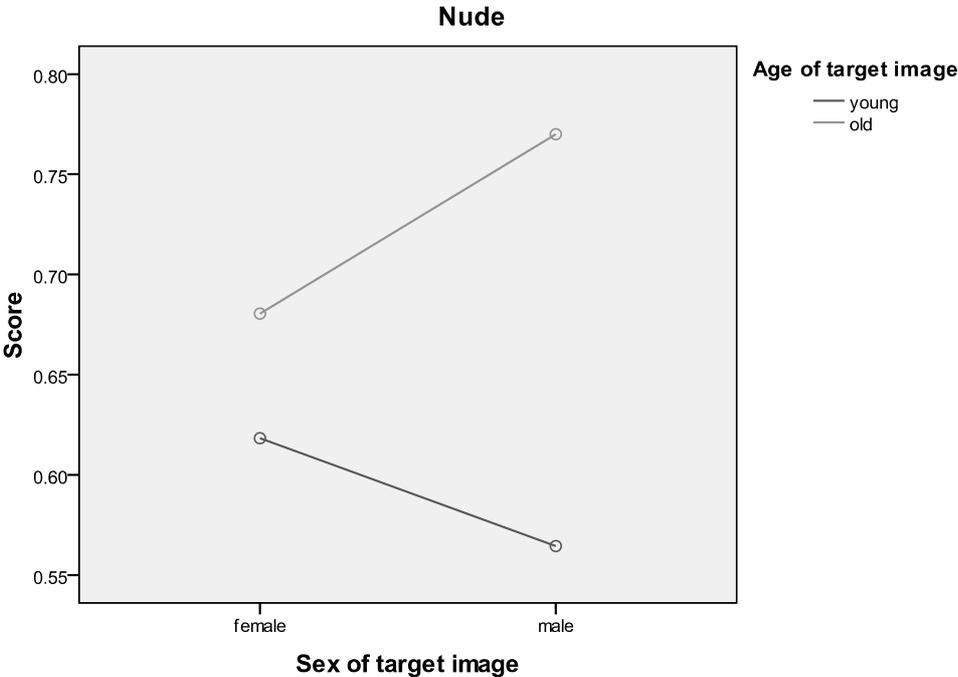
Nude

Figure 4. Plot showing interaction between nude images, sex of target image and age of target image. Young males caused the largest Attentional Blink in this condition.

Discussion

The results from this study show some very interesting findings. Initially, and counter-intuitively, it appears that the sex of the target does not influence the overall Attentional Blink. This seems to suggest that the Attentional Blink as a measure of sexual interest may not be as robust as previously thought. When examined further, however, we see that there is in fact an increased Attentional Blink shown from the male respondents to female stimuli, and the effect is being weakened by the female participants. This is not really an issue, as most research will involve male participants, due to the majority of paedophiles being male (Adshead, Howett & Mason, 1994).

Using clothed images was not as effective in eliciting the Attentional Blink as using nude images. This indicates that the sexual provocation of the image is a big factor in assessing sexual interest. It also means that using real clothed images of children in paedophile assessment may not be useful, which further underlines the importance of developing CG images for this purpose.

The nude CG images used in this study did have more of a reaction than the clothed images, whether they were real or CG. This finding supports the development of this type of image, also suggested by Laws and Gress (2004). Computer-generated images of older adults had less of an effect on recall accuracy than either CG images of younger adults or either age group of real images. This is interesting as it suggests that the CG images discriminated age better than real images. This result may prove useful as perhaps it could be repeated using images of children. It was unexpected to have found this difference as with the real images, the difference in Attentional Blink shown for young and older adults is very small.

Limitations of the Study

The results of this study were based on student samples, and consisted overwhelmingly of heterosexual females, which is not ideal as the measure is being looked at for use with sexually offending paedophiles. The number of male participants was small. Also, the sample was quite young, due to it being all students. A more varied age group may have got some quite different results, with there being more of a variation in sexual interest, for example with the older adult images. All males in the study were heterosexual also, which is not representative of a normal sample. There are limits of generalising to sex offenders. However, it is still assessing sexual interest, which exists in any sample.

Suggestions for Future Research

It would be useful to run the study again with a large all-male sample to see if the nude/clothed effect would be repeated for males. Although the effect for clothed images was weaker, this does not necessarily preclude their usefulness. When assessing paedophiles, the attentional blink just has to be stronger for images of children over images of adults, not necessarily strongly. In fact it may be more unobtrusive to use clothed images when assessing this population.

While CG images did not work as effectively as real images, they did show some promise. Perhaps more developed and realistic images could be used. The sample age was also young as it was all students, a larger range of ages could provide some interesting findings. At further study could look at using images of children. A larger cross-section of sexualities would also be interesting to look at.

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Appendix

1) naked adult male real; 2) naked adult male computer generated image (cgi); 3) naked older adult male real; 4) naked older adult male cgi; 5)clothed adult male real; 6) clothed adult male cgi; 7) clothed older adult male real; 8) clothed older adult male cgi; 9) naked adult female real; 10) naked adult female cgi; 11)naked older adult female real; 12) naked older adult female cgi; 13) clothed adult female real; 14) clothed adult female cgi; 15) clothed older adult female real; 16) clothed older adult female cgi.