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The Effect of Affective Priming Through Dynamic Stimuli on Recognizing Emotions[1]*

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Abstract

Emotions are important for everyday communication and it is very useful to recognize them accurately as well as to regulate them. Researching how certain emotional states can be evoked has significant practical implications for everyday life, but also for the work of professionals. Studies of affective priming provide a useful methodological framework for investigating this issue. The aim of this study is to explore affective priming with dynamic stimuli (video material), and the contribution of the age and gender variables to this process. The study involved a total of 307 students from the University of Banja Luka, consisting of 236 female and 71 male participants aged between 19-25 years (M=22.6, SD=1.4). The research was conducted online with special software created for this purpose. Three factors were varied: congruence of prime and target (congruent, incongruent and absence of prime), gender (male and female) and age (late adolescence and early adulthood). The photos from KDEF (Karolinska Directed Emotional Faces) base were used for the assessment of the emotional facial expressions, and two short video cuts from the Filmsammlung Johannes Hewig´s collection called "A revised film set for the induction of basic emotions" were shown as primes. The effect of affective priming was analyzed separately for two emotions - happiness and sadness as targets. The results show a priming effect on recognition of happiness in relation to age. Incongruency between prime and target leads to the inhibition of happiness recognition for younger students. Affective priming was not found in experimental situations where emotion of sadness was targeted.

*Keywords***:** affective priming, facial expression, age, type of emotion, gender

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The Effect of Affective Priming Through Dynamic Stimuli on Recognizing Emotions

Emotions are an important part of our lives and they occur as a response to a situation. Through evolution, they have evolved so that we can respond quickly and efficiently to important life events. Emotions affect our behavior, thinking, memory, and perception, which is why it is very important to recognize and understand them appropriately (Ekman, 2003). The first research on recognizing emotions was related to Ekman's cross-cultural studies that found that expressions of these basic emotions are recognized within different cultures with great accuracy (Ekman & Friesen, 1986). The focus of his interest were primary emotions (happiness, sadness, fear, anger, surprise, and disgust). Longitudinal cross-cultural studies have found that expressions of these basic emotions are recognized within different cultures with great accuracy (Ekman & Friesen, 1986). Such research was aimed at monitoring spontaneous reactions and micro-expressions characteristic of individual emotions. It was determined that the minimum amount of information needed for accurate recognition depended on the type of emotion displayed and on the gender of the model in the displayed photograph. The least information for accurate recognition is needed for the emotion of happiness, whereas the most information is needed for the emotions of sadness and disgust, which are again more easily recognized in male models (Čižmak, 2017). A recent study examined the importance of certain parts of the face in recognizing emotions (Bandyopadhyay et al., 2023). One group of subjects was presented with whole faces that showed a certain emotion, while the other group was presented with only parts of the face - mouth and eyes. The results showed that the accuracy of recognition of universal emotions is very high, but also that there is a difference depending on the way of presentation. Recognition success is higher when only parts of the face are shown compared to the whole face. Such results were obtained for all emotions except disgust.

As already mentioned, emotions affect different aspects of human functioning. They also affect brain activity and can trigger hormonal and autonomic body responses that prepare it for various reactions and complex behaviors (Damasio, 2004; van der Zwaag et al., 2011). Most often, a distinction is made in terms of the arousal-valence of an emotional stimulus, so there are positive/happy and negative/sad emotional stimuli. Considering the above, it can be concluded that it is very important to examine different stimuli and how they induce certain emotional states. Affective priming provides a methodologically valid approach to investigate this. Priming means that context can influence the processing of certain material. In the first phase of the experiment, the subjects are shown a stimulus (a prime), followed by the second stimulus (a target), and the subjects' task is to respond to the second stimulus. The effect of priming is reflected in the facilitation or inhibition of the response to the target stimulus caused by the previously presented prime. Facilitation of the response occurs when the prime and target are congruent, while inhibition occurs when there is an incongruence. Affective priming is one type of priming and

can be more precisely defined as the temporal process in which the target assessment as pleasant or unpleasant decreases when the emotional valence of the prime and target is congruent rather than non-congruent (Abbasi et al., 2019).

