



A Neuropsychological Study on Unconscious Information Processing when Receiving Affective and Non-Affective Visual Stimuli

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Abstract

Background & Aims: Throughout recent years, the study of unconscious visual processes has increased. Sufficient reductions of the stimulus presentation time are ways to achieve conditions of unawareness. Tachistoscopic experiments are used for this purpose. The recognition of affective word in tachistoscopic is due to the activation of the unconscious state. The main question in the present study was whether affective visual stimuli recognition during a computerized presentation could be influenced by unconscious interference.

Materials & Methods: The samples of 20 to 30 years were presented with affective and non-affective visual stimuli on the computer for one millisecond only.

Results: Results showed a significant difference between the recognition of affective and non-affective visual stimuli. Also, the spiritual and religious stimuli in comparison to other stimuli were significant as affective visual stimuli. Therefore the effectiveness of visual stimuli was an important variable. The results indicated a significant difference between males and females for recognizing non-affective visual stimuli.

Conclusion: It seems that inhibition in the subjects to recognize the affective visual stimuli could be due to inhibition in the retrieval processing in-memory system. According to results, males were better than females on the recall of prose passage details after listening to a single spoken presentation. This could also be related to the fact that males process faster and at a more superficial level than females.

Keywords: Affective visual stimuli, Gender difference, Non-affective visual stimuli, Unconscious

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Introduction

There is a broadcasting mass of sensory information in the world around us that yet only a fraction of it reaches our conscious experience. Nonetheless, the lost

information can accumulate outside of awareness and affect our behavior (1). These unconscious processes have always attracted an immense amount of interest (2). Feldman stated that the unconscious consists of

desires, wishes, instinctive drives, needs and demands that are hidden from human awareness (3). Pervin believes that after one century of neglect, suspicion and frustration unconscious processes are accepted by the collective mind of psychologists (4). Spear held that the unconscious consists of our memories, knowledge, and thought processes that are hidden from the conscious, that is, a person has no direct awareness of them but they can influence our thought and action (5). Hence, the existence of the unconscious is undeniable, although its presence is intangible. According to Corsini and Auerbach, the positive evidence from unconscious information processing has been accumulated from studies of human visual perception (6). Classical experiments in this area started with studies using of tachistoscope and similar studies were done by Sperling (7) and Macphail (8). A subliminal stimulus that is responded by the brain could influence subjects' subsequent behavior and it is a long-standing debate in the field of experimental psychology and more recently in cognitive neuroscience (9, 10).

The affective stimuli are those particular stimuli which are related in one form or another to human being's history, beliefs, memories, emotions, feeling and cultural and religious ideas in comparison to the non-affective stimuli. They can function as a vital variable during information processing and have an affective influence on human perception. Non-affective stimuli are those which are neutral and have no significant emotional relation with human perception. They do not function significantly as vital variables during information processing and have no beliefs, memories, emotions and feelings or cultural and religious ideas influencing human perception. In this study, the main question is whether the recognition of affective visual stimuli during computerized presentation is influenced by unconscious interference or not. It is worth mentioning that the previous studies have used only lingual stimuli in their surveys of unconscious information processing. The significant nature of these stimuli has lingual code, and it is different from pure visual stimuli and its coding during information processing. Hence, in the present study, a new practical

method is employed to further develop the previous studies, which were concerned with only lingual stimuli. For this purpose, some non-lingual stimuli of affective and non-affective nature are selected. Therefore, the purpose of the present study is to understand whether affective visual stimuli in comparison to non-affective visual stimuli can act as unconscious influence upon subject's responses during tachistoscopic study.

Material & Method:

Fifty young adults (undergraduate students) with an age range of 20 to 30 years served as participants in this study (50 males and 50 females). Participants were Hindu students and familiar with symbols and stimuli used for this research study. Subjects were recruited from the University of Pune, India. All members were matched with race, religion, education, culture, and mental health. Subsequently, they were invited to participate in the study after a brief description of the experiment. Then, each subject was asked to participate in an interview for checking the mental health status via mental status examination. The subjects who met the inclusionary criteria of the study were asked to participate in the experiment. They were informed about the experiment.

