

Basic Technical Requirements for the Use of Subliminal Messages in Marketing

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The term subliminal perception is used to indicate the effects that stimuli, exposed for a short period of time so that they cannot be perceived consciously, have on people's behaviour. The use of subliminal messages for marketing purposes is well-known. The data on the effectiveness of subliminal messages originate from laboratories where special equipment was used. Having analysed technical characteristics of contemporary television sets and computer monitors of the world's leading manufacturers, we checked whether they can be used to subliminally display text messages and images. A subject cannot perceive a text message exposed for 50 ms (Kouider & Dupoux, 2001).

However, the length of exposing images depends on their content and ranges from 1-4 ms (Murphy, 1990), up to 20 ms. The refresh rate limits the shortest exposure of stimulus on contemporary monitors. On CRT monitors, it relates to the maximal number of images which can appear on the screen within one second and is expressed in Hz. With most monitors it amounts to 60 Hz, thus the shortest exposure of a picture on the screen is $1000\text{ms}/60 \approx 16.67\text{ms}$. LCD monitors have a different way of creating images and a different refresh rate in comparison to CRT monitors, but devices with nominal 60Hz, 120 Hz $\approx 8.33\text{ ms}$ and 240 Hz $\approx 4.16\text{ ms}$ are available on the market. These monitors usually have a response time of 5 ms. Therefore, contemporary computer monitors and television sets have technical preconditions for

subliminal exposure of text messages and images.

Keywords: subliminal message, marketing, television monitor, computer monitor.

Introduction: Definition of Subliminal Perception and Marketing

It seems that everything in connection with the term subliminal perception is disputable: its name, the theoretical basis, the existence of effects and practical use. Subliminal perception is usually used to indicate the effects that stimuli, exposed for a short period of time so that they cannot be perceived consciously, have on people's behaviour. The term unconscious perception and suboptimal perception are somewhat better for explaining the phenomenon we have just defined, since there are various causes that make people unaware that the stimulus is exposed (the stimulus may be exposed only for a short period of time, it may be masked by other stimuli, or it may be out of focus with the subject's attention).

It is appropriate to use the term subliminal when we talk about studies conducted in the psychology of marketing, given that this definition was created for the needs of those studies, along with numerous prejudices. In this paper, we will deal with the effects of short exposure to visual stimuli for marketing

purposes. The term subliminal perception will be used besides its controversy since it is well-known to general public. A study by Zanot et al. (1983) showed that 81% of respondents knew what subliminal advertising was, while a study by Rogers & Smith (1993) showed that 74% of respondents were acquainted with subliminal advertising and that 61.5% of respondents believed that advertisers used subliminal messages in their advertisements.

Furthermore, people usually consider this type of advertising as manipulative and unacceptable, which has led to the legal prohibition of subliminal advertising in the USA, United Kingdom and Australia (Karremans et al., 2006).

In its broadest sense, the term marketing implies the communication between the one who sells and the one who buys. Within such a communication it is necessary to attract the buyer's attention, inform them on the product and finally persuade them to buy it. At the beginning of the twentieth century, marketers used newspapers, leaflets and the radio, but the situation changed drastically with the appearance of films.

It turned out that it was not irrelevant how the marketing message would be formed, what its target would be, how long it would be, etc. Therefore, marketers turned to psychologists, who, between the two world wars, became more open for practical application of the results of their studies. Inspired by the marketers' needs, psychologists checked which colours used in commercials attracted the buyers' attention the most, how long should commercials last, how often should they be broadcast to be effective, which personal characteristics should be targeted, how to formulate a slogan to be catchy and easy to remember, etc.

Studies which were carried out intensively for a quarter of a century pointed to some of the most important principles, but marketers thought it was not enough given the fact that even the best commercials could not sell some products in quantities that would satisfy manufacturers.

Politicians and military strategists were looking for more reliable methods to spread propaganda and undermine the morale of the enemy. A great

number of influential people, including the founder of behaviourism John Watson, went into marketing. Nevertheless, the results were still not impressive enough for marketers (Watson, 1922; Buckley, 1982; Petty, Cacioppo & Schumann, 1983). Meanwhile, the idea of the possible use of subliminal stimuli for advertising purposes emerged as one of the ways to increase the effectiveness of advertising messages. When the studies of subliminal perception started, they were actually the continuation of earlier studies and their results had almost been forgotten.