There are several theories explaining this phenomenon, among which the best known are the theory of spreading activation (Collins & Loftus, 1975), the theory of affective priming (Fazio et al, 1986; Fazio, 2001), and the theory of separate affective and cognitive systems (Le Doux, 1996; Murphy & Zajonc, 1993; Murphy et al., 1995; Zajonc, 1980). According to the theory of spreading activation, semantic memory is conceptualized as a network of mutually interconnected concepts (Collins & Loftus, 1975). The concepts are represented as nodes that are connected to other nodes of semantic memory by different types of connections. Depending on the specific input, the corresponding node in semantic memory is activated. Activation spreads through the network and it declines after some time. According to the theory of affective priming, the mechanism of action of this phenomenon is based on the time interval between the prime and the target (Fazio et al, 1986; Fazio, 2001). Traces of prime-induced activation enable the facilitation of the response to the next stimulus of the same affective valence if the time interval is optimal. The theory of separate affective and cognitive systems emphasizes that affective and cognitive systems are relatively independent and that the subjects can form an emotional response to a stimulus without its previous recognition due to a short exposure (Le Doux, 1996; Murphy & Zajonc, 1993; Murphy et al., 1995; Zajonc, 1980). This implies that the affective response precedes the cognitive one.

The majority of affective priming studies have used static stimuli, images, or words (Abbasi et al., 2019; Chenggang et al., 2020; Fazio et al., 1986; Fazio, 2001; Kim et al., 2021). In addition to the usual examination of word congruency, a number of studies have used different methodologies with those stimuli. Wu and his colleagues (2020) examined the effect of affective priming depending on the type of word. They used two types – "emotion words" and "emotion-laden words". Emotion words directly demonstrate affective states, such as sadness, happiness, while emotion-laden words relate to emotion without referring to certain affective states, such as death, promotion. Through two experiments that used a masked and an unmasked paradigm, primes were presented (two types of emotion words), and the subject's task was to evaluate the valence of the target word. At the same time, their encephalogram was recorded. Behavioral and event-related potential (ERP) results showed that positive words produced a priming effect, whereas negative words inhibited target word processing. The same results were obtained in both experiments. The practical implications of this study are the possibility of improving the effectiveness of emotional communication.

In order to investigate whether affective states influence our decisions even when processed unconsciously, Kim and colleagues (2021) employed a CFS (*Continuous Flash Suppression*) priming task to examine the effect of the two main types of information conveyed by faces on the evaluation of target words as positive or negative. Specifically, they conducted an experiment to determine how two types of facial information (facial identity and emotion) influence subsequent decisions

using a subliminal face with positive and negative target words. A significant interaction effect on response time was observed after priming the angry face, but not the happy or neutral face. This interaction was mainly due to the "positive bias" effect, that is, the advantage of processing positive stimuli, which is in line with earlier research (Kauschke et al., 2019).

Some research indicates that there are gender differences in the successfulness of recognizing facial expressions and that women are superior in comparison to men (Carter & Horgan, 2000; Hall, 1978; Hall, 1984; Mitrović & Trogrlić, 2014). Evolutionary psychologists suggest the "primary caretaker" hypothesis to explain these results. According to this hypothesis, a woman is more capable of recognizing emotions because of her dominant role in the life of her offspring, which increases the probability of their survival (Babchuk et al., 1985). Mothers are very sensitive to the crying of the newborn and to other signals that it sends (need for security, a smile, anxiety, etc.). Hall and Matsumoto (2004) try to explain the mechanism of response to such signals by early socialization. The advantage of women is that they are "taught" from their earliest days to decode emotions better than men, resulting in this ability being more automated than with men (Čižmak, 2017). Gender differences were also found in studies with affective priming and hemispheric lateralization, where it was shown that the affective processing of words is much faster in women (Abbasi et al, 2019).

On the other hand, there are recent studies that do not confirm that women are better at emotion recognition tasks (Hall & Matsumoto, 2004; Hoffman et al., 2008; Hoffman et al., 2010; Kauschke et al., 2019; Leppänen et al., 2003). In research in which participants viewed faces with increasing or decreasing emotional intensity and indicated when they either detected or no longer detected the emotion, both genders were equally successful (Covieres et al., 2021). The only gender differences were found in identifying anger (men were more successful). Men also responded more slowly to fear than women.