In this study, we used affective and non-affective visual stimuli of an appropriate size for computerized presentation in a predetermined order on monitor that replaced the tachistoscope to provide presentation of visual stimuli for one millisecond. Affective and non-affective visual stimuli were Seventeen black and white pictures rated by five Indian psychologists. In affective visual stimuli, pictures were selected of national, cultural, symbolic, political and religious nature that include Om (an important symbol for Maharashtra Hindu subjects), Ganapati (an important God for Maharashtra Hindu subjects), Mahatma Gandhi (the charismatic Indian leader), Diwali light (a holy symbol, which is used in Diwali celebrations by Maharashtra Hindu subjects), Amitabh Bachchan (an outstanding well-known and influential figure in Indian movies), Lokmanya Tilak (a freedom fighter of Indian), the map of Indian (a national geographical image, which is

important for Indian people), Ashoka Chakra (the emblem of the Indian government), Taj-Mahal (a historical and national monument of India), coconut (a holy fruit, which is used in all auspicious activities by the Hindus), professor Abdul Kalam (the president of Indian and atomic scientist, who is a popular figure among Indians), Lotus (a significant and meaningful national flower for Hindus), Pervez Musharraf (the president of Pakistan, a rival country as a negative affective visual stimuli), Lord Krishna (the important God in India who is respected and considered holy among Hindus), Cow (a holy and important animal in Hindu culture), Sachin Tendulkar (a popular national cricket player in India).

While non-affective visual stimuli had no significance (or value) for the Maharashtrian Hindu subjects. These included Allah (an Islamic symbol), mother Mary (a widely-known religious character), Abraham Lincoln (a global character who was against slavery), candle, Spider-man (a recurring television figure), Yasser Arafat (Head of the former Palestine Liberation Organization), the map of Australia (a non-rival foreign country), United Nation symbol, mosque (as Muslim place of worship), Pineapple (a common Indian fruit), Albert Einstein (an international scientist), Tulip (a non-affective flower for Hindus), Bill Clinton (42nd President of the United States), Mona Lisa (an artistic masterpiece), Jesus Christ (a widely-known prophet), Zebra (a non-affective animal), a picture of Steve Waugh (an international well-known cricket player).

Using the DSM- IV classification criteria subjects were selected with the help of an interview. In addition, information was obtained about the subjects' past medical history that could impact brain functioning.

All the subjects were invited to participate in the

study after a brief description of the experiment and were interviewed in order to check their mental status and past medical history. The subjects who met the inclusionary criteria of the study were asked to participate in the experiment. They were informed about the experiment but not its purpose. Then, individually they were presented with all the affective and non-affective stimuli in a predetermined order on the monitor. Each stimulus was presented for one millisecond only. The gap between the presentations of two stimuli was 20 seconds. In this study, the affective stimulus was followed by non-affective stimuli. All the subjects were presented with the stimuli in this order. This study was conducted in the laboratory of the department of psychology, University of Pune, Pune. The laboratory had cubicles of which one was used for this study. The cubicle contained a table for the computer and subject was seated on a comfortable chair. The experimenter sat on the adjacent chair to operate the mouse and record the responses. The experiment was conducted between 10 a.m. and 2 p.m. daily.

The Chi-square test (the statistical analysis system (SAS) program) was used to compare the responses to affective and non-affective visual stimuli. The test also was used to calculate the difference, if any way, across gender for the recognition of affective and non-affective variables.

Results

In Table 1, the chi-square test showed that the recognition of affective visual stimuli was significantly different from recognition of non-affective visual stimuli ($\chi^2=15.8066$, $p < 0.001$). The finding showed that the effectiveness of stimuli has had its unconscious influence in subject's recognition during the visual information processing.

