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THE RELATIONSHIP BETWEEN SOCIAL DESIRABILITY AND VISUAL EVOKED POTENTIALS: IMPLICATIONS FOR PERSONALITY MEASUREMENT

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ABSTRACT

The main aim of this research was to explore the biological bases of social desirability with possible implications for future personality measurement. Fifty four female psychology students (Mage = 20 years) participated in the research. Social desirability was measured with Eysenck's Personality Questionnaire – Revised version *(Eysenck, Eysenck & Barrett, 1985). The evoked brain potentials (N1, P2, N2, P3 & SW) were elicited by a standard visual oddball paradigm, in two measuring trials for each subject, using two occipital and two parietal electrodes. The results revealed a positive correlation between subjects' results on the social desirability subscale and visual N2-P3-Sw-latency on occipital and parietal electrodes. These findings confirmed earlier research results about prolonged EP-latencies during information processing in giving more socially desirable answers during self-rating at personality questionnaires. Consequently, current findings generate possible implications for improving personality assessment methodology.*

KEYWORDS: *event-related potentials, social desirability, students, personality assessment, implications*

INTRODUCTION

Social desirability is defined as humans' tendency to *"present themselves as good individuals"*, which is especially pronounced in highly desirable situations (Eysenck & Eysenck, 1994). As it was elaborated within Eysenck's personality theory (1967) this characteristic reflects a stable personality factor that indicates the extent of a person's social conformity. Therefore, in this study social desirability and social

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conformism are used as equivalent. Besides the definition of social conformity as a stable personality characteristic, it has also been characterized as a major difficulty when it comes to predicting outcomes in high-stakes situations. Specifically, social conformity also reflects individuals' potential to fake their responses in self-rated personality questionnaires (Mesmer-Magnus, Vieswesvaran, Deshpande, & Joseph, 2006). Consequently, when trying to measure it, participants' tendency to conform could result in various methodological problems. Therefore, it can have two facets: as a stable personality trait and as a form of dissimulation. Although one could say that it is more than useful to investigate the electrophysiology of social desirability as personality trait, it is even more valuable to use these findings as a possible solution to deal with dissimulation effects in personality measurement.

The theoretical and empirical framework of the relation between social desirability and personality assessment improvement is not novel and it represents a main focus in previous studies (e.g., Paulhus, 1984; Holtgrawes, 2004; Kulas & Stackhowski, 2012; Mentus & Opačić, 2013). All studies ask the major question: *"Does lying on personality questionnaires take time?".* In the contemporary literature, there are three theoretical models that have the potential to provide the answer to the previous question. The first model, the *Response editing model* (Holtgraves, 2004), emphasizes that lying takes time, while the second one, the *Response Reflection model* (Kulas & Stackhowski, 2012) emphasizes that actually giving an honest answer takes more time. The most recent model is an *Interactive model*, which states that time for answering on the personality questionnaire depends on the individuals' cognitive schema (Mentus & Opačić, 2013). If individuals' answers on specific questions or tasks are in accordance with that schema, the answering time is shorter, and vice versa. Some studies have confirmed this interactive model (e.g., Mentus & Opačić, 2013), yet these studies did not take into consideration the biological bases of social desirability and its relationship to the response latencies of evoked potentials (EP) in order to determine all relevant factors of social desirable answering in personality measurement. Therefore, the main aim of this study was to explore the biological background of social desirability through its relationship with evoked brain potentials, with possible implications for personality measurement improvement.