The first studies of subliminal perception emerged at the beginning of the twentieth century and were supported by Scripture's assertions presented in his book "The New Psychology", published in 1907, in which he described the basic principles of the effect stimuli has on respondents who were not aware of it (Scripture, 1897). A study carried out by Dunlap (Dunlap, 1900) is also worth mentioning. In one of his experiments, Dunlap cast "an invisible shadow" on the eyes of the subjects who were looking at the Müller-Lyer illusion, which consists of two lines of the same length with arrows on both ends pointing to opposite directions, creating the illusion of different line lengths. Dunlap concluded that casting this shadow affected the way his subjects perceived the line lengths. Even though these results were not confirmed by other scientific research, Hollingworth (1913) suggested that such subliminally presented material could be used in advertisements. Further research in this field was accelerated by the emergence of the tachistoscope during the World War II, which enabled a very short exposure time to images and messages.

The Use of Subliminal Messages in Marketing

Given that the term subliminal is defined as below threshold, it is crucial to define what is meant by the threshold. Depending on the way research and measuring are conducted, psychology makes a difference between subjective and objective thresholds. The objective threshold is measured using a forced choice when a subject has to choose between offered alternatives. Subjects are exposed to an image or a word for a very short period of time. Then, they are given a few alternative images

or words, including the one which was shown. They are, afterwards, asked to say which one they were exposed to. The objective threshold is reached when subjects are able to say what they saw only on the basis of a mere guess. The stimulus exposure time which was so short that subjects recognize it only based on a guess, in a situation of a forced choice, is later used to subliminally expose the stimulus (Chessman & Merikle, 1984).

The subjective threshold is determined by the exposure time during which subjects are not able to say whether they consciously observed the exposed stimulus, but they were not forced to choose between alternatives. They only have to say whether they noticed something and what that was. One should bear in mind that the subjective threshold is higher (i.e. slower), for on average 40 ms, than the objective one (Merikle, Smilek & Eastwood, 2001). In subliminal perception, there is a disagreement between a subject's awareness of the stimulus and their behaviour under the influence of that stimulus. In other words, the subject is not aware of the subliminal stimulus.

However, the stimulus still has influence on their behaviour, and that is the reason why this paradigm is named the dissociation paradigm (Snodgrass, Bernat & Shevrin, 2004; Merikle, Smilek & Eastwood, 2001). McConnell et al. (1958) pointed out that it can be claimed, with a degree of certainty, that the closer the stimulus is to the threshold of consciousness, the more effective it will be.

However, the main difficulty is in determining the threshold, given that it is variable, both among subjects and in only one subject, from one day to another. In professional literature, subliminal advertising is usually related to the alleged experiment carried out by James Vicary (Merikle, 2000). This experiment could have been considered the first test of the influence subliminally exposed material has on advertising purposes, if it had really been carried out. In 1957, Vicary said that he had designed a special machine capable of displaying messages for a short period of time while the spectators, not being aware, watched a film.

The term subliminal advertising was created by Vicary, who also founded the "Subliminal Projection Company". In the alleged study which lasted for six weeks, Vicary exposed the audience to messages such as "Drink Coca-Cola" and "Hungry? Eat

Popcorn". The messages were being repeated every five seconds and the message duration time was 1/3000 seconds. After processing the results, Vicary concluded that the sales of Coca-Cola increased for 18.1%, while the sales of popcorn increased for 57.5% (Merikle, 2000; Karremans, Stroebe & Claus, 2006). This discovery had a great impact on the public, and journalists also paid a lot of attention to it. Companies competed to get his services and, as a consequence, Vicary became popular and rich. Cinemas, television and radio stations started to use this technique.

However, at the peak of the frenzy for his technique, it was discovered that Vicary falsified both the entire experiment and the results in order to raise the rating of his marketing company. Although Vicary himself admitted what he had done, his false results are quoted and published even today. Vicary's assertions served as an inspiration for a large number of studies, which consequently led to the use of subliminal messages with the aim of persuading potential buyers to choose new products.

Since the exposure time of subliminal messages is very short, a few words or a single image may unconsciously internalize with a possible effect on behaviour, therefore the message needs to be simplified as much as possible. This is illustrated by the following experiment carried out by Byrne (1959). In his experiment, he exposed the word "beef" for 5 ms, several times, during the film. The experiment had the control group, which was watching the same film, without exposing the subliminal material. In the final stage of the experiment, the subjects were offered to choose one out of 5 different types of food on the list.

The results showed that subjects from the study group did not, statistically, significantly choose beef sandwiches more often, in comparison to subjects from the control group. Still, based on a questionnaire given to estimate the degree of hunger among the subjects, it turned out the subjects from the study group were hungrier than the subjects from the control group. Giving a TV presentation on thirst-related subliminal messages, Cooper & Cooper (2002) showed that subjects exposed to such a program were thirstier after the presentation, compared to the estimations before the exposure to subliminal messages, and compared to the control group which had watched the same program, but without subliminal messages.