Several studies have shown that there are also age differences in the affective priming effect. Younger subjects react faster in conditions when the target is congruent with the prime compared to older subjects. Older subjects are less sensitive to both congruence and incongruity The priming effect was also found for positive and negative targets in young people, while in the elderly it was present only for positive ones, which implies a favoring of positive emotions in older subjects (Simonetti et al., 2022). Age differences were also found in the recognition of emotions. Relative to their young counterparts, older adults are poorer at recognizing facial expressions, but this is not uniform results. Differences are greatest for the emotions of anger, fear, and sadness, comparative with happiness and surprise, with no age-effect found for disgust (Hayes et al., 2020).

An age period that is particularly significant when it comes to emotional states and reactions is the transition from late adolescence to early adulthood. During this period, changes occur in terms of emotional regulation (Park et al., 2020). Emotional regulation implies processes of modification of emotions and adaptation of the way of their expression. It is very important for success in life and well-being, and it is

assumed that it matures in late adolescence. At that time, young people usually enter university, which is a challenge for them because they have to navigate academically, socially, and interpersonally stressful situations. Therefore, research into the determinants of emotional response and development is particularly important.

In this research, we wanted to examine the effect of affective priming in conditions in which video material is used as a prime. Most previous research has used static stimuli and monitored their effect on the target answers (Abbasi et al., 2019; Chenggang et al., 2020; Fazio et al., 1986; Fazio, 2001; Kim et al., 2021). In these research studies, it was found that the response was facilitated if a face with the same facial expression was shown, as well as that there was an effect of familiarity with the person displayed in the photographs. It was also found that the subjects recognized the emotion of happiness faster than other emotional expressions in the situation when it was preceded by a congruent prime. This research tried to determine how strong an effect can be obtained on a video material, given that it is richer in details and dynamics than a picture or a word. We also wanted to determine whether there were gender differences in the effect of affective priming, as well as whether there were age differences in this process. The practical implication of the research was to understand the connection between emotional state and perception of emotional facial expressions. Recognizing and interpreting emotional expressions is very important because it affects the dynamics of communication with other people. The answer to the question of whether there is affective priming with dynamic stimuli such as video clips could be used in both professional and personal development because it indicates the possibility of consciousness guiding the focus on the desired emotional states.

Method

Sample and Procedure

The sample consisted of students, between 19 and 25 years of age (M = 22.6, SD = 1.4). The total number of subjects was 307, out of which 236 were female. Participants were divided into two age categories: late adolescence (18-21 years) and early adulthood (22-25 years). In the first category there were 111 students, while in the other there were 196. Since two types of emotions were used as targets, the students were randomly divided into two groups in relation to the displayed target. All subjects gave their voluntary consent for participation in the experiment. There is no Ethics Committee at our Faculty, but we conducted our research in accordance with ethical guidelines stated in American Psychology Association -APA and Declaration of Helsinki.

A mixed factorial design (3x2x2) was used. The first factor is *congruency* (congruent, incongruent, prime absence), second is *gender* (male and female) and third is *age* (late adolescent age 18-21 and early adulthood age 22-25). All three

factors were between-subjects. Congruency was determined by the match between the emotion in the video clip (prime) and the emotion to be recognized (target). An online version of the experiment was created where subjects could answer on a computer or on the mobile phone. A full customized web application was created and set up on the purchased domain live research. The web application collected data that it would store on the „Google Cloud Platform". Each experiment consisted of three parts:

1. Entering basic data (gender, age).
2. Explanation of the experiment and video content.
3. Experiment

Before the experiment, a general explanation of the research itself was given, after which the subjects could decide whether they wanted to participate or not.