NEURAL CORRELATES OF SOCIAL DESIRABILITY

A great number of studies have demonstrated a strong biological determination of social conformity (Berns, Capra, Moore, & Noussair, 2010; Botvinick, Cohen, & Carter, 2004; Edelson, Sharot, Dolan & Dudai, 2011; Klucharev, Hytönen, Rijpkema, Smidts, & Fernàndez, 2009; Morgan, & Laland, 2012). There are numerous research findings providing evidence for different psychophysiological patterns in high and low social desirability responders. Brody and colleagues have analysed the relationship between lie (or social desirability) scores and cardiovascular reactivity to various stimulations (Brody, Veit, & Rau, 1997). In their sample, increased scores on the lie scale were negatively associated with systolic blood pressure reactivity to a computer administered mental arithmetic task. The authors have emphasized that their findings are consistent with other results of higher lie or social desirability scores being associated with diminished responsiveness to a variety of stimuli. Furthermore, Functional magnetic resonance imaging (fMRI) studies of social conformity showed significant relationships between specific neural networks and differentiation between lying, truth-telling, and social conformity (Berns, Chappelow, Zink, Pagnoni, Martin-Skurski, & Richards, 2005; Wu, Loke, Xu, & Lee, 2011). However, subjects' initial judgement in a mental rotation task could be altered, same as related brain activity in appropriate regions. Hence, when individuals are in conflict with group opinion, the amygdale and the caudate are activated, which are regions involved in emotion processing (Berns et al., 2005). Furthermore, it was determined that exposure to social norms such as group opinions affect individuals' neural representations of their subjective value of that stimuli by increasing the brain activity in the nucleus accumbens and orbitofrontal cortex, regions involved in reward processing (Campbell-Meiklejohn, Bach, Roepstorff, Dolan, & Frith, 2010; Zaki, Schirmer, & Mitchell, 2011).

Moreover, transcranial direct current stimulation (tDCS) and positron emission tomography (PET) studies demonstrated that lying is strongly related to the activation of two brain regions: prefrontal cortex and superior temporal sulcus (Abe, Suzuki, Tsukiura, Mori, Yamaguchi, Itoh, & Fujii, 2006; Langleben, Loughead, Bilker, Ruparel, Childress, Busch, & Gur, 2005). The activation of the same brain regions has been mentioned in relation to various social-cognitive processes (Ochsner & Lieberman, 2001). Furthermore, Reeves and her colleagues (Reeves, Mehta, Montgomery, Amiras, Egerton, Howard, & Grasby, 2006) revealed a significant correlation between the striatal dopamin (D2) receptor measures and lie scores (Eysenck & Eysenck, 1994). This is consistent with studies showing a dopaminergic involvement in socially rewarding behaviours. Research revealed that the property of social desirability showed the same kind of relation with dopamine as extraversion did (Reeves et al., 2006). Finally, Chen and colleagues (2012) in the study of event-related potentials (ERPs) correlates of social conformity clearly demonstrated that participants who were more likely to conform to others (i.e., changing their initial choices) exhibited stronger medial frontal negativity effects compared to individuals who were more independent (Chen, Wu, Tong, Guan, & Zhou, 2012)

EVOKED BRAIN POTENTIALS AND SOCIAL DESIRABILITY

Although numerous studies revealed strong biological determination of social desirability, there is a lack of empirical research on this personality dimension and its relationship with EPs. Furthermore, although social-cognitive neuroscience has recognized the utility of ERP-method within the research, the number of electrophysiological studies of social desirability is rather limited. Very few findings were revealed by studies that mainly focused on the relationship between other personality dimensions, such as extraversion and neuroticism, and evoked brain potentials (Beauducel, Brocke, & Leue, 2006; Gurrera, O'Donnell, Nestor, Gainski, & McCarley, 2001; Mathews, 2004; Polich & Martin, 1992; Rammsayer & Stahl, 2004; Stelmack & Geen, 1992; Stelmack & Houlihan, 1995; Stenberg, 1994; Tatalović Vorkapić, Tadinac, & Rudež, 2010).

Nevertheless, most studies investigating personality have not found a significant association between the level of social desirability and EPs (Pritchard, 1989; Golding et al., 1986; Polich & Martin, 1992; De Pascalis, 1994). However, while measuring the early and late EP components in the visual and auditory modality, De Pascalis (1993) found a significant relationship between EPs and the participants' results on the *Eysenck's Personality Questionnaire (EPQ)* lie-subscale. First, findings revealed a significant negative correlation of the visual N1-amplitude and P3-amplitude with the result on lie-scale. Second, they revealed a significant positive correlation between the auditory N2-amplitude results on lie-scale, too. Although the author did not provide an explanation for these results, this study suggests that two variables play an important role in the relationship between lie-scores and EPs. The first variable is the modality in which potential was evoked (visual or auditory), whereas the second variable represents the type of EP – i.e. whether the evoked brain potential presents an earlier or a later EP-component (N1 or P3).