Karremans et al. (2006) modified some details of Vicary's study, conducted it, and, based on the results, concluded that subliminal advertising of a brand affects the choice of that brand and the intention to drink that brand, but only in case people who this brand is advertised to are thirsty. Similar results, though in another context, were obtained by Strahan et al. (2002). Based on her own study, Bermeitinger et al. (2009) concluded that subliminally exposed material affects subjects only if it is related to their current need, or if subjects are in an appropriate motivational state. Contrary to the aforementioned studies, a great number of studies show that subliminal advertising is not that efficient after all.

In 1959, Champion and Turner conducted a study including two groups of students which did not show the significant effect of the images presented for 1 ms on participant's decisions. Having meta-analysed 23 works which tested the efficiency of subliminal advertising, Trappey (1996) concluded that subliminal messages did not have a strong impact on behaviour. The same was confirmed by Saegert (1987). What is frequently criticized about studies on subliminal perception, carried out in the first half of the twentieth century, are methodological mistakes and exaggerated claims.

These studies were not only criticized for their shortcomings, but the very idea that the stimulus can be observed and processed unconsciously was rejected. Certainly the most influential and the most powerful criticism of subliminal perception can be found in the works of Eriksen (1956; 1960) and Goldiamond (1958). According to Moore (1988), the biggest issue was that studies which examined the effects of subliminal perception did not pay enough attention to the fact that stimuli should actually be below the threshold. In some studies, stimuli were far below the objective threshold; therefore, they were practically non-existent for subjects and without any effects on their behaviour.

The main criticism of subliminal perception research in the psychology of marketing was related to the studies which asserted that there were significant and long-lasting changes in the behaviour of subjects under the influence of subliminally exposed stimuli. However, during the seventies and the eighties, numerous studies were conducted by imposing stricter control of experimental situations with the aim to check whether subliminally exposed stimuli can be seen on an unconscious level and whether

that way of collecting information affects decision making and the behaviour of subjects, without an intention to show big and permanent changes in the behaviour of subjects. A group of researchers used visual presentation of words and images under conditions which prevented the possibility of their conscious perception. This is primarily related to the use of the stimulus exposure for a very short period of time, with the use of masks in order to neutralize afterimages.

The era of modern research in the field of subliminal perception started with experiments carried out by Marcel (1978; 1980) which tested the impact of subliminally exposed words on different types of cognitive judgement. In his experiments, Marcel exposed words (primes) for an exceptionally short time (at or below the level of detection, between 20-110 ms), after which masks were exposed to neutralize subsequent effects, followed by words to be recognized or classified in different ways.

The results of the experiments showed that subjects made lexical decisions faster when primes were semantically related with targets, which can be explained as the effect of semantic priming. The results of Marcel's experiments are important since they imply that cognitive processing of primes and the target achieve significant depth, even though their conscious recognition is blocked by short exposure and the use of masks.

Nevertheless, these set effects of subliminally exposed stimuli are not the only ones. In fact, it turned out that it is possible to use such stimuli to influence both the affective and aesthetic experience of targets exposed after them (Zajonc, 1980; 1984). Namely, subjects may develop an emotional reaction to a stimulus, which follows a stimulus exposed for a short period of time, and which they cannot recognize. It was believed that this was a consequence of the possibility that the affective reaction can be developed not only independently but also prior to the cognitive response (Moreland & Topolinski, 2010). Zajonc named this phenomenon "affective priming".

Studies which were aimed to test the effects of primes based on semantic content or physical attributes did not show effects when the exposure time was below a certain limit (usually below 20 ms). However, studies that used primes with affective content confirmed the existence of positive effects with the exposure of 1-4 ms (Silverman & Weinberger, 1985; Murphy, 1990). These differences

should be considered a consequence of the nature of the stimuli themselves (emotional vs. non-emotional), and not a consequence of the methodological differences in the performed experiments. Since stimuli were presented with such a short exposure time, numerous methodological remarks against studies in this field were avoided in studies by Zajonc and Murphy (Hollender, 1986). The problem with all studies of this kind is that many of them do not provide any data on whether subjects are aware of their exposure to prime, that is, we usually don't have data on whether the prime was visible or not. Kouider & Dupoux (2011) examined precisely this awareness of primes in subjects using several different prime exposure times, and their data suggest that primes below 50 ms can be considered invisible for subjects. Also, it should be noted that these data relate to priming with words only.