Table 1. Chi-square for responses to the affective and the non-affective visual stimuli

	Affective Stimuli	Non-affective Stimuli
No: of "Recognized" Responses	1063	1173
No: of "Non-recognized" Responses	637	527

$N=100$, $df=1$, $\chi^2=15.8066$, $p<0.001$

Table 2 shows the comparison of responses to recognition of affective and non-affective visual stimuli among male and female respondents. The X^2 obtained was significant ($X^2=12.077$, $p=0.001$ and $X^2=4.711$,

$p=0.030$ in males and females, respectively). This means that, among male and female respondents, non-affective visual stimuli were recognized more than affective visual stimuli.

Table 2. Chi-square for recognition of the affective and the non-affective visual stimuli among male and female respondents

	Affective Stimuli	Non-affective Stimuli
No: of "Recognized" Responses in male	542	609
No: of "Non-recognized" Responses in male	308	241
No: of "Recognized" Responses in female	521	564
No: of "Non-recognized" Responses in female	329	286

$N=100$, $df=1$, $x^2=15.8066$, $p<0.001$ in male and $df=1$, $x^2=4.711$, $P=0.030$ in female

The results showed that the gender of respondents and recognition of affective visual stimuli were not related but males recognized the non-affective visual

stimuli better than the females. That is recognition of non-affective visual stimuli was significantly associated with subjects being male than female (Table 3).

Table 3. Chi-square for gender and responses to the affective and non-affective visual stimuli

	Male	Female
No: of "Recognized" Responses to the affective visual stimuli	542	521
No: of "non-Recognized" Responses to the affective visual stimuli	308	329
No: of "Non-recognized" Responses to the non-affective visual stimuli	609	564
No: of "Non-recognized" Responses to the non-affective visual stimuli	241	286

$N=100$, $df=1$, $x^2=1.107$, $P=0.293$ in the affective stimuli and $df=1$, $x^2=5.569$, $p=0.018$ in the non-affective stimuli

Table 4 shows the comparison of responses to the affective stimulus and non-affective stimulus. The results showed that the X^2 obtained was significant between the photos of Lord Ganapati's and mother Mary, Diwali Lamp and Candle, Amitabh Bacchant and Spider-man, the map of India and map of Australia, the symbol of the Asoka Chakra and symbol of the United Nations, Taj Mahal and a mosque, Coconut and

Pineapple, Lotus and Tulip, president Pervez Musharraf and Bill Clinton, Lord Krishna and Mona Lisa, a cow and a zebra (Ps ranging <0.01 – <0.001). However the X^2 was not significant between the photos of Mahatma Gandhi and Abraham Lincoln, Lokmanya Tilak and Yasser Arafat, Abdul Kalam and Albert Einstein, Lakshmi and Jesus Christ, Sachin Tendulkar and Steve Wagugh (Ps ranging <0.06 – <0.88).

Table 4. Chi-square for recognition and non-recognition to affective and non-affective stimulus

	No: of "Recognized" Response	No: of "non-Recognized" Responses	Total	p-value
Om	22	78	100	$p=0.001$
Allah	88	12	100	$x^2=88$
Lord Ganapati	48	52	100	$p=0.001$
Mother Mary	76	24	100	$x^2=16.63$
Mahatma Gandhi	83	17	100	$p=0.28$