Consistent with previous findings, Robinson (2001) found a significant negative correlation between P3 amplitude in the auditory modality and the results of the EPQ lie scale. Hence, following the social desirability definition presenting it as the tendency to present ourselves in a socially preferred light or inclination to conformism, we can expect that the EP-latencies would be extended due to *"taking more time"* to give social desirable answers and not the true ones.

Moreover, Kline and his colleagues (1993) investigated the relationship between social desirability and auditory EPs and revealed that high-defensive participants (those subjects with high scores on social desirability scale) showed significantly lower P2-amplitudes on frontal and central electrodes. Authors suggested that defensiveness is strongly related to desensitization to intense or painful stimulation. Therefore, EP-recording procedures are among several methods used to provide measures of explanatory constructs for various personality properties and social cognition (Ibanez, Melloni, Huepe, Helgiu, Rivera-Rei, Canales-Johnson, Baker, & Moya, 2012; Kubota & Ito, 2009).

Hence, the neural-level processes underlying social conformity have received very little attention in scientific research (Morgan & Laland, 2012), hence the main aim of this study was to analyze the relationship between social desirability operationalized within Eysenck's personality theory (1967) and early and late visual EPs. Based on the previously described interactive model about lying in personality questionnaires and previous research findings, significantly longer EP-latencies (especially those of late EP-components) are expected in participants with higher lie-scores. The rationale for this hypothesis lays on the interactive model explanation that longer EP-latencies (time for producing answer is longer) are significantly related to higher social conformity, since it reflects higher level of inconsistency between subjects' answers and their cognitive schemas.

METHODS

Participants

The final sample of this study consisted of fifty-four female psychology students from the Department of Psychology, Faculty of Humanities and Social Sciences in Rijeka. Their age range was between 19 and 23 years (*M*age = 20.5 years, *SD* = 1.28). All of them were right-handed, naive to electrophysiological studies and with no reported visual or neurological/psychiatric problems. In order to control for possible effects of gender and hand-dominance on EP-results, all male students (*N* = 15) and left-handers (*N* = 8) were excluded from the research. All participants signed an informed consent form and received course credits for their participation in the study. The study was approved by the Commission of Postgraduate studies in Zagreb.

Social desirability measurement

In order to measure social desirability, the translated and adapted version of the *Eysenck's Personality Questionnaire – Revised version, EPQ-R* (Eysenck, Eysenck, & Barrett, 1985; Eysenck & Eysenck, 1994) was used. This instrument originally consisted of 106 items, but for this study only Social conformity subscale was used, which has 21 items (item example: *"Have you ever damaged or lost others' stuff?"*). Participants answered on items choosing between YES and NO. Item analysis on this study sample showed lower but still satisfactory levels of reliability Cronbach alpha (α =. 68), than in original standardization research in Croatia (α = .82; Eysenck & Eysenck, 1994, p. 26). This will be taken into account when discussing the results.

Evoked brain potentials measurement and procedure

After completing the personality questionnaire (5-10 minutes), all subjects who have read and signed the informed consent received the time-schedule for EP measurements. The measurement took place at the Department for Neurology in Clinical Hospital Centre Rijeka. The visual oddball paradigm has been applied in two trials for evoking: N1, P2, N2, P3 and SW components. The measurement took place within a 3-months period, always at the same time, using the device Medelec/TECA Sapphire II 4E (1996) with five Ag/AgCl disc electrodes. According to 10-20 system, two occipital (O1 & O2) and two parietal (P3 & P4) with referred to Fz were used. The electrode impedance was kept below 5kΩ and the filter bandpass was 0.1-50 Hz.

A pattern reverse binocular full-field stimulation was performed in a dark, quiet room using a 16x16 checkerboard pattern, 70 cm away from the nasion, with 1Hz frequency and 100% contrast. Subjects were instructed to look at the centre of the monitor and to react to the rare (target) stimuli (checkerboards consisting of the smaller quadrangles) by pressing the pen, and to ignore frequent (non-target) stimuli (checkerboards consisting of the larger quadrangles).