The existing data on the characteristics and effectiveness of subliminal messages originate mainly from laboratories in which special equipment was used. The aim of this paper was to verify whether text messages or images can be displayed subliminally on contemporary television sets and monitors of the world's leading manufacturers and what the shortest exposure time is. In particular, we compared the stimulus exposure time required so that stimuli could be considered subliminal, which we have discussed earlier in the paper, with technical characteristics of contemporary monitors available on the Internet, with the aim to determine whether it is possible to display such shortly exposed messages on them. Widely used monitors that create an image in three different ways currently available on the market are: CRT, LCD, and LED monitors (Sixto, 2003)

Here, we will not deal in detail with the way the image is formed on these screens. Instead we will mention only the most necessary information needed to understand the factors that determine the shortest period of time in which a picture is kept on the screen. Within the cathode-ray-tube (CRT), the display image is formed when an electron beam from one or more electron guns travels throughout the vacuum tube causing the pixels at the phosphorescent screen to glow. CRT televisions and computer monitors are based on analogue technology (Van Gorkom, 1997).

An LCD monitor is an improvement over the older cathode ray tube (CRT) monitors; it uses fluorescent panel and cold cathode technology (Menozzi et al. 2001).

Liquid crystal diode (LCD) technology Liquid crystal

diode (LCD) technology is a form of lighting used in computer monitors and televisions. Cold-cathode fluorescent lights known as CFL lights are used to illuminate the screen for viewing graphics and video. The image is created by blocking light which passes through a layer of liquid crystal molecules (pixels) sandwiched between two layers of polarized glass. The naturally twisted liquid crystal molecules are forced to unwind or coil tighter by an electrical current; thereby the amount of light that passes through the glass is changed. In comparison to CRT, LCD needs almost half the power usage, is mercury-free, and has low electromagnetic interference (EMI) (Sluyterman, 2006).

The Properties of the Monitor Which Determine the Shortest Time of Image Exposure

The process of image formation in plasma screens is similar to LCD technology, but instead a layer of liquid crystal molecules there is a layer of cells coated on one side with red, green, or blue phosphor and containing inert gases. The gases are charged, they heat and emit a visible colour that forms the image with a progressive scan. The viewing angle of the plasma screens is wider, and it can generate more colours and darker blacks than LCD screens, also, it is not prone to latency problems (blurred motion). On the other side, plasma displays generally don't create image as crisp as LCD because plasma-screen pixels cannot be made as small as LCD pixels (Opara et al. 2012).

Light-emitting diode (LED) computer monitors use neither cold-cathode technology nor fluorescent technology. The screen is illuminated by light diodes in one of the two different ways, or a combination of both. There is edge lighting in which the white LED lights are clustered around the rim of the screen and diffuse evenly. LED lights are also spaced evenly behind the screen, and they are either not controlled or are controlled with a "local dimming" option.

The advantage of LED backlighting is in an even better energy savings, better colour quality, clarity, and faster refresh rates. The shortest time for an image to be displayed on the computer screen is dependent upon refresh rate and pixel response time. The refresh rate is the number of times per

second a complete image is drawn on the screen and is expressed in Hz. It should be distinguished from frame rate. The refresh rate is an attribute of the monitor, while frame rate is an attribute of the information which is sent to it from graphics processing unit. The frame rate signifies how often the image being displayed is repeated per fraction of a second before it is changed. In this paper we will assume that the frame rate is as high as the refresh rate of the monitor or even higher. The refresh rate of the CRT screens depended on the frequency of the electricity.

In the U.S., electricity runs at 60Hz, and elsewhere, 50Hz is common. Later, 60 Hz refresh rate became standard. This refresh rate causes the display's image to flicker which leads to eye fatigue and headaches in users, but this is individual. After all, nearly all the TV and movies we see are rendered at somewhere between 24 and 30 frames per second (Didyk, 2009). The newest LCDs are using greater refresh rates, having improved from 60Hz to 120Hz and faster panels rated at 144Hz are also now available along with 240Hz.

In the early days of LCDs this was predominantly a consequence of the "response time". Response time is the time the pixels need for changing from light to dark. The response times on modern LCDs are quite short, and this is the big issue anymore.

High-end televisions now have up to 600Hz refresh rate (60" Full HD Plasma TV with 600Hz, 2016), additional interpolated frames are inserted between the real images to smooth the image motion via advanced digital processing. It should be noted that this number is not the amount of frames per second it can display, but the inverse of the duration of a small pulse. For example, 600Hz plasma means its pulse length is 1/600 second, even though it only draws 60 frames per second. Plasma TV manufacturers wanted their products to appear as good as LCD TVs and started advertising higher refresh rates meant to reduce motion blur. It should be noted that the refresh rate has input lag impact. Input lag is the amount of time that passes from one refresh to the next, and at the same time, this is the shortest period of time in which the image is presented on the monitor.