Measures

Photographs from the **KDEF database [Karolinska Directed Emotional Faces] were used to assess facial expression recognition (Lundqvist et al. 2018)**. The database contains a total of 4900 photographs of faces that express a neutral facial expression and six basic emotions: happiness, sadness, fear, anger, disgust and surprise. Each facial expression is photographed from several different angles. There are a total of 36 facial expressions that are shown from three angles, front, left and right profile. For the purposes of the research, 30 facial expressions were selected (15 photos of women and 15 photos of men), only the front side, which showed happiness and sadness.

Short video clips from the **Filmsammlung database by Johannes Hewig "A Revised Film Set for the Induction of Basic Emotions"** lasting 01:30 - 02:30 minutes had the prime function. Permission for use was obtained from the author. The two films portrayed two different emotions - sadness and happiness. Video clips were without sound. The sound was turned off for more precise control, as the subject's focus was on the visual modality. Sounds can enhance an emotional experience, but they can also change it. By turning off the auditory mode, we wanted to avoid such effects.

Results

Before the statistical analysis, the database was checked for outliers with the Interquartile range. It was determined that there are extreme values and they were excluded from further analysis. It was also found that the distribution of the data deviates from the normal (tested with Kolmogorov-Smirnov test) so the reaction times were log-transformed. Three-way ANOVA was then applied. Separate analyses were performed for the two types of emotions (happiness and sadness) that had the function of a target. Descriptive statistical analysis procedures were first applied to the normalized data for happiness. The obtained results are shown in Table 1.

Table 1

Descriptive statistics for reaction time in recognizing happiness emotion

N	*M*	*SD*	*Min.*	*Max.*
156	4564.09	1911.44	1876.90	10780.98

Descriptive measures in relation to varied factors are shown in Table 2 (for happiness) and Table 4 (for sadness).

Table 2

Descriptive statistics for reaction time in relation to varied factors and emotion of happiness as target

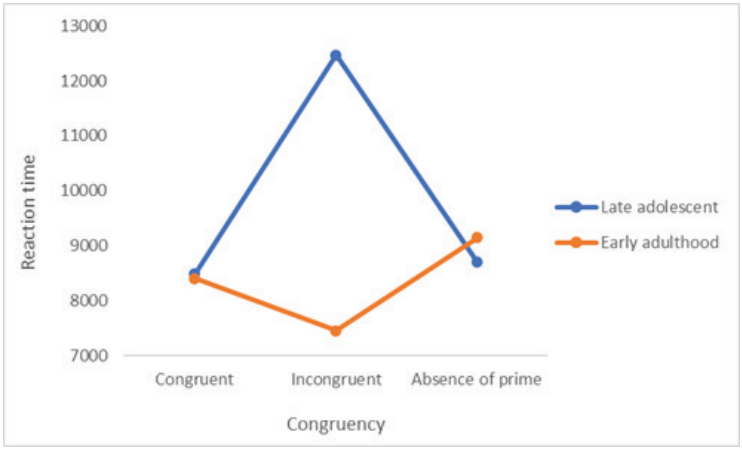
Gender	Age	Priming	*M*	*SD*	*N*
Female	LA	Congruent	4784.43	1611.97	13
		Incongruent	5532.34	2250.83	11
		Absence of prime	3978.44	1786.23	11
	EA	Congruent	4571.27	1677.03	22
		Incongruent	4464.13	2246.33	26
		Absence of prime	4748.42	2129.13	37
Male	LA	Congruent	3703.94	707.77	3
		Incongruent	6939.67	1203.87	3
		Absence of prime	4719.43	1173.79	8
	EA	Congruent	3829.69	1086.82	9
		Incongruent	2985.42	982.16	6
		Absence of prime	4398.43	1860.03	7

Note: LA- late adolescence (18-21 years); EA – early adulthood (22-25); N-number of subjects in experimental group

The significance of the obtained differences was tested by applying the analysis of variance. We performed ANOVA by subject. Based on the obtained results, it can be noticed that there are certain differences in the average response speed in different experimental situations.

Analysis shows that the main effect of priming on reaction time is not statistically significant (F (2, 156) =1. 13, p>.05). But the main effect of age was determined (F (1, 156) =3.87, p<.05, ηp^2=.026) and interaction between age and prime was statistically significant (F (1, 156) = 4.57, p<.05, ηp^2=.060). The priming effect was found for younger subjects (late adolescent). Incongruency between prime and target leads to the inhibition of happiness recognition. For the purpose of clarity, the results are also shown graphically (Figure 1).