The marking procedure of the amplitudes and latencies of the EPs (N1, P2, N2, P3 and SW) was performed manually following the EP-parameters (Hugdahl, 1995). The same medical technician used a cursor for both trials. To provide a higher quality of data, the effect of the latency jitter should be avoided for the EPs to be more stable over trials (Coles, Gratton, Kramer & Miller, 1986; Hoormann, Falkenstein, Schwarzenau & Hohnsbein, 1998). Therefore, in the second trial they were marked by the same latencies as those from the first trial, resulting for each participant with a same EP-latency for both trials, but different EP-amplitudes (Tatalović Vorkapić, Lučev & Tadinac, 2013). Consequently, there were data on EP-latencies from the first trial only and on EP-amplitudes from both trials. SPSS 18.0 has been used for performing needed statistical procedures: descriptive and correlation analyses.

RESULTS

Descriptive results for social desirability and evoked brain potentials

Conducted statistical analyses for social desirability revealed a lower mean level (M = 3.52, SD = 2.72, Range = 0-10; see **Figure 1**) compared to the mean found in the normative sample. Age norms for social desirability level in female subjects (N = 878) in two age groups (16-20 years and 21-30 years) are: $M_{16\text{-}20}$ = 5.45, SD = 3.25 and $M_{21\text{-}30}$ = 6.33, SD = 3.82 (Eysenck & Eysenck, 1994). Furthermore, Kolmogorov-Smirnov test resulted with no significant difference between this distribution and normal one (D = 1.23, p = .10). In addition, measured latencies and amplitudes of visual EPs at two occipital and two parietal electrodes, are within the expected range of their parameters.

As presented in **Table 1**, N1-component showed range of mean latencies from *M* = 137.7 (*SD* = 30.3) to *M* = 143.3 (*SD* = 29.5), with average amplitudes from both trials ranged from *M* = 10.2 (*SD* = 5.3) to *M* = 15.4 (*SD* = 8.5). The range of mean latencies for P2-component was from *M* = 209.4 (*SD* = 24.7) to *M* = 220.8 (*SD* = 20.1), with average amplitudes from both trials ranged from *M* = 8.9 (*SD* = 4.6) to *M* = 14.7 (*SD* = 9.1). Determined range of mean latencies for N2-component was from *M* = 291.5 (*SD* = 51.5) to *M* = 300.6 (*SD* = 36), with average amplitudes from both trials ranged from *M* = 4.5 (*SD* = 4.2) to *M* = 8.9 (*SD* = 6.1). Cognitive P3-component showed range of mean latencies from *M* = 388.8 (*SD* = 65.7) to *M* = 413.7 (*SD* = 44.3), with average amplitudes from both trials ranged from *M* = 3.5 (*SD* = 2.7) to *M* = 9.2 (*SD* = 7.3). As for measured Slow wave mean latencies at four electrodes, the results expectedly ranged from *M* = 495.8 (*SD* = 58.2) to *M* = 480.9 (*SD* = 78.3).

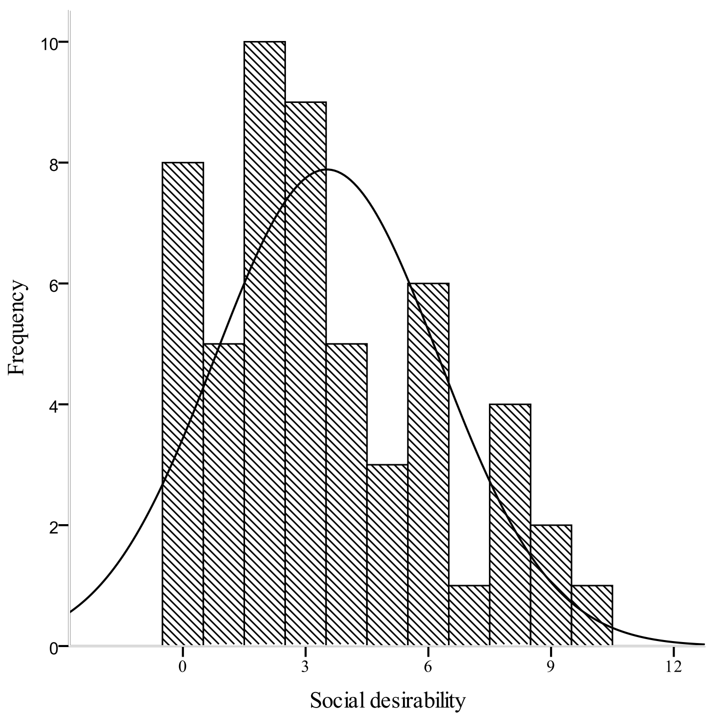

Figure 1.
The distribution of social desirability in female students

Correlation analyses of social desirability and evoked brain potentials

The results from conducted correlation analyses of social desirability and evoked brain potentials are presented in **Table 1.**