The shortest period of time in milliseconds, in which the image could be presented, is calculated by dividing the 1000ms with the number of Hz in the refresh rate. Table 1 shows the common refresh rates and the shortest time the image is held on the screen.

Table 1: The refresh rate and the shortest time the image is held on the screen

REFRESH RATE	TIME IN MS
60HZ	16.67
75HZ	13.33
80HZ	12.5
100HZ	10
120HZ	8.33
144HZ	6.94
240HZ	4.16

Conclusion

The shortest exposure time of the stimuli on modern monitors is limited by the refresh cycle (refresh rate). A higher refresh rate enables a shorter exposition time of the image. The refresh rate in CRT monitors is usually 60 Hz. Consequently the image on the screen can be exposed as briefly as $1000\text{ms}/60 \approx 16.67\text{ms}$. LCD monitors create images in a different way and have a different refresh rate from CRT monitors, but there are devices in the market with the nominal 60 Hz, and between 120Hz and 240 Hz. As we see from Table 1, for monitors which have 120Hz, the shortest exposure time is 8.33ms and for those of 240 Hz it is 4.16ms. These monitors typically have a response time of 5ms. The experiments that we mentioned in the first part of the paper showed that the text primes exposed for 50ms are below the conscious perception, image primes should be exposed below 20ms, and emotionally charged image primes should be exposed 1-4 ms. So, we can conclude that the modern computer monitors and TV sets have technical prerequisites for the subliminal presentation of text and images. We should bear in mind that contemporary monitors can be used for subliminal exposition of images and texts if graphics processing unit has the frame rate as high as the monitor, which is usually the case. Computer and TV monitors are made with such high refresh rates in order to cope with motion blur and make the illusory movement look as natural as possible. In this paper we tried to examine whether these technical improvements may be used for other purposes. The use of subliminal messages in marketing is forbidden, but there are examples that it is still used. The ethical and legal concerns are possibly a constraint for using subliminal messages in marketing, technical prerequisites, as we tried to show in this paper, are no more.

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Osnovni tehnički preduslovi za upotrebu subliminalnih poruka u marketinške svrhe

SAŽETAK

Subliminalnom percepcijom označavaju se efekti koje na ponašanje ljudi imaju draži koje se izlažu veoma kratko tako da se ne mogu opaziti svesno. Javnosti je poznata upotreba subliminalnih poruka u marketinške svrhe. U istraživanju Rogers & Smith (1993) o subliminalnom reklamiranju znalo je 74% ispitanika, a 61.5% veruje da reklame sadrže subliminalne poruke, mada je ovaj manipulativni vid reklamiranja zakonski zabranjen. Podaci o učinkovitosti subliminalnih poruka potiču iz laboratorija gde je korišćena specijalna oprema. Analizirajući tehničke karakteristike savremenih televizijskih prijemnika i kompjuterskih monitora vodećih svetskih proizvođača proverili smo da li se na njima subliminalno mogu prikazivati tekstualne poruke ili slike. Tekstualna poruka izložena u trajanju od 50 ms nevidljiva je za ispitanika (Kouider & Dupoux, 2001), dužina izlaganja slika, pak, zavisi od njihove sadržine i kreće se između od 1-4 ms (Murphy, 1990), pa do 20 ms. Najkraće izlaganje stimulusa na savremenim monitorima ograničeno je ciklusom osvežavanja (refresh rate). Ciklus osvežavanja kod CRT minitora odnosi se na maksimalan broj slika koje se mogu pojaviti na ekranu u okviru jedne sekunde i izražava se u Hz, kod većine monitora on iznosi 60 Hz, dakle slika se na ekranu može najkraće izložiti $1000\text{ms}/60 \approx 11.67\text{ms}$. LCD monitori imaju drugačiji način stvaranja slike i ciklus osvežavanja od CRT monitora, ali su na tržištu prisutni uređaji od nominalno 60 Hz, $120\text{Hz} \approx 8.33\text{ms}$ i $240\text{Hz} \approx 4.16\text{ms}$. Ovi monitori obično imaju i vreme odziva od 5 ms. Na savremenim kompjuterskim monitorima i Televizijskim aparatima, dakle, postoje tehnički preduslovi za subliminalno izlaganje tekstualnih poruka i slika.

Ključne riječi: subliminalna poruka, marketing, televizijski monitor, kompjuterski monitor, ciklus osvežavanja.