Figure 1
Affective priming for happiness emotion in relation to age



The results further show that there is no effect of gender on reaction time in the experimental task (F (1, 156) = 0.40, p > .05). Both men and women evaluate and recognize emotion of happiness at approximately the same speed.

On the other hand, when the recognition accuracy was analyzed, the results show that there is no difference in the number of correct answers depending on the prime (F (2, 156) = 1.67, p > .05). Additionally, male and female subjects are equal in recognition accuracy (F (1, 156) = 0.04, p>.05). Furthermore, the main effect of age is also not statistically significant (F (1, 156) = 0.425, p > .05).

When the emotion of sadness was the target, different results were obtained. Table 3 shows descriptive measures for total reaction time, while Table 4 shows statistical descriptive parameters in relation to varied factors. The results of the analysis of variance show that there is no effect of prime on the speed of recognizing the sadness emotion (F (2, 151) = 0.90, p > .05). Regardless of content congruency, the video prime did not affect reaction time in recognition tasks. The main effects of age (F (1, 151) = 0.83, p>.05) and gender (F (1, 151) = 0.08, p > .05) are also not statistically significant.

Table 3
Descriptive statistics for reaction time in recognizing sadness emotion

N	*M*	*SD*	*Min.*	*Max.*
151	5073.81	1739.80	1805.03	11300.23

Table 4

Descriptive statistics for reaction time in relation to varied factors and emotion of sadness as target

Gender	Age	Priming	*M*	*SD*	*N*
Female	LA*	Congruent	4624.27	1939.13	17
		Incongruent	4637.97	2069.24	20
		Absence of prime	6033.67	2186.07	13
	EA*	Congruent	5183.49	1681.59	26
		Incongruent	4681.99	1186.27	16
		Absence of prime	5094.44	1731.78	24
Male	LA	Congruent	4737.14	671.78	3
		Incongruent	5006.63	1901.28	12
		Absence of prime	4513.18	1585.35	3
	EA	Congruent	6636.60	1753.77	4
		Incongruent	4771.32	1285.14	12
		Absence of prime	5207.34	1222.33	7

Note. LA- late adolescence (18-21 years); EA – early adulthood (22-25)

In the analysis of the recognition accuracy of the sadness emotion, certain differences were obtained. There is the main effect of gender (F (1, 156) = 5.63, p<.05, ηp^2=.039) and it explains 3.9% of the variance in total accuracy. Females are more accurate in recognizing sadness compared to men (Figure 2). Results also show that interaction between three factors is statistically significant (F (2, 156) = 4.47, p<.05, ηp^2=.060). In older male subjects, the presence of a congruent prime led to an increase in accuracy in recognizing an emotion (Figure 3).