Table 1.
The correlation matrix of social desirability and evoked brain potentials

Latencies of evoked potentials		***M***	***SD***	**Correlation with Social desirability**
N1-component	O1-electrode	143.3	29.5	10
	O2-electrode	143.3	29.5	.10
	P3-electrode	138.1	30.1	.08
	P4-electrode	137.7	30.3	.06
P2-component	O1-electrode	220.8	20.1	.16
	O2-electrode	220.4	19.9	.16
	P3-electrode	209.4	24.7	.16
	P4-electrode	209.9	24.9	.13
N2-component	O1-electrode	300.6	36	**.27***
	O2-electrode	300.6	35.9	**.27***
	P3-electrode	291.5	51.5	**.28***
	P4-electrode	291.4	51.5	**.28***
P3-component	O1-electrode	412.8	42.9	.09
	O2-electrode	413.7	44.3	.11
	P3-electrode	389.1	65.5	**.34****
	P4-electrode	388.8	65.7	**.34****
SW-component	O1-electrode	495.8	58.2	.13
	O2-electrode	499.2	58	.13
	P3-electrode	480.6	77.6	**.38****
	P4-electrode	480.9	78.3	**.37****

$^*p<.05$ $^{**}p<.01$

The results revealed significant positive relationships between social desirability and latencies of three evoked brain potentials: N2, P3 and Sw. As expected, later EP-components were positively related to higher social desirability levels. In other words, the higher the social desirability revealed by the participants, the longer were their late components latencies. In addition, that relationship is more stable on parietal electrodes, than on the occipital. Since there were no significant correlations between social desirability and any of EP-amplitudes from both trials, these results were not presented.

DISCUSSION

The general aim of this research was to analyze the relationship between social desirability as presented in Eysenck's personality theory (1967) and early and late visual evoked potentials (N1, P2, N2, P3 and SW).

Descriptive statistics for the main variables of this study revealed that mean levels of all measured EP-latencies and EP-amplitudes (in both trials) are within expected range (Polich, 1993). At the same time, the mean level of social desirability on this sample was lower than the one found on the equivalent age group for female subjects. This could be explained by the socio-demographic properties of the current sample, as all participants were psychology students. Hence, the homogeneity of this variable was definitely higher than in the normative sample, which should be taken into account in future studies.

Concerning the investigated relationship between social desirability level and visual EPs, as expected, the results revealed a significant correlation between social desirability and EP-latencies, but not EP-amplitudes. In other words, giving socially desirable answers were significantly associated with prolonged latency of N2-wave at all electrodes and P3-Slow-wave only at parietal electrodes. Although most of the previous research work has not found significant correlations between social desirability levels (the tendency presenting ourselves in a socially desirable way) and EPs (Pritchard, 1989, Goldinget al., 1986; Polich & Martin, 1992; De Pascalis, 1994), we expected these associations following the interactive model's predictions regarding prolonged EP-latency in participants who show a greater tendency towards conformism. From the Interactive model (Mentus & Opačić, 2013) perspective, these same answers are not consistent with the participants' cognitive schemas. Individuals who are prone to higher levels of social conformity employ an additional information processing level when giving answers, which allows comparing their real answers to the socially desirable ones. Due to that additional information processing level, they may need more time for processing, which is consequently reflected in prolonged EP-latencies. Finally, the answer they give is not the "real" or honest answer; as it is not consistent with the answers within their cognitive schema, but with socially desirable ones. At the same time, findings must be regarded with caution as subjects' reaction time is not synonym to EP-latencies, and time taken to respond was not possible to measure within this research.