	No: of "Recognized" Response	No: of "non-Recognized" Responses	Total	p-value
Abraham Lincoln	77	23	100	$\chi^2=1.12$
Diwali Lamp	92	8	100	$p=0.014$
Candle	80	20	100	$\chi^2=5.98$
Amitabh Bachchan	53	47	100	$p=0.001$
Spider-man	19	81	100	$\chi^2=25.08$
Lokmanya Tilak	85	15	100	$p=0.84$
Yasser Arafat	84	16	100	$\chi^2=0.038$
Map of India	98	2	100	$p=0.001$
Map of Australia	46	54	100	$\chi^2=67.06$
Ashoka Chakra	95	5	100	$p=0.001$
United Nations	76	24	100	$\chi^2=14.55$
Taj-Mahal	99	1	100	$p=0.001$
Mosque	64	36	100	$\chi^2=40.62$
Coconut	64	36	100	$p=0.003$
Pineapple	86	14	100	$\chi^2=12.90$
Abdul Kalam	71	29	100	$p=0.64$
Albert Einstein	68	32	100	$\chi^2=0.212$
Lotus	67	33	100	$p=0.001$
Tulip	91	9	100	$\chi^2=17.35$
Pervez Musharraf	29	71	100	$p=0.001$
Bill Clinton	56	44	100	$\chi^2=14.91$
Lord Krishna	17	83	100	$p=0.001$
Mona Lisa	87	13	100	$\chi^2=98.15$
Lakshmi	40	60	100	$p=0.88$
Jesus Christ	39	61	100	$\chi^2=0.02$
Cow	33	67	100	$p=0.001$
Zebra	90	10	100	$\chi^2=68.60$
Sachin Tendulkar	67	33	100	$p=0.06$
Steve Waugh	54	46	100	$\chi^2=3.53$

Discussion & Conclusions

The results of the chi-square test showed that a significant difference exists between the recognition of affective and non-affective visual stimuli. The findings showed that the effectiveness of visual stimuli has had its unconscious interference in the subject's recognition during the visual information processing. Also, results showed that there was no significant difference between the recognition of affective and non-affective visual stimuli among the males. The chi-square test used to find out gender difference for the affective visual stimuli also

showed that the females were significantly poorer on recognition of affective visual stimuli than the males.

This study showed that there was a significant difference in the recognition of the affective and non-affective visual stimuli presented for a short duration of one millisecond among Maharashtrian Hindu subjects. The outcome of the present study is similar to the findings of Blum (11) according to which the taboo words were less recognized as compared with non-taboo words during tachistoscopic presentation. Surprisingly, there was a great deal of similarity among the

experiments carried out in the studies concerning the notion of unconscious and the comparison of two stimuli of different nature. The findings were supported by a study done by Naccache and Dehaene on a French sample in which they found that unconscious semantic priming occurs even for primed stimuli (12). It indicates that unconscious utilization of semantic information is indeed possible (9). It seems that inhibition in the subjects to recognize the affective visual stimuli could be due to inhibition in the retrieval processing in-memory system.

The findings of the present study are consistent with the cognitive approach. Cognitive process during perception of external stimuli could be related to interpretation of its semantic function. It means that subjects' perceptual processes for recognizing stimuli are affected by whatever one expected to see. Therefore, the cognitive processes for recognizing stimuli are related to their previous experiences; belief system, language, culture, education, ethnic and religion. Hence, the effectiveness of the stimuli on human perception could be related to their belief systems and memory. This interpretation gets support from Hockenbury (13). He explained that human perception occurs when the sensory information is integrated, organized, and interpreted in a meaningful way. The inability to recognize affective visual stimuli during brief presentation in the present study can be a kind of information censor and trace of the unconscious, and interference of the unconscious in information processing.

The results obtained indicated that there was no gender difference in recognition of affective visual stimuli. This finding gets support in Roberts and Bell's study (14). They have reported that there was no gender difference between boys' and girls' electroencephalogram (EEG) hemispheric activation (at the 10.5 Hz to 13.5 Hz frequency band), and 2-d mental rotation task. The present results somehow were in the same direction and showed that males and females were not different regarding subjective moods or behavioral ratings of presented images through the

cortical electrophysiological processing of visual emotional stimuli.