Figure 2

Number of correct answers in recognizing sadness in relation to gender

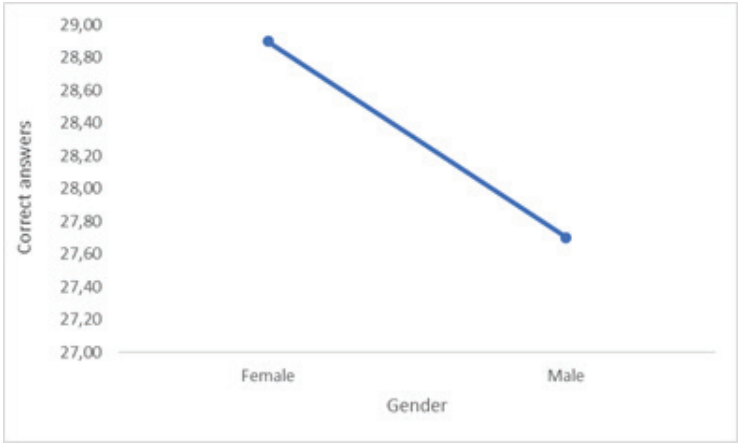
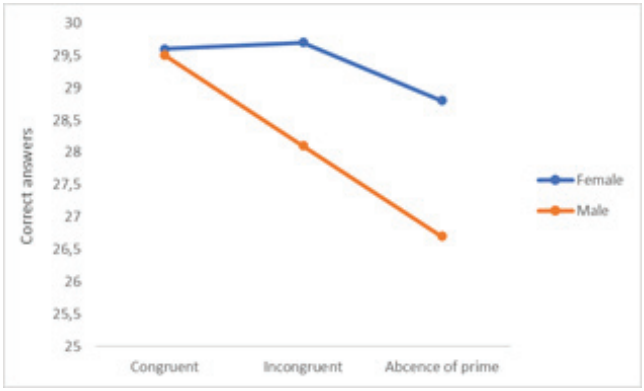
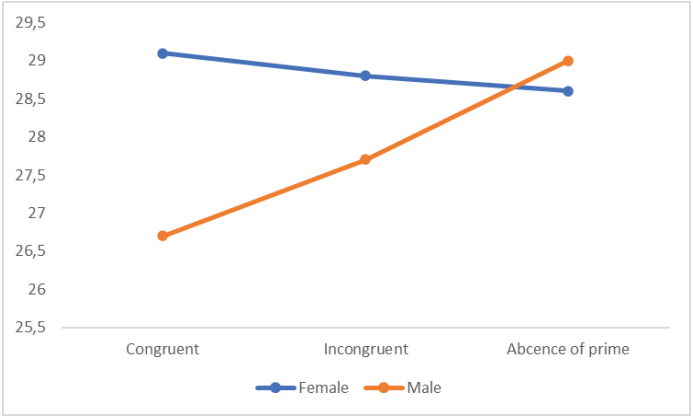


Figure 3

Number of correct answers in recognizing sadness in relation to gender, age and priming (left-late adolescents, right-early adulthood)*





Discussion

The aim of this research was to explore affective priming with dynamic stimuli - video clips from movies, since most previous studies used static stimuli (Bandyopadhyay et al., 2023; Calvo & Lundqvist, 2008; Ekman & Friesen, 1975; Hoffmann et al., 2010; Montagne et al., 2005). Although a number of previous studies have shown that priming can lead to facilitation or inhibition of target responses, this study with dynamic prime partially confirms this (Chenggang el al., 2020; Fazio, 2001; Fazio et al, 1986; Murphy & Zajonc, 1993). Inhibition of responses was obtained in younger subjects, when the prime was incongruent with the target. Such a result was present only in the experimental situation in which the subjects responded to the emotion of happiness. A similar finding was also obtained

by Jing and colleagues (2007), which indicates a greater sensitivity of young people to affective priming. In their research, they had subjects with larger age differences, but the focus of our research was the transitional period between adolescence and early adulthood, when more people enroll in college and start a new phase of life. Our results indicate that younger subjects are more sensitive to the incongruency between the prime and the target, but response facilitation was not found, which is not in line with earlier research (Fazio et al, 1986; Jing et al., 2007; Murphy & Zajonc, 1993). In contrast to those research studies, videos were used as primes in this study. Although videos are more dynamic, it is also possible that they are more complex, and thus the mechanism of their influence is more complex. One of the possible explanations is that the video without sound is not strong enough to induce an emotional state, considering that Loizou and Karageorghis (2014) in their research found an interactive effect of video and music in priming. Zhu and Takeda (2023) found a significant effect of stimulus relevance on affective priming. The presentation of video material enables the redistribution of attention to different aspects of the content, and the way of processing that content can be changed. On the other hand, the results can perhaps be best explained by the Affective Persuasion Theory most advocated by Fazio (Fazio et al., 1986; Fazio, 2001). According to this theory, varying the time interval proved to be a very significant factor for the affective priming effect. The strongest effect is obtained when the interval is 300ms, and it is absent when the time interval is 1000ms. The length of the presentation of the video was longer than two minutes, which is much longer and is probably the reason for the lack of influence on the emotional states of the participants. Moreover, results show that recognizing accuracy of happiness emotion are the same independently of varied factors. It has already been shown that this type of emotion is the easiest to recognize because it requires the least amount of information, which can also explain these results.