The associations found in this study could be more objectively investigated if verified through experimental designs. EP-latency can be investigated in experimental situations with varying situation - conformism, where Eps can be measured while providing answers to a certain situation. On the other hand, findings in the current study emphasized the question of biological determination of social desirability, or conformism. Previous research strongly demonstrated clear biological determination of all Eysenck's personality traits: extraversion, neuroticism and psychoticism (Tatalović Vorkapić, 2010). It is not so rare to define empathy and social conformism as opposites of psychoticism, which largely represents asocial, antisocial, nonconformist and socially maladaptive behavioral tendencies with no respect or obeying of social rules and norms. As it was elaborated in the introduction, the level of conformity has its own biological, and evolutionary basis, what some other studies in the field of neuroscience have confirmed (Frans, Stallen & Ridderinkhof, 2008; Klucharev et al., 2009). It is interesting to note that in the framework of social relations and conformity studies, the neurological basis of perspective taking are intensively explored, which is considered as a significant part of the conformism (Frans, Stallen & Ridderinkhof, 2008). On the other hand, perspective taking presents one of the cognitive facets of the multidimensional model of empathy (Davis, 1980; Tatalović, 1997). Therefore, recently, the study of the neurophysiologic basis of empathy has been also very intensively studied in the framework of the social neuroscience (Decety & Chaminade, 2003; Decety & Lamm, 2006).

Furthermore, findings revealed that the relationship between social desirability and EP-amplitude is not significant, which is consistent with a number of the above mentioned articles (Pritchard, 1989, Golding et al., 1986; Polich & Martin, 1992; De Pascalis, 1994). In other words, there was no significant correlation between the social desirability level and EP-amplitudes in this study. This is contrary to findings of some studies that have shown significant relationships and in different directions, depending on whether the EP-component is early or late (De Pascalis, 1993).

Some research limitations need to be addressed. First, future research should take into consideration that determined lower reliability level of social desirability scale could negatively affect current results. In addition, some other measures of social desirability, for example an experimental measure might also result in different findings. Regarding the sample characteristics, it is possible that results would be different if the number of participants was larger, more heterogeneous regarding age, gender, and studies. Furthermore, some objective limitations of EP-measurement need to be addressed. These include using only two occipital and two parietal electrodes, as well as manually EP-marking, which could distort study results. Great possibilities of contemporary EP-measurement such as measurement of time reaction, errors, and task variations in different modalities (not only in visual) could reveal more valid findings regarding the relationship between social desirability and evoked potentials.

Finally, even though authors of previous studies did not provide sufficient explanations about the social desirability - EP relationship, the main contribution of this study lies in the objective approach to electrophysiology of social desirability. This approach allows sufficient explanation for research findings and some future study guidelines. Current findings point out not only the need for further investigation, but also at the possibility to improve measurement of personality that use self-rated personality questionnaires. As it was clearly determined that late EP-latencies are prolonged in subjects with higher levels of social desirability, they definitely need more time for their information processing while self-rating. If this is discussed within the framework of the previously mentioned Interactive model (Mentus & Opačić, 2013) of social desirable answering, it could be hypothesized that subjects with higher social desirability have lower concordance between their cognitive schema and the task significantly related with longer EP-latencies. Varying the instruction for filling in the personality questionnaire (between experimental and control groups of subjects) could contribute to higher level of personality measurement methodology. So, the aim of getting "real" and honest answers from subject in personality research could be obtained. This guideline represents a major contribution of this study to be taken into account by future experimental studies.

CONCLUSION

Current findings showed a significant positive association between subjects' results on the Social desirability subscale and visual N2-P3-Sw-latency on occipital and parietal electrodes. These results confirmed earlier research results about prolonged EP-latencies in giving more socially desirable answers in self-rated personality questionnaires. Even though some study limitations have been determined and critically discussed, these findings represent a possible argument for further experimental research for giving different instructions to subjects when tested with self-rated questionnaires. Personality measurement could be improved and answers that are more honest could be obtained if subjects must give their answers in a limited time for their information processing. Finally, it could be stated that according to these results, lying does take more cognitive resources, but further research is necessary to prove this hypothesis. Additionally, this study emphasized the importance of exploring the biological background of social desirability, both separately and in relationship with other personality properties.

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