In the case of non-affective visual stimuli, male respondents exhibited more recognition than female respondents. Among both males and females, the recognition of the non-affective visual stimuli was greater than the recognition of the affective visual stimuli. The findings of this study regarding gender difference in recognition of non-affective visual stimuli get support from previous studies (15, 16). According to results, males were better than females on the recall of prose passage details after listening to a single spoken presentation. This could also be related to the fact that males process faster and at a more superficial level than females (17).

It is clear that informal education at the family level in India happens right from birth which ingrains cultural beliefs, rituals, and spiritual knowledge. So signs and icons which directly relate to these sectors provide stronger stimuli because of familiarity of icons and ideas attached with spiritual meaning as against the things children learn at social institutes under the formal educational system. Therefore, it seems that in Maharashtrian Hindu families, religion and traditions have more weight than some of the other issues.

Another significant point in the interpretation and analysis of the results of the study is that among all of the affective visual stimuli presented to the subjects only seven stimuli were found to be affective (non-recognizable) as compared to the other stimuli. As illustrated through statistical analyses of the content of the contingency tables, the above-mentioned stimuli were: Krishna, Om, Cow, Lotus, Ganapati, Pervez Musharraf, and Coconut. Heeding the social, cultural and religious bases of the Maharashtrian Hindu people showed that the reasons for the effectiveness of these stimuli are as follow:

A) Krishna: Krishna is an incarnation of Lord Vishnu on earth over 5000 years ago. This perfect human being with divinity is an example of divine-human being and remains revered by his devotees in and outside India.

B) Om: In Hinduism, Om symbolizes God in the past, present, and future and whatever we have seen and will

see is Him. The basic idea is that Om represents the manifest and the un-manifest.

C) Cow: A cow is treated like a mother in Hindu culture. She is called Go-Mata (Go-com, Mata-mother). It is also believed that all Gods reside in the cow.

D) Lotus: Lotus is a flower that is regarded as a holy flower in Hindu culture. This beautiful flower springs out of the mud and remains unaffected by the mud's qualities and generates a beautiful fragrance. So it shows how even human beings after their inevitable birth in this world can rise and bloom like the Lotus to make this world full of that beautiful deep, intoxicating fragrance.

E) Ganapati: In Hindu mythology Lord Ganapati (God of literacy and intelligence) is known as the son of Goddess Parvati and Lord Shiva and is also defined by his unusual appearance with an elephant face. Ganapati is also known by the name of Mangalmurti (the lord of the auspicious), hence in Hindu society, he is the God who is worshipped first among all the Gods because of his highest attributes and powers.

F) Pervez Musharraf: It is assumed that the image of General Pervez Musharraf as a president and leader of the rival country (considered as a negative affective visual stimulus) had a negative effect on the subjects because he caused political tension in India.

G) Coconut: In Indian culture, coconut is a sacred fruit and represents Lord Shiva because of its three eyes. Coconut represents the head of human beings.

In the present study, it was quite clear if some of the emerged non-affective visual stimuli to be significantly negative (Beta error, as Type II error) had not been presented to subjects, and then the statistical difference between affective and non-affective stimuli would have been stronger than the obtained results. This problem was not observed during the primary pilot study of the research, as there were only a limited number of subjects (10 subjects). The reason for the negative significance of the non-affective visual stimuli such as the spider-man, the map of Australia, the mosque, and the symbol of the United Nations are as follow:

A) Spider-man: Due to the fact that the average age of the subjects was 22.7 years, it was assumed that the

Spider-man was an affect-loaded stimulus for young students.

B) The map of Australia: The map of Australia was expected to be a non-affective stimulus against the map of India. When the map of Australia was presented to the subjects, they said that it was the map of Maharashtra. Therefore 54% could not recognize the Australian map but called it the map of Maharashtra. Probably the state-level pride was more than national pride.