In the experimental situation in which the facial expression of sadness was the target, no priming effect was obtained. It is not clear whether the effect was absent because of the nature of the emotion being recognized or because of the prime. The importance of the time frame, which could have influenced the results, has already been mentioned. An explanation for those results can be found in the works of the authors who emphasized individual sensitivity. There, the separation of perceptual processing from affective processing is highlighted, but the need to adapt the stimulus to individual participants is also emphasized (Delicato, 2020). We did not measure or control individual sensitivity to the selected primes.

When it comes to gender differences, previous research studies show the dominance of female gender in terms of accuracy and speed of recognition of facial expressions (Calvo & Lundqvist, 2008; Leppänen et al., 2003; Milovanović et al. 2013), which was partially confirmed in this research, since we found gender differences only in recognition accuracy, and for sadness emotion. The results also showed that there was an interactive effect of priming, gender and age on the recognition of the emotion of sadness. The congruence of the prime and the target affected the accuracy of recognition among male subjects of the older age category.

Some of the limitations of this study are related to age categories. The differences between them are small. The differences could be more noticeable if subjects with larger age differences were compared. We have already mentioned the time frame of the prime that was used, as well as the lack of pilot testing of its subjective experience. Also, we used only two primary emotions. According to the FACS coding model (Ekman & Friesen, 1975), the expression of emotions activates different groups of muscles in the area of the eyes and mouth, and the differences between primary emotions are easily noticeable. Considering the differences obtained in this research, in future studies the effect of persuasion through video material should be investigated in the context of the facial feedback hypothesis. The concept of individual sensitivity to different video primes should also be considered.

It would also be interesting to use the same procedure to examine the recognition of other basic emotions that are classified as unpleasant, such as anger or fear. In some of the future research, it could be examined whether there is a certain pattern of responding to facial expressions. Such research has significant practical implications because it can help in understanding emotional reactions, and can also shape our emotions, behaviors and social interactions.

Conclusion

This research provides significant insights into the mechanisms of affective priming and demonstrates the importance of context in emotional responding. However, it is a very complex process that requires further research and the inclusion of a large number of factors.

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Efekat afektivnog primovanja pomoću dinamičnih stimulusa na prepoznavanje emocija

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Apstrakt

Emocije su važne za svakodnevnu komunikaciju i veoma je korisno da ih tačno prepoznamo kao i da ih regulišemo. Istraživanje načina na koji se mogu izazvati određena emocionalna stanja ima značajne praktične implikacije za svakodnevni život, ali i za rad profesionalaca. Studije afektivnog primovanja pružaju koristan metodološki okvir za istraživanje ovog pitanja. Cilj ove studije je da se istraži afektivno primovanje sa dinamičkim stimulusima (video materijal) i doprinos varijabli uzrasta i pola ovom

procesu. U istraživanju je učestvovalo ukupno 307 studenata sa Univerziteta u Banjoj Luci, od toga 236 ženskih i 71 muških ispitanika uzrasta između 19- 25 godina. Istraživanje je sprovedeno onlajn uz pomoć specijalnog softvera kreiranog za ovu svrhu. Tri faktora su varirala: podudarnost prima i mete (kongruentno, nekongruentno i odsustvo prima), pol (muški i ženski) i uzrast (kasna adolescencija i rano odraslo doba). Za procjenu emotivnog izraza lica korišćene su fotografije iz baze KDEF (Karolinska Directed Emotional Faces)i dva kratka video isječka iz kolekcije Filmsammlung Johannes Hevig pod nazivom „Revidirani filmski set za indukciju osnovnih emocija". Efekat afektivnog primovanja analiziran je odvojeno za dvije emocije- sreću i tugu kao mete. Rezultati pokazuju primarni efekat na prepoznavanje sreće u odnosu na starost. Nepodudarnost između prima i mete dovodi do inhibicije prepoznavanja sreće kod mlađih ispitanika. Afektivno primovanje nije pronađeno u eksperimentalnoj situaciji u kojoj je meta bila emocija tuge.

Ključne riječi: afektivno primovanje, izraz lica, uzrast, vrsta emocije, pol

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