C) Mosque: Mosque was recognized as an affective visual stimulus even though the psychologists had rated it to be a non-affective stimulus. As compared to Taj-Mahal, which was expected to function as an affective stimulus, a mosque emerged to be an affective stimulus. This was a very interesting outcome as it indicates that most of the subjects perceived the mosque as a place of worship which they respected and held positive feeling. Taj-Mahal is a monument built by Moghul emperor of India for his beloved wife in the 17th century A.D., therefore, it is a symbol of love and a popular image even today.

D) United Nations' Symbol: The reason why the United Nations' symbol emerged as an affective stimulus when expected to be non-affective may be due to the fact that subjects were not familiar with it as they may have been with Ashoka Chakra.

Of the 17 affective and non-affective visual stimuli pairs, six pairs emerged with non-significant X2 value; Mahatma Gandhi and Abraham Lincoln, Diwali Lamp and Candle, Lokmanya Tilak and Yasser Arafat, president Abdul Kalam and Albert Einstein, Lakshmi and Jesus Christ, Sachin Tendulkar and Steve Waugh. This outcome may be explained thus:

A) Mahatma Gandhi and Abraham Lincoln: The X2 being non-significant indicates that these are almost equally non-affective as 160 subjects out of 200 recognized both of the pictures. This probably stems from the fact that the sample belonged to the younger generation who apparently carry no affect for the leaders.

B) Diwali lamp and candle: The non-significant X2 could be a result of both the flames being recognized without any effect attached to the stimuli.

C) Lokmanya Tilak and Yasser Arafat: These two stimuli did not emerge as significantly affective and non-affective. Apparently, no effect was attached to the two personalities, as was the case with Tilak two generations ago. Arafat was a familiar figure but non-affective. Hence, the non-significant X2 was obtained.

D) President Abdul Kalam and Albert Einstein: Though both are famous scientists, they were both recognized by 139 subjects out of 200, indicating that both are equally non-affective. Subjects as young students have read about both during their recent times in school and college, but without much effect attached to either personality.

E) Lakshmi and Jesus Christ: The statistical analysis showed that there was no significant difference between the recognition of Lakshmi and Jesus Christ. The low rate of recognition among subjects implies that both stimuli were equally affective for subjects. Lakshmi is the Goddess of wealth and was recognized by only 40% of the subjects, indicating that this stimulus is held by them with affect. Similarly, Christ is seen perhaps as a universal spiritual prophet (or Saint) and is associated with good, peaceful coexistence. Moreover, in Maharashtra, Christian and Hindus exist harmoniously with mutual respect. Probably, secularism in attitudes developed since schooldays has affected the development of respect to Christ in the subjects.

F) Sachin Tendulkar and Steve Waugh: Though the X2 value obtained was statistically non-significant, there seemed to be a near-significant trend. In other words, Sachin Tendulkar could have emerged as affective as expected since he is a favorite of the cricket lovers in the younger generation who formed the sample of this study. However, Steve Waugh is also among the top cricketers of the world and much admired in India. This non-significant X2 value must have emerged because of this high degree of admiration held nearly equally for both players by the young subjects in this study.

Limitation of current study and suggestion for further studies

In the present study the research was limited to the selected Maharashtrian Hindu students of Pune city who shared the same culture, and beliefs. Inclusion of other states' students and other religions or cultures would have perhaps given different results. The sample used in this study was of a particular age- group; however, a sample of older age subjects may give some different results. The sample included in the current research was from normal population. If the sample would have been extended to include neurotic or psychotic individuals probably different results would have emerged. Since the nature and quality of effectiveness of stimuli for subjects greatly differ from one culture to another, and even among different religions, creeds, ethnic groups and the nations, it is suggested that similar studies be done on these different groups.

Ethical disclosures

Protection of human subjects:

The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data:

The authors declare that they have followed the protocols of their work center on the publication of subject's data.

Right to privacy and informed consent:

The authors have obtained the written informed consent of the subjects mentioned in article.

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Conflicts of interest

The authors have no conflict of interest in this study